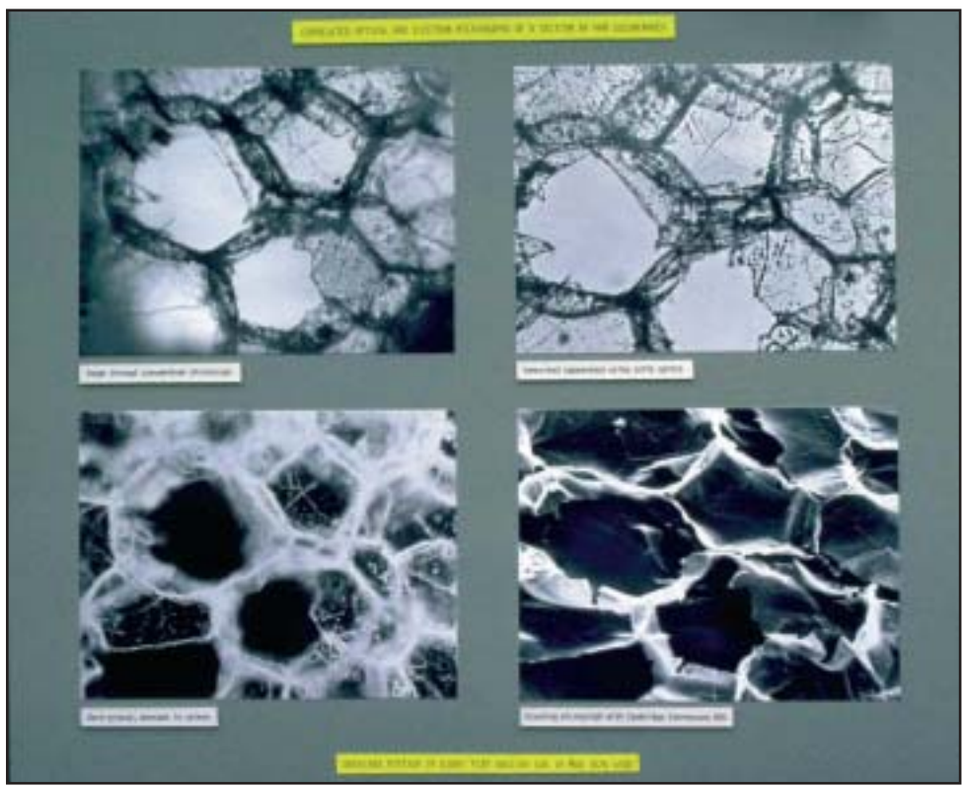

Twenty years of the Leeuwenhoek specimens

In 1981 biologist Brian J Ford discovered Leeuwenhoek's original specimens, lying forgotten among papers at the Royal Society. Laboratory News asked him to look back over the two decades since

When Leeuwenhoek, the father of modern biological microscopy, sent his original specimens to London on 1 June 1674 he assumed they'd become the centre of attention.

He was wrong. There was nobody in London up to the task — and that's how they came to lie for over three centuries in the vaults of the Royal Society in London.

I was looking into the dawn of microscopy with a grant from the Kodak Bursary Scheme, and it was the then President of the Society, Sir Andrew Huxley, who suggested that I might care to examine the original letters. I assumed they'd been seen by many scholars. They were being systematically translated by the Dutch, but it turned out that they had been given microfilm copies of the originals, and had not worked through the actual documents. Nobody had been through the letters since they had been bound for the archive many decades earlier.

Just a few pages from the front of the first volume, I experienced something nobody would have expected: the final page of one of the earliest letters was unexpectedly heavy. It had something stuck to the back. As I turned the folio, I saw that the final, blank page had a white handmade envelope glued to the paper. The microfilm operator had apparently ignored it. There's little point in photographing a blank page.

Cautiously, I opened the envelope. Inside were four neat little packets of paper. I held my breath as I eased them open to photograph the contents — not so much a dramatic response, but in order to avoid contamination. There were original specimens inside three of the four packets. Two were of plant sections, the discrete hand-cut specimens compacted into a single mass with the passage of years. A search through the letters later turned up five more. Eventually we had nine specimen packets from the dawn of the modern era of science; a curious counterpart to the nine microscopes associated with Leeuwenhoek that also survive.

Clearly, detailed microscopy of small portions of these materials would be a wonderful opportunity, but borrowing such unique material from a major Society involves a deal of form-filling for committees. Not this time, though. There was no record in the Society's catalogue that the specimens existed, so I was allowed to take my samples away without difficulty. I was borrowing a copy of Robert Hooke's *Micrographia Restaurata* that day, too, and was working with the microscope of Robert Brown with which he first observed Brownian Movement.

Thus I hopped in a cab to the station that day with Leeuwenhoek's specimens in my breast pocket, Brown's original microscope in my coat, and the great folio book in my briefcase. It was the most nerve-wracking journey of the year.

There were several projects I had in mind. One was to identify the nature of the material, so that we could confirm exactly what Leeuwenhoek had been observing. Another was to carry out optical microscopy on the material, both to determine its nature but also to see how diligently the specimens had been prepared. I was equally keen to subject samples to scanning electron microscopy, so that one could obtain finely detailed images. These would be suitable, first, to see changes and deterioration or contamination over the centuries, and secondly to provide a reference that revealed the finest detail in the specimens. These would be of the greatest value in assessing the view through an original Leeuwenhoek microscope, for one could compare the finest detail he could have observed with identifiable structures viewed at high resolution.

The head of my old department at Cardiff University, Denis Bellamy, was always a wise source of advice and he arranged for me to book time on the Cambridge Stereoscan, assisted by Carol Morgan, our first-rate SEM technician. Many hours of microscopy followed, and the extraordinary manual dexterity of Leeuwenhoek began to emerge. His specimen-cutting technique involved a slowly rising path for the razor, offering a progressively thinner section, until the tissue began to break up. He would then cut a fraction deeper and repeat the process.

The resulting sections contained material that compares favourably with many present-day preparations. Some modern texts have reprised his experiments, without producing such skilled results. He also established serial sectioning (of cotton seeds) and his dehydrated algal films allowed us to reconstitute them and view once more the aquatic material he had first described in the 1670s.

In the Netherlands, Peter-Hans Kylstra, head of the Utrecht University Museum, presented me with the gift of a replica and arranged for me to have time working with the original Leeuwenhoek microscope in their collections. This is the best known, with a magnification of around 300x. At Antwerp, my colleague G. Van Steenbergen arranged for me to work with their collection of microscopes, which includes a Leeuwenhoek instrument, whose provenance is in doubt. At the Deutsches Museum in Munich, Dr M. Seeberger arranged a programme for me to work with their silver Leeuwenhoek microscopes.

Meanwhile, the publishers Heinemann were keen to publish a popular book on the research — it emerged as *Single Lens, the Story of the Simple Microscope*, with overseas editions including the USA and Japan — while Biopress and Farrand joined forces to publish the academic book, *The Leeuwenhoek Legacy*.

The research was exacting and arduous though immensely rewarding. Although I had numerous other commitments there was little time to spare, for R. V. Jones, Churchill's wartime scientific adviser who was by then the editor of the Royal Society's journal *Notes and Records*, wanted my paper for publication in the summer. *New Scientist* and *Nature* were both eager for accounts of the work, while *Scientific American* wanted a report of their own.

The Royal Society paper was written piece by piece as the research unfolded; the finished version narrowly made their deadline and publication was set for 31 July 1981. *New Scientist* and *Nature* both had issues on the same date, and I spoke to several science correspondents who agreed not to break the embargo until *Notes and Records* had been safely published.

Publication day was frenetic. National papers and magazines were all keen to cover the story, and so were newspapers abroad. In Brussels I recorded a television documentary, and was kept busy with broadcasters anxious for interviews. As chance would have it, 31 July was also the day of the wedding of Prince Charles and Lady Diana, so I had the

unusual experience of being interviewed by Robin Day after he'd finished commenting on the nuptials at St Pauls. There were even television chat show producers eager to embrace this unusual affair. One of them said 'It's like the tomb of Tuntankhamun, only smaller' and the phrase soon stuck.

In some ways, the lecture presentations on the research were the most rewarding. The Natural History Museum arranged a special public lecture, which was followed by lectures at Oxford and Cambridge, while the Autonomous University of Barcelona arranged the first of many lectures abroad. Americans were particularly fascinated by the work, and organisations in many states arranged for lectures. Meanwhile, the Spencer-Tolles Fund of the American Microscopical Society, and in Britain the Leverhulme Trust, the Welcome Trust, the Royal Society and the Appleyard Fund of the Linnean Society were among those offering grant funding for the continuing programme of research.

Once the project was well in hand, Sir Andrew Huxley arranged a private meeting at the Royal Society with a dozen of our most eminent microscopists. The event, in President's rooms, was reminiscent of eighteenth-century science and allowed me to demonstrate the single-lens microscopes and the preparation of fine sections in seventeenth-century Holland. Illustrated demonstrations were given at the *Conversazione* of the Royal Society, and were again requested for their *Soirée*. Not only were microscopists fascinated by it all; Harold Wilson was among those who spent much time going through the work, revealing a genuine interest in the ramifications of science of which he was such a stalwart proponent.

In England, Irene Manton offered great interest in the work and showed eager enthusiasm for these new developments. Cyril Burch at Bristol was equally supportive. In the United States, Walter McCrone arranged for me to give a major presentation at his Inter Micro symposium, and Derek de Solla Price put at my disposal his work on the Leeuwenhoek microscopes. Meanwhile, J van Zuylen in the Netherlands brought in his uniquely detailed knowledge of the lenses, while in Belgium Henri Hansen and his son Erik offered their insights into the production of replica Leeuwenhoek microscopes. They gave me two more replicas for further research. I visited George Svihla at his home laboratory in Indiana, where he showed me how he had recreated many of Leeuwenhoek's observations of yeast cells. That great amateur enthusiast Horace Dall of Luton helped with microscopy, and presented me with one of his handmade simple microscopes with a fine lens made of spinel.

I had been inspired by Clifford Dobell's biography of Leeuwenhoek since boyhood, and was given so much help and insights by his widow Monica, who lived in the original family home until her death a few years ago. She gave me his annotated copy of the original biography, which remains a treasured possession. I always regarded my modest *Leeuwenhoek Legacy* as a modest appendix to Dobell's great work.

A host of Dutch scientists became involved, including Pieter Baas who helped with a major paper in the Netherlands and Lodewijk C Palm of the Leeuwenhoek Commission. My long-standing friend Bev Collins worked on the translations of Leeuwenhoek's writings. Elsewhere there were subtle signs of chauvinism: some Dutch historians put together a travelling exhibition on Leeuwenhoek, the catalogue for which made no mention of the research, but simply carried on as though nothing had happened to change our view of Leeuwenhoek. Holland has never made much of its great pioneer. A plaque in Delft announcing Leeuwenhoek's residence was erected in the wrong place, and there is no more than a little lane near the station named after him which a few cafes and bars.

As some Dutch scholars have observed, it is curious that the nation that gave us this phenomenally skilled investigator should show relatively little interest in promoting his work, or the research that has extolled it. The Leiden museum does have several of the Leeuwenhoek microscopes, of which one was clumsily stuck together with glue for many years. But it's high time that Leeuwenhoek was effectively celebrated. His work was all-embracing, and laid the groundwork for our modern era of biology. The cells, gametes and nuclei with which we work today were studied by this admirable Dutchman three centuries ago, and his legacy is amongst the greatest in the history of science.

By Brian Ford