"A Co-operation of Observers"

Impact Paragraph

Academic Impact

This dissertation started from the premise that working with a microscope required a kind of craft knowledge that was difficult to teach and learn without personal instruction. Late-nineteenth-century microscopists themselves observed that the use of the microscope in making observations, the production of microscopes, as well as the making of slides and other accessories required knowledge that could not always be found in books. Microscopy asked for a steady hand and care in handling microscopes and microscopic objects, skill in working with varying mounting ingredients in different climatic conditions, as well as the ability to interpret what was seen through the microscope. For a long time, historians of science tended to argue that acquiring such skills depended on on-site interaction among artisans, but a few scholars have begun to explore alternative ways of craft knowledge exchange in the early modern age and beyond (see Chapter One). This dissertation contributes to that literature by showing that microscopists' long-distance exchange of craft knowledge was intimately linked to the emergence of new trade and communication infrastructures in the second half of the nineteenth century, which afforded the sharing of skills.

As explained in the introduction, the history of microscopy, and especially microscopy in the late nineteenth century, has not been a favourite topic for historians of science. The literature has so far primarily looked at how microscope users came to agree that what they saw through the microscope was true, most often focusing on the time between the late seventeenth to the early nineteenth century, when the use of the microscope for scientific research was still controversial. This dissertation, however, has shown that the late nineteenth century is a crucial period if we want to understand how infrastructures of making and doing microscopy were built, and how they helped to share craft knowledge of microscopy widely. The second half of the nineteenth century saw the rise of microscopy societies, publications, and commercial slide and instrument makers, aiming to teach their members, readers, and customers, skills in microscopy. This flurry of activity around microscopy lasted only a couple of decades. It peaked in the 1870s and early 1880s, but was almost gone by the turn of the twentieth century. Yet, as this dissertation has shown, microscopists left a lasting mark on the American postal law, helped the advent of industrial science, and made microscopy accessible to a whole generation of students when training in microscopy had only begun to make its way into school and university curricula.

Microscopists attuned their knowledge infrastructures to sharing skills in microscopy and vice versa, for instance by developing mounting media that would withstand the strain of postal exchange. They formed (virtual) communities around their knowledge infrastructures and provided a scientific education that reached diverse groups of learners, even those studying microscopy outside formal spaces of learning. This dissertation, therefore, asks us to consider the role of infrastructure in acquiring skills in microscopy and beyond, inviting further research into the kinds of infrastructure that allow for the sharing and generation of craft knowledge at a distance. Moreover, as I have argued in Chapter Five, the history of microscopy can serve as a heuristic tool that directs our attention to the long historical trajectory of collaborations between formally trained and untrained researchers, and the challenges these collaborations entail, which can help us reimagine present-day and future participatory science projects, like web-based citizen science initiatives.

During the PhD, I noticed that my research speaks to scholars working in many different fields, including historians of science and technology, media studies scholars, STS researchers with an interest in infrastructure studies, digital humanists, data scientists, and even life scientists who work with microscopes in their labs on a day-to-day basis. I have been fortunate to meet and learn from these diverse scholars at national and international workshops and conferences, and through several publications, some of them written collaboratively. Over the course of the PhD, I presented my research at 12 (inter)national workshops and conferences and gave one invited lecture at the University of Heidelberg. I also presented my work at numerous events at Maastricht University, including departmental and graduate school meetings, a crowdsourcing workshop at the UM Institute of Data Science, and a conference to celebrate the launch of the BA Digital Society.

I published a peer-reviewed paper in *The British Journal for the History of Science* (BJHS), an earlier version of which received the 2020 Singer Prize of the British Society for the History of Science (BSHS). Moreover, I turned Chapter Four into a feature article for *Physics Today*, which is currently being edited. Another paper (based on Chapter Two) will be published as a chapter in *Networks: The Creation and Circulation of Knowledge from Franklin to Facebook*, a book edited by the American Philosophical Society, and yet another paper is currently under review to be published as part of a special issue of *Berichte zur Wissenschaftsgeschichte*. I also published a paper in the BJHS together with a group of BSHS scholars who organised a digital science festival at the beginning of the Covid-19 pandemic. The paper reflects on the challenges of moving conferences online during a pandemic and climate emergency.

Societal Impact

Involving non-academic audiences in my research is close to my heart and has been central to this PhD project. To some extent, research outreach was integrated in the PhD from the beginning through the *Worlds of Wonder* citizen science project (see Chapters One, Two and Five), which managed to attract ca. 2,400 online participants. The citizen scientists helped me classify and analyse some of my historical sources, and we learned about the history of microscopy together in the process. In the *Worlds of Wonder* chat forum, we exchanged ideas about how to improve the project workflow and what aspects of the history of microscopy we found particularly interesting. For example, some of the participants put together their own virtual collections of microscopy illustrations, including one of illustrations by female illustrators. One of the citizen scientists, Peter Mason, offered to write Python scripts that would enable me to analyse the data resulting from *Worlds of Wonder* in much more depth, which was a tremendous help and reminded me that although citizen scientists may not be professional researchers, they are often experts in other areas.

Worlds of Wonder, including an accompanying blog and Twitter account, made up the biggest part of my outreach activities, but there were several other projects I became involved in during the PhD. I gave a magic lantern lecture at the Maastricht PAS Festival in 2019, inspired by a magic lantern performance I had been part of during an internship at the University of Leicester (see Chapter Five), where I introduced the audience not only to my research, but also to the magic lantern, a historical slide projector. In 2020, I successfully applied for a masterclass on community-engaged research with Alan Irwin, which allowed me to present my research at a public panel discussion in Maastricht. Moreover, in 2021, I came in second in the *Bake Your Research!* competition organised by the Maastricht Young Academy. I had shared my research in the form of baked microscope slides, using melted candy as a mounting medium for chocolate specimens. The baking competition inspired me to further explore the potential of sensory research communication and encouraged me to (successfully) apply for a KNAW award for research communication in 2021, together with a whole group of FASoS colleagues interested in sensory research communication.

Throughout the PhD, I have also been acutely aware of the politics of research communication, thinking about whom we can (and should) share our research with, and how, and the consequences this may have for political decision making. In 2020, I co-founded the *Historians for Future* climate collective, which seeks to provide a historical perspective on the climate and biodiversity crisis, and which has by now launched a podcast and blog. Since 2020, I have also been a member of the digitalisation committee of the Duisburg city council, working to make sure that the city provides digital services that meet the needs of its citizens.

In my role as an advisory member of the committee I have certainly profited from my work on the digital infrastructures of participatory research.

The microscope slides I made for the *Bake Your Research!* competition, taking inspiration from Mary Ward's nineteenth-century slides, which were wrapped in emerald green paper.

The magic lantern I used for my 2019 PAS lecture on citizen science.

Looking Ahead

From October 2022, I will work as science editor for a start-up that combines tech education and tech journalism. The company helps other organisations navigate the digital transformation, figure out how digitalisation affects their established work processes, and empower employees to actively shape the digital future of their work. I am confident that both my PhD research and outreach activities have equipped me well to understand technological change in theory and practice. For example, the concept of user innovation (Chapter Four) will be helpful in understanding how employees can creatively use and adapt digital technologies to their needs. Likewise, the question of how knowledge can be shared at a distance will continue to be important in my new position, since being able to collaborate remotely has already profoundly changed the way we work and will continue to play a crucial role in the digitalisation of our workplaces. I feel lucky that, as science editor, I will be able to keep thinking and writing about technology, society, and knowledge exchange, and look forward to reaching out to new audiences and collaborators.