



(THINKING ABOUT) BACTERIA IN BERLIN
RACHEL WHEATLEY

Rachel is an evolutionary microbiologist and currently a Prize Fellow at Magdalen College, University of Oxford. She is interested in understanding: (1) the processes underpinning host-microbe interactions (from human infections to plant symbioses), (2) how bacteria respond to environmental perturbations (including antibiotics, host immunity, and phage), and (3) how these fundamental biological processes happen not just in single-species settings, but in the context of a microbiome. She graduated with a BSc. in Molecular Biology and Biochemistry from Durham University in 2014, before going on to study a DPhil in Biological Sciences at the University of Oxford. – Address: Department of Zoology, University of Oxford, 11a Mansfield Road, Oxford, UK OX1 3SZ. E-mail: rachel.wheatley93@gmail.com.

Arrival

When I applied for the College for Life Sciences fellowship in November 2020, I had no idea what I would be doing from June onwards when my postdoc finished. Thankfully, by March I had a bit of a clearer picture. After my postdoc finished, I was incredibly excited to be spending four months at Wiko, and then starting a research fellowship in Oxford in January.

I left for Wiko in August, to join in with the German classes. Entry from the UK to Germany was still very restricted up until June, due to Covid. Many, many email exchanges with Vera later (thank you Vera!), I had wrapped my head around travel navigation and visas. It being my first time flying since the start of the pandemic, I over-eagerly headed to the airport at 4 a.m. to get my flight. After spending the last 1.5 years pretty much in the same 2-mile radius, by the time I “navigated” myself to Wiko, I was exhausted,

but in awe of the gorgeous flat I found myself in Villa Walther, with the incredible views of leafy Grunewald!

Work at Wiko

With the new research fellowship starting in January, it was firstly a great opportunity to prepare for the project – and think deeply about what I wanted to do, with the input of a fascinatingly broad range of interdisciplinary colleagues around me. Broadly speaking, I'm interested in the lungs and what determines success from a microbial perspective in this ecosystem. In reality, it ended up being a lot more holistic than just project input. As someone just starting on an independent career path, it was brilliant to have discussions and get perspectives on varied academic paths, managing groups, applying for funding, and all the life in between from so many talented and thoughtful individuals.

A major focus during my fellowship also ended up being a theoretical project considering CRISPR-Cas systems in bacteria. Just like us, bacteria have their own immune systems. These are mechanisms that can protect them against cellular invaders, including the viruses that infect them (bacteriophages or phage). CRISPR-Cas systems are effectively considered the adaptive immune systems of bacteria. They provide bacteria with a “molecular memory” of past infections, which enables both the targeting and the degradation of repeat invaders. From a theoretical perspective, possession of these systems confers many benefits. However, they are observed at an unexpectedly low prevalence across the bacterial domain. So the question I was interested in was: what are the costs associated with CRISPR-Cas carriage that might help explain their absence in populations of bacteria?

I had first started thinking about this in March, while supervising a brilliant master's student writing a “Covid-alternative” project to experimental lab work. My time at Wiko allowed me to dive deep into the literature and gave me headspace to fully explore ideas. Excitingly, this project has now been written up as a paper and published in *Microbiology* (<https://doi.org/10.1099/mic.0.001209>), and importantly, I think this work has generated a clear set of additional questions and intriguing issues that I hope to explore in the future.

An extremely enjoyable part of my stay was discussing bacteria-phage interactions with Britt. These are the interactions that occur between bacteria and the viruses that infect them. Similarly to the viruses that infect our cells, these viruses can be bad news for the bacteria – infecting them, rapidly reproducing inside, and sometimes ultimately resulting in cell death. As a result, we see a diversity of bacterial resistance mechanisms to phage (CRISPR-Cas systems being an example of one), and on-going research tries to better

understand how these viruses shape the populations and communities of their bacterial hosts. I was very excited by Britt's invitation to collaborate as a co-author on an *Annual Review of Virology* paper she'd been invited to write. Here, we discussed how to draw the link between fundamental experimental work that probes the ecology and evolution of bacteria-phage interactions and trying to understand how these processes occur in natural ecosystems where complex microbial communities exist along with many other variables. It is great to see the Review in Advance version of this now online (<https://doi.org/10.1146/annurev-virology-091919-075914>), and we are continuing to work together on a second project.

Wiko, Berlin, and Beyond

I won't fit in all the other things for which I will also remember my time at Wiko here, so I'll just touch on a couple. I will remember the very early on College for Life Sciences trip to Jena and Weimar, brilliantly organised by Jana and with on-the-ground directional help from Clara! The excitement of Wiko in the snow, the glorious S7 and M19, so much good food, and the visit to Leipzig Zoo. Donut trips with Tatenda, the Wiko Runners Club, the Thursday dinners, and lunches together every day. Opening my mind to new and different research themes at the Tuesday Colloquia and, of course, all the wonderful people who made the stay such a delight. I have found now when hearing anyone discuss definitions and meanings of words – a slightly rephrased *Is a burrito a burrito a burrito* always comes into my head. I have been back in Oxford since January and have started the work I was planning for at Wiko. The College for Life Sciences fellowship was really good for my confidence as an academic, my development as a person, and the openness of my mind to new perspectives and places – and I will forever be grateful for my time at Wiko.