I was six years old the first time my family traveled through the Blue Ridge Mountains in West Virginia. Rising above the tall trees that filled the landscape were massive satellite dishes. Even at six, I knew there was something peculiar about these white giants. I remember crudely outlining two or three of the large dishes in my sketchpad, imprinting the awe-inspiring image in my mind. Twelve years later, my family returned to the area to investigate the complex that had caught my gaze so many years before.

The "satellite dishes," as I had called them, were actually radio telescopes—large metal contraptions that explored the invisible universe from the National Radio Astronomy Observatory (NRAO) in Green Bank, West Virginia. During my visit, I learned how the telescopes served as receivers to collect radio emissions from distant stars and gas clouds, allowing radio astronomers to study the physical makeup of the vast spaces beyond our solar system. The most remarkable thing I learned about the NRAO, however, was that they employ scientists from a range of backgrounds, from engineers who work on the instruments to physicists and chemists who assess an astronomical object's state or chemical signature. After struggling with what type of scientist I wanted to be when I grew up, radio astronomy inspired me to incorporate diverse scientific interests into an interdisciplinary education.

In the summer of 2013, I returned to Green Bank a third time, but this time to work my dream job—tuning into the galaxy's radio signals to learn about its chemistry. Several of my experiences while working at the NRAO greatly influenced my goals and academic interests. The first was that I experienced first-hand the interdisciplinary nature of radio astronomy research that had so intrigued me two years before. Specifically, I used both my chemistry and mathematics background to study neutral hydrogen gas in the interstellar medium (ISM). My interest in physical chemistry significantly enhanced my comprehension of spectra, and my mathematics background helped me quickly learn many of the rules and parameters of working with computer language (specifically IDL). Moreover, I was the only chemist among physicists, astronomers, and engineers. Yet my perspective of astronomy was not considered inferior, only different, showing me the appreciation of perspectives from a variety of disciplines.

Second, I seized several opportunities to present my research, perhaps the most rewarding of which was a presentation to more than 30 high school students participating in the West Virginia Governor's School for Math and Science.[1] Initially, I was excited to have an opportunity to use every new technical term I had accumulated into my vocabulary over the previous month at the NRAO. I soon realized, however, that my audience was a younger version of me when I arrived at NRAO; I had been someone merely fascinated by telescopes without any knowledge of astronomy research. As I prepared my presentation, I challenged myself to keep my audience in mind. Breaking away from my fellow summer students' trend of giving a traditional research talk, I told the audience my story—how telescopes had inspired me, how I knew very little about astronomy, and how creativity and critical thinking led me to an awe-inspiring research experience at NRAO. Throughout my talk, the high schoolers laughed, shouted out questions, and generally were excited by my enthusiasm. This interaction made me realize the value of not only public outreach, but outreach that is engaging, that inspires audiences to get excited about the scientific problems at hand.

[1]Wilkins, O.H. "Life in the Quiet Zone". National Radio Astronomy Observatory, Green Bank, WV. July 2013. West Virginia Governor's School for Math and Science.

Finally, despite a small population of 134 in Green Bank, I was constantly interacting with scientists from around the world and learning that collaborations across international borders are imperative for enhanced critical analysis and maximum scientific productivity. It was in these interactions that I first heard the term "astrochemistry." After Green Bank, I became increasingly interested in radio astronomy research globally. My international interactions at NRAO prompted me to study abroad the following spring (2014) in England. There, I seized the opportunity to visit both the Lovell Telescope at the Jodrell Bank Observatory in Cheshire, England, and the Radioteleskop Effelsberg near Bad Münstereifel, Germany. At Jodrell Bank, I was inspired by the hospitality and enthusiasm of the people who worked in the visitors center. We chatted about radio telescopes we had visited, shared some of our favorite radio astronomical discoveries, and described the atmosphere around radio astronomy in our local communities. I learned so much about local radio astronomy culture and methods on that trip, but more importantly I was convinced that assuming global opportunities to do research or participate in discussions would be an imperative part of my research career.

Upon returning to the U.S. in summer 2014, I was determined to explore the field of astrochemistry. I began research at the Harvard-Smithsonian Center for Astrophysics (CfA) under the tutelage of Dr. Karin Öberg. Where the NRAO had attracted me to interdisciplinary research, the CfA grounded my interdisciplinary goals in the chemistry of the stars. Once again, I implemented my double major in chemistry and mathematics, this time to study organic chemistry in protostellar environments. The dominant formation pathways of interstellar organic molecules—which are present as saturated complex organic molecules (COMs, e.g. CH_3N)[2] and unsaturated carbon chains (e.g. C_4H)—are often poorly contrained, limiting our understanding of more complex chemical pathways. Dr. Öberg's group had observed a small sample of protostars using microwave spectroscopy and had conducted a pilot survey on complex organic molecules in the sample.[3] I focused on unsaturated carbon chains, identifying three kinds of species—sulfur-bearing, nitrogen-bearing, and pure hydrocarbon—and using rotational diagrams to determine excitation temperatures and abundances. We found that all of the detected carbon chains have rotational temperatures of about 12 K, and abundance relationships suggest multiple types of carbon chain chemistry in the sample.

My summer at the CfA yielded multiple professional results, exposing me to a small but innovative network of astrochemistry research. In March 2015, I presented the results of my project at the American Chemical Society National Meeting in Denver.[4] At the meeting, I connected with other astrochemists as well as learned about other areas of research in the field. The CfA influenced the transformation of my interdisciplinary career path into an intercontinental one as well. I identified and quantified carbon chains using information from the Cologne Database for Molecular Spectroscopy, inspiring me to connect with the Cologne Laboratory Astrophysics Group. For the next year, I am continuing to explore my astrochemistry passion in Cologne, Germany, as a Fulbright Research Fellow.

The results of working at the CfA also had a personal impact. My summer had begun

[2] In interstellar environments, "complex" describes organics with six or more atoms.

[3] Öberg, K.I., Lauck, T., and Graninger, D. 2014, *ApJ* 788, 68

[4] Wilkins, O.H., Graninger, D.M., Öberg, K.I. "Carbon Chains in Low-Mass Young Stellar Objects. 249th ACS National Meeting, Denver, CO. 25 March 2015. Physical Chemistry Poster Session.

with a reading assignment, "Complex Organic Interstellar Molecules,"[5] which was a crash-course in the many out-of-this-world research areas under the category of astrochemistry. Reading the paper challenged me to think of my own research questions because it concretely showed me that there are numerous questions and methods that can be applied to a research subject. In my previous experiences, the research objectives were already stated for me at the front of a lab manual or determined by my advisors. Dr. Öberg helped me shape my own research questions when looking at protostars, and I saw a significant change in myself as a scientist. She also helped me become a more independent thinker, challenging me to think critically about and answer my own questions. I began as a student quick to ask for help and afraid to express my ideas even to only my advisor, but by the end of the summer, I was eager to talk in group meeting and confident to think through problems on my own.

After my summer at the CfA, I returned to Dickinson College to begin my senior honors project in chemical ecology. The growth I had undergone was evident as I devised critical research questions for my project on my own. I was proud of my new-found confidence to work on my own when, just one year before, I was constantly seeking my advisor, Amy Witter.

In the midst of these research experiences, I learned to appreciate how interactions with other scientists shape my worldview. I was inspired to share my experiences with the world, remembering the staff and scientists at astronomical observatories that had shared the stories which turned my eyes to the heavens. I began giving seminars at high schools, giving younger students a taste of how creativity and imagination could be applied to an "unconventional" education path. One such experience was at the University of East Anglia during their "Move on Up" program for high school students. I volunteered to give a workshop entitled "Maths in Space," in which I introduced radio astronomy and demonstrated how mathematics could help us understand space. By sharing my passion for science, I found another passion—education and public outreach. From talking about science with high school students and keeping a blog and telescope database (*http://theskyisnotthelimit.org*) to giving research presentations to peers and professionals, I am eager to expand the knowledge of my audiences.

I am committed to graduate school because it gives me access to two areas I am determined to incorporate into my career goals: research and teaching. Many of my advisors and colleagues in graduate school have described a thesis as becoming an expert in a particular topic. In my intended course of study, this is especially true. I am particularly interested in programs at institutions such as California Institute of Technology and Harvard University where, during the anticipated five-year program, chemistry graduates typically enroll in one year of coursework rather than two, the benefits of which are two-fold for my professional aspirations. First, the extended time available for thesis work is an opportunity to truly become an expert in both laboratory *and* observational work. In the laboratory I could control conditions, study surface chemistry, and propose formation pathways in simulated interstellar conditions; through astronomical observations I could test these theories by studying chemical abundances in interstellar environments directly. Second, I would have more flexibility for teaching experience beyond the base teaching assistant requirements. By serving as teaching assistant for additional courses, I would be more prepared for working in dynamic class environments later as a professor.

[5] Herbst, E. and van Dishoeck, E.F. 2009, *AARA*, 47, 427