Armourers & Brasiers' European Placements-Non-Techincal Report
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For a long time, I've understood that education should entail more than book learning. This is particularly important for an education of a scientific nature, as the foundations of what you learn are based in sound experimentation and reasoning. Yet I felt that, largely due to time constraints, any laboratory experience that I've had to date consisted of highly controlled undergraduate labs, in which experiments are designed to deliver a set of expected results and students have little opportunity for innovation. So when the opportunity arose to gain this valuable experience in a university in which Einstein himself studied, I jumped at the chance. I had visited Zurich a few summers ago and simply fell in love with the architecture and atmosphere. Additionally, and quite serendipitously, my twin sister had also secured a placement in Zurich for the summer.

Though my internship at ETH was not my first experience of research, my previous placement took place in vastly different conditions; last year, I took off to South America to learn about environmental chemistry. After a month-long stint on a research boat in the middle of the Peruvian Amazon, I realised that I was not quite the intrepid explorer I once thought I was and the perhaps it was best that I conduct any future research in the comparative comfort of a laboratory.

Just one of the many breathtaking classic mountain scenes we encountered during our time in Switzerland

However, much like in Peru, I was concerned by the language barrier. I had no knowledge of German, though I was quickly assured by my colleagues that this didn't matter on two counts: first, Swiss German was sufficiently different from High German that conversations between Swiss and Germans were fraught with confusion and misunderstanding. Secondly, I looked baffled enough that people spoke to me in English anyway. Though the latter point made it hard for me to even attempt to learn the language, it also meant that I didn't feel as isolated. Interestingly, it was my high-school French that improved, thanks to the international student population of my accommodation.

True to ETH's international reputation, my colleagues comprised researchers from across the globe, and ranged in experience level from students completing their thesis projects for their bachelor's degree to post-docs and professors with years of research under their belts. Although I was primarily working under the supervision of one PhD student, all of the staff and my fellow students made a concerted effort to make me feel welcome and comfortable approaching them with any questions I had about my stay, whether they concerned a technical aspect of my report or simply suggestions on where to take my family when they visited me.

Despite my concerns, the experimental components of my project eventually became second-nature to me. The aim was to study the polymerisation of benzyl chloride using Freidel-Crafts catalysis, and try to figure out which catalysts provided optimal conversion rates. We wanted to achieve a low polydispersity index with high number- and weight-average molecular weights-something much easier said than done. One of the major difficulties in this polymer synthesis was the lack of a "directing" group on the monomer species-therefore, although we only desired para-substitution, there was no manner of guaranteeing that ortho- or meta-substitutions were also occurring. Quantitative NMR techniques were required to distinguish between the different types of substitutions made, and thus which catalysts were best able to provide the desired results.

Although I was not at ETH long enough to learn how to use quantitative NMR techniques, I became familiar with a variety of synthesis routes and tools of analysis, such as GPC, TGA, DSC and a range other forms of NMR analysis. After about two weeks, I had learned enough to be able to perform a synthesis from start-to-finish autonomously (although still under the watchful eye of my supervisor). As somebody who was initially quite nervous even at the mention of practical work, this surprising development certainly bolstered my confidence and inspired a newfound enthusiasm for the experimental components of my subject.

Since a major component of my project was synthesising the polymer, not only did my project test (and expand on) my knowledge of materials science, but also the organic chemistry courses I had taken during my time in Cambridge. Unlike most of the syntheses I would have performed in my undergraduate organic chemistry practicals, which were all completed in the six-hour time slot allocated to them on long afternoons, these polymers took upwards of 36 hours to synthesise. This didn't mean I had spare time while I was waiting for the results; I was able to talk with my colleagues about their own research, and they offered invaluable advice about career paths and post-grad opportunities. It appeared to me that they were just as keen as I was to make sure that I could maximise on my 10 short weeks in Switzerland. While every synthesis was not a success (see the pictures below), each "failure" still provided valuable data-which again was a refreshing change from the standard undergraduate lab, in which a failed experiment was little more than a disappointment.

The good, the bad, and the ugly-needless to say, the rightmost picture does not depict my finest work

My family are keen travellers, and from the beginning I was told (read: warned) to maximise on my central European location whilst interning. Weekends were no longer times to lounge in my room, but were instead filled with pre-dawn starts and dizzying heights as coaches transversed the Alps. A highlight, surprisingly, was Lichtenstein, whose fusion of traditional Alpine (but definitely not Swiss) and modern architecture was delightful and fresh, despite being a tiny 160 km^2 in size. Other trips included Jungfrau (known as "Top of Europe", being the highest railway station in the continent), Milan and St Gallen. On one indulgent weekend, I went on a "chocolate tour of Zurich", sampling the city's delights whilst also learning that the Swiss have more types of chocolate than I could have previously fathomed.

I didn't spend all of my free time travelling; Zurich itself had a plethora of opportunities to capitalise on during my stay. Rarely an evening went by without meeting my sister after work to jointly explore the city. As she attends Imperial College, London, she was used to the bustling life that London offered-and was surprised that, although considerably smaller, Zurich was just as lively. Our time there happened to overlap with several festivities, such as Swiss National Day (August 1st), Zurich Festival (which only happens every once every three years), the Street Food Fair and

My friend and I managed to take a picture with all of tiny Lichtenstein in the background

hoard of smaller summertime festivals ranging from open-air concerts to vintage car shows. We even managed to discover where a favourite author of ours-and fellow Irishman-James Joyce had lived and worked on his masterpiece, Ulysses. We also took time to simply indulge in the coffee-shop culture which permeated the city, simply taking time to sit and relax at any of the city's pristine lakeside locations.

Before I set out to Switzerland, I never would have expected that I would want to return there to continue my studies; having moved once from Ireland to the UK, I didn't foresee another move in the near future. However, my experience at ETH Zurich exceeded any of my tentative expectations. The science is universal, but the outstanding research facilities and dedicated staff made my time there incredibly rewarding, and something I would not hesitate to repeat in the future. My time at ETH has already begun to shape my future career. I developed a particular interest in the interdisciplinary science of materials chemistry, which I have chosen as the focus of the final year of my undergraduate degree.

I have mentioned several times in this report how I took every possible opportunity to travel both within and around Switzerland during my stay; this would not have been possible without the generous financial support offered to me by the Worshipful Company of Armourers and Brasiers, the University of Cambridge, Christ's College and ETH Zurich. In particular, I would like to thank Prof Markus Niederberger for facilitating my placement, and Andreas Brändle, for his infinite patience, helpfulness, and for introducing me to the secret Irish pub in the basement of the building.