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ON THE COVER

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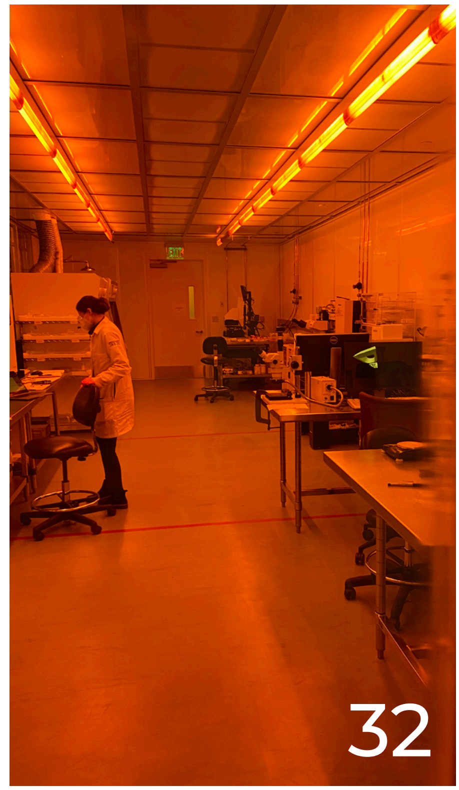


DREAM CAREER

Automation Engineering

ARTICLE BY ALEC DAMON, HARTLAND, WI

ARTWORK BY ANTIGONE STANLEY, ADELAIDE, AUSTRALIA

In eigth grade, I was in robotics class working with Vex robots, when I successfully programmed a motor to rotate a crane mechanism. I felt very proud and accomplished; this was when I knew I wanted to work with robots and program them when I grew up. I have always been very interested in anything dealing with computers, robotics, and programming. When I came across automation engineering while touring Waukesha County Technical College, I instantly knew that it was what I wanted to do after high school. Seeing all of the different robotic arms and what people had programmed them to do hooked me into wanting to become an automation engineer.

SEEING ALL OF THE DIFFERENT ROBOTIC ARMS AND WHAT PEOPLE HAD PROGRAMMED THEM TO DO HOOKED ME INTO WANTING TO BECOME AN AUTOMATION ENGINEER

Since I was a kid, I have wanted to work with computers and do anything that dealt with using different technology in my future career. Whether it was 3D modeling different parts, putting together computers, helping others with their computer problems, or even building computers, I wanted to do it all. My ability to quickly learn and adapt to using different things to solve problems is something that will allow me to excel in the automation industry, and that realization alone is what made me want to pursue my dream career of being an automation engineer.

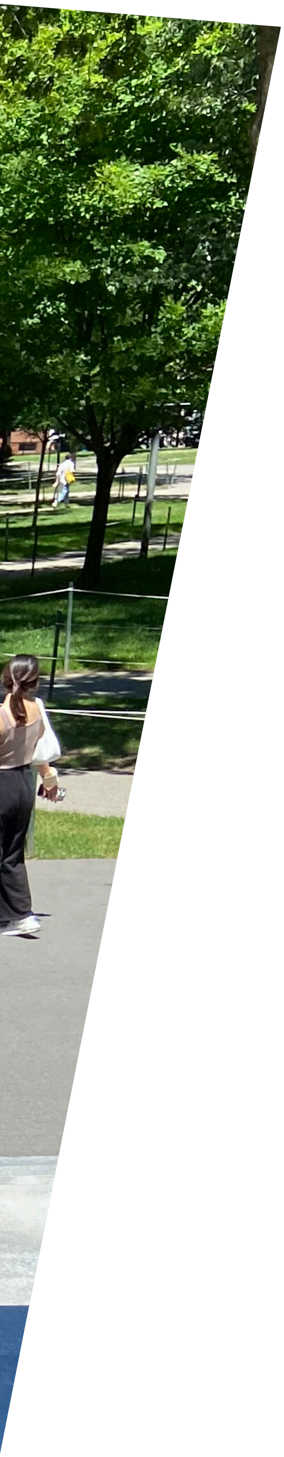
Throughout my education, I've been introduced to many aspects of the industrial and engineering fields. I have taken classes that taught me how to design parts in CAD (Computer-Aided Design) programs and make various items using techniques, such as welding, plasma cutting, woodworking, staining, and painting. I even took a class that focused on machining different parts to create a final product. These have allowed me to familiarize myself with many programs and processes that automation engineers deal with daily.

Recently, I started researching what automation engineers do and what skills are essential to the position. Automation engineers need to be great at problem-solving and thinking of the most efficient way to solve the problem. Some of what automation engineers do is streamline manufacturing processes, program robotic arms to complete tasks, work with computers to program automation systems, and automate different systems to maximize efficiency.

There is a promising future in the automation field, being that a lot of manufacturers and distribution centers are starting to become autonomous. Companies can now run "lights-out," which means that the machines can keep producing parts or products without needing anyone there to operate them. For example, shipping companies, such as Amazon, utilize autonomous distribution centers to minimize the number of workers they need and to maximize the efficiency of their delivery process so that you can get your package as quickly as possible. This means that there will be a great demand for automation engineers in the future, which means that it will be an up-and-coming field to get into.

To obtain this career, I intend on going to WCTC and enrolling in automation classes that focus on programming robotic arms and learning to program different systems to automate processes. Once I complete these classes, I would love to find an internship to start using my knowledge and gaining experience in the automation field. Through that internship, I hope to get a job in automation so I can finally accomplish my dream of becoming an automation engineer, programming robots, and streamlining operations. ◆

Is Engineering Right For You?



ARTICLE BY LUCAS NELSON, MIAMI, FL

PHOTO BY SOEUN LEE, TENAFLY, NJ

Engineering is more than just using math and science to invent things. For me, engineering means a way to discover about our world and find ways to make our lives and society better. Engineering is also a way to test yourself and see how creative one can be. However, this way of thinking was not always the case. I once thought engineering was merely designing and building things like what inventors do. Now I know engineering is far more complex and a very intriguing study, and it can be taken both recreationally and professionally. So, what changed, and most importantly, what gave me certainty of the profession I want to pursue?

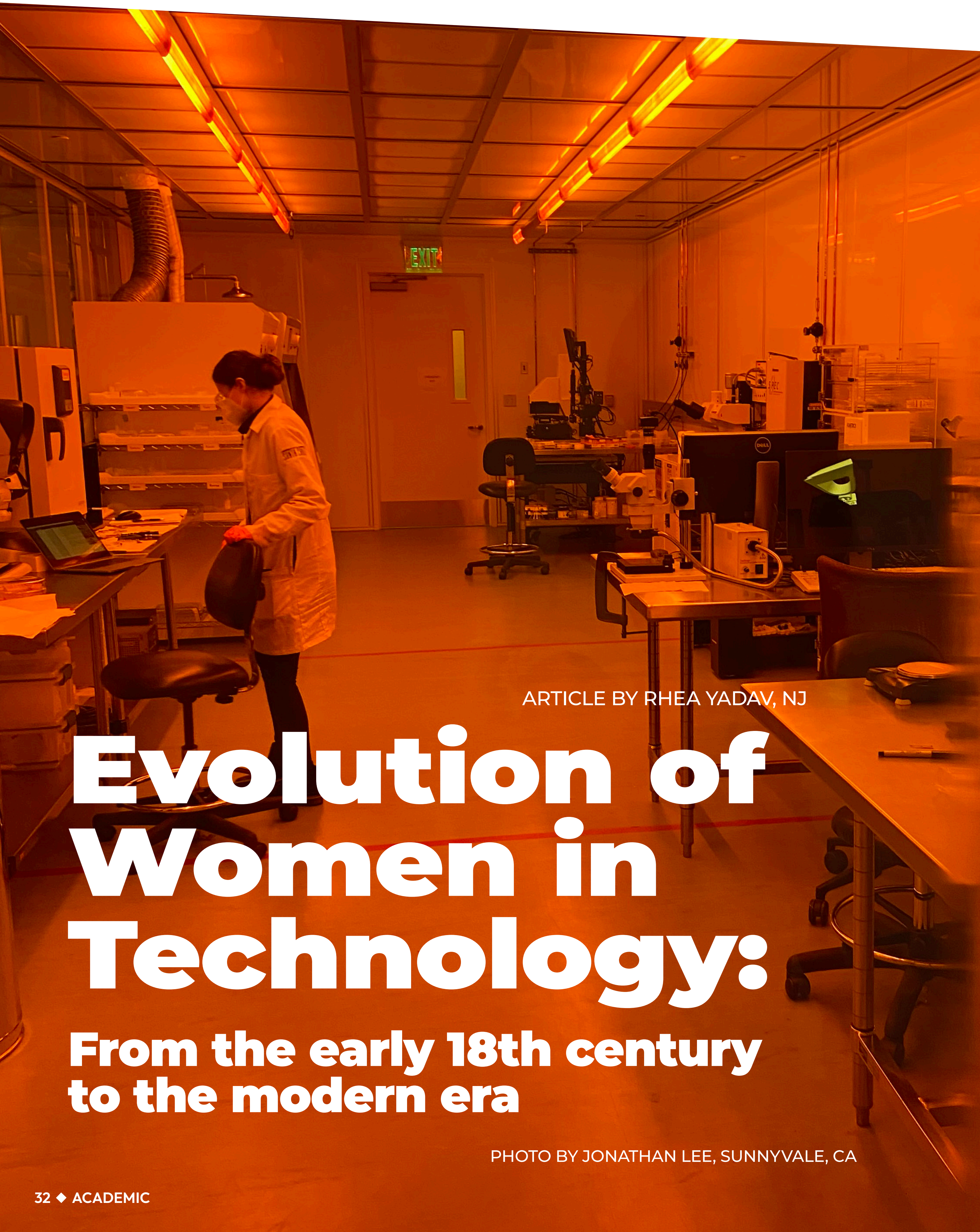
Well, choosing a profession is important, and I decided I needed to experience the daily routine of an engineering student and/or professional if I was serious about becoming an engineer. I also decided it was just as important to visit the different engineering departments of some of the most prestigious universities to become acclimated and familiar with different resources and mindset. Luckily enough, there is a diversity of summer camps, classes, and workshops available for highschoolers to attend all over the world, and there are university tours available all year long.

FOR ME, ENGINEERING MEANS A WAY TO DISCOVER ABOUT OUR WORLD AND FIND WAYS TO MAKE OUR LIVES AND SOCIETY BETTER

During the summer of 2022, I chose to embark on a small, but helpful expedition. I was able to eliminate astrophysics engineering after participating in an interesting and informative course at Case Western Reserve University and having an insightful conversation with a research graduate student at the MIT astrophysics department in Boston. I was able to see and learn the equipment, data, and information used to discover the existence of other planets, though it never fully piqued my interest. I encountered a surprisingly fun and engaging experience at the Engineering Technology housing program camp at Pennsylvania College of Technology — Penn State, where I embraced the "college" life of staying at college dorms, eating at college cafeterias, and attending hands-on classes and workshops.

It was a surreal experience. We were able to experience the different fields of engineering. We had a nine-to-five schedule with classes ranging from one to three hours. These classes consisted of engineering workshops that included information and hands-on activities with machinery and gadgets in different fields, such as manipulating plastics and polymers, welding, manufacturing, civil and electrical engineering, and more. In addition, we attended lectures and Q&A sessions with professional engineers who provided us with relevant information about their field. Having a brief glimpse of what college life is all about — roommates, meeting students from different parts of the country, and independence — was the cherry on top.

Engineering is a fascinating, multiplex field, and having the opportunity to become acquainted with the different branches is important for a high school student who is in the process of selecting a major. Institutions like PCT are a great place to start. Now, not only do I know what I want to study, but I am also eager to continue the work I started with my teachers and classmates back in my summer semester in 2022. I foresee lots of fun, creativity, growth, challenges, hard work, learning, impact on society, collaboration and great friendship among professionals. I hope you find the same results in your future, with engineering or in any other field. ◆



ARTICLE BY RHEA YADAV, NJ

Evolution of Women in Technology:

From the early 18th century to the modern era

PHOTO BY JONATHAN LEE, SUNNYVALE, CA

Technology — a world full of computers, types of machinery, codes, software, and applications — a word that was unknown to many women during the early 18th century across the globe, specifically in the United States. During the early 1700s, women were not intended to pursue their interests, rather, they were to remain in their domestic sphere and perform daily household tasks. However, a major shift occurred during World War II when women were able to take on wartime occupational jobs. Various mathematicians, computer programmers, and scientists contributed to their societies by showcasing their logical and problem-solving skills. During the 1700s, one of the early individuals, Nicole-Rein Lepautre, a French astronomer and mathematician, contributed to the field of astronomy by accurately predicting a comet's appearance in the night sky. This paved the way for trailblazers like Ada Lovelace, who in the 1800s became known as a remarkable woman who is known as the first-ever computer programmer and scientist. Lovelace paved the way for women in technology tremendously. Her work ethic strongly portrays her inspiration to other women in the technology field.

THEIR CONTRIBUTIONS TO SOCIETY HAVE OVERALL AFFECTED COMPUTER SCIENCE AND PROGRAMMING, WHICH CREATED A SIGNIFICANT INCREASE OF WOMEN IN TECHNOLOGY

As the timeline progresses, the evolution of women's strengths, bravery, and courage are showcased. Factors such as the market and the industrial revolution significantly affected women's roles in the technology field. As the need for women grew larger, during the midst of the Second World War, many women gained the experience of working in factories with large machinery. According to statistics, data shows that by the year 1900, 80 percent of telephone operators were women and progressed as the main operators by the 1960s. Theories developed that led to logical thinking, and modern computer algebra emerged as a consequence. As a result of the Second World War, many women became computer programmers; however, they were not recognized highly. Moreover, in 1945 during the wave of feminism, society saw large numbers of women as computer programmers, later they would be recognized as "human computers."

During the 20th century, society saw many individuals whose legacies and stories are still known today. Their role in the field of computer science helped shape society and modern technology. To name a few, Grace Hopper was a prominent computer scientist who created the first computer programming language all in English, and Annie Easley advocated for women in Science, Technology, Engineering, and Mathematics (STEM) fields while simultaneously working as a computer programmer at NASA. Their contributions to society have overall affected computer science and programming, which created a significant increase of women in technology.

Within the technology industry, statistics further illustrate that the percentage of women receiving computer science bachelor's degrees has increased from 1970 to 2019, from 14 percent to 21 percent, respectively. During the years, the percentage peaked in 1985; however, it significantly decreased following 2019. Despite the rise of women seen in technology and engineering fields, women have also faced a significant gender gap with employment rates and lower as well as unfair wages. Although women are the minority in the technology field, they have made remarkable contributions to society that have been impactful, and their achievements will continue to stay as a legacy. All in all, the evolution of women in the technology industry has undergone significant changes. Currently, in the modern era, many advocates are raising awareness about the distinct differences in the gender gap. Ultimately, as women faced difficulty in the industries, their bravery and confidence highlighted their determination. ◆

The Implications of a Dyson Sphere for Mankind

ARTICLE BY LIAM LOBL, ARDSLEY, NY

Humans have always been obsessed with the prospect of going further. We constantly send out satellites to map the stars. We dream of going to Mars, and from there, branching out into the depths of space. Our solar system. The Galaxy. Just how far can we go?

Perhaps the greatest possible limitation for us becoming an intergalactic civilization can be summed up in one word: energy. In order to advance as a society, energy is a necessity. Human civilization began by using more primitive forms of energy, such as fire. However, as societies grew, new forms of power were needed. Eventually came coal, fossil fuels, and other modern, more efficient forms of energy. As the population increases, energy must do the same. It powers our everyday life, and without it, no matter the quantity of advanced technology we have, it would be impossible to survive. If we are to truly maximize our access to technology and aim to go beyond our planet, we would need a technological breakthrough in the way that we produce energy. The amount we would need to travel among the stars and build civilizations on other planets is unfathomable. Luckily, there is one source that can provide enough energy to do this: the sun.

IN ORDER TO ADVANCE AS A SOCIETY, ENERGY IS A NECESSITY

In 1960, physicist and astronomer Freeman J. Dyson introduced a proposal for how we may be able to harvest the sun's energy, resulting in the name Dyson sphere. Such a device would be a megastructure encompassing the entirety of the sun with the goal of trapping and delivering the energy of the sun to humans. In reality, a Dyson sphere would not likely be an actual spherical shape. In fact, according to most scientists, a giant solid shell encompassing the sun would not be the most practical solution, as it would be prone to impacts, liable to drifting, and could potentially crash into the sun. A more realistic solution might be a Dyson swarm, a massive set of orbiting panels that collect the sun's power and beam it elsewhere. If successfully pulled off, this technological feat would allow our species to transform from a planetary one to an intergalactic empire.

If such a device would completely change the capabilities of humankind, why haven't we begun developing one already? As it turns out, there are many challenges that must be overcome in order to successfully build a Dyson Sphere, including the design of the megastructure itself. It would require satellites with a simple design, unlike the complex and short-lived solar panels we have right now. These satellites would also need to be able to operate without repairs or any human intervention for extremely long periods of time. They would also need to be extremely cheap to produce. One proposed way to create light, durable, and cheap satellites would be to create structures that are giant mirrors that refocus sunlight into central energy collection stations.

Even after a working design has been formulated, there comes the challenge of building the structure itself. Given the massive size of the sun, it would require an unimaginable number of satellites to encompass it. A video by Kurzgesagt estimates that if each satellite were a square kilometer long, it would require 30 quadrillion to surround the sun. In order to obtain just the raw materials for the Dyson sphere, we would likely need to extract all the raw materials from a planet that contains just the right substances. Even if these satellites were built as lightly as possible, it would take hundreds of quintillions of tons of materials. We would also need to have established some sort of permanent structure in space, akin to a factory, specifically for the construction of the Dyson sphere.

Besides requiring an extremely large amount of natural resources, building a Dyson sphere also requires a massive amount of energy. First, it would be necessary to take apart a planet and extract all of its resources to build the structure. Then would come the challenge of launching the satellites into their location around the sun, requiring more power output. Even if all of the fossil fuels and uranium on Earth were extracted, it would not be anywhere near the amount of energy required. This energy problem has made various scientists skeptical of the plausibility of a Dyson sphere. Since there is such a great amount of energy required to build it, many scientists theorize that the amount of energy needed would have to come from a source that could output as much energy as a Dyson sphere or a similar structure. Given that such a source would not yet exist before the creation of a Dyson sphere, it may be impossible to build one in the first place.

Despite all of these challenges, if successfully pulled off, a Dyson sphere would usher in an age of exploration unlike anything before. It would enable colonies on other worlds to have the ability to terraform (modify a planet to be habitable) other planets and the option to build more megastructures. We would be able to travel to other stars and create an interstellar civilization.

Given the fact that Dyson spheres are very logical, a requirement for getting off of a home planet, and work within the bounds of science and physics, many scientists theorize that there may already be many Dyson spheres in the Milky Way alone, built by multi-planetary species. While we haven't spotted one yet, it does not rule out the possibility of their existence. Perhaps looking for a Dyson sphere may become our best option for finding hyper-intelligent life in our galaxy.

While a Dyson sphere largely remains a science-fiction fantasy right now, it may one day become a reality, expanding the boundaries of what is possible for humanity. ◆

PHOTO BY ANONYMOUS

ada lovelace: a female trailblazer

ARTICLE BY ERICA PAN, BEIJING, CHINA

When asked about female scientists who inspired younger generations of girls to pursue scientific study, the first person that comes to most people's minds is Marie Curie. And that isn't surprising. Not only is she the first woman to win a Nobel Prize, but she is also the only person to win two Nobel Prizes in two different disciplines — physics and chemistry. However, despite her remarkable accomplishments, she is not the first female scientist. Before the world knew Marie Curie, there were numerous other determined young women who left their mark on the STEM fields. In particular, Ada Lovelace, who was known as "the first computer programmer."

What was special about Lovelace and what set her apart from other women in her era was that she was encouraged to learn mathematics. Lovelace's parents divorced when she was only five weeks old. Lady Byron, her mother, took Lovelace and became obsessed with the idea of educating her. Lady Byron was scared that if Lovelace went down the same path of "imaginative self-indulgence" Lord Byron had, Lovelace would succumb to a fate of madness. So, Lady Byron turned to math as a way of "taming" Lovelace's imagination. For most of her childhood, Lovelace was educated by tutors hired by Lady Byron. However, when she was 17, she met an English polymath named Charles Babbage, who became her greatest aid in exploring mathematics. They bonded over a project that Babbage was working on, called the "Difference Engine." It was meant to do calculations without error, somewhat similar to the modern calculator, but, eventually, Babbage gave up on it. Later, Babbage started on a new project called the "Analytical Engine," the world's first digital computer. The creation of this machine was when Lovelace's influence truly shone through.

"MARIE CURIE" BY ELA M. SURREY, BC, CANADA

"Ada Lovelace" from The New York Public Library

In 1842, Babbage met Luigi Menabrea, a mathematician who agreed to write a paper about the "Analytical Engine." They published the 8,000-word article in a Swiss academic journal and asked Lovelace to translate it from French to English. Her translation included several of her own notes and totaled up to 20,000 words, more than twice the original length. In her translation, Lovelace explained with great clarity regarding the foundation of the "Analytical Engine" and how it might operate. She even wrote that "[t]he science of operations, as derived from mathematics more especially, is a science of itself, and has its own abstract truth and value." Although not known by its modern name, this marked the beginning of the field of computer science. For the very first time, the science of operations was seen as something distinct from the field of mathematics. Lovelace's contribution to this paper was also her greatest contribution to computer science. Later on, historians would speculate whether her contributions truly were that "great" and whether her contributions were overstated. Despite this, Lovelace's story continues to resonate with other female scientists as it recognizes that there will always be people who seek to discredit female achievements. However, pushing past those challenges and contributing to scientific exploration is the ultimate goal all scientists should strive to complete. ◆

the inspirational sommer gentry

ARTICLE BY ERICA PAN, BEIJING, CHINA

ARTWORK BY GENEVIEVE GUNGOR, NEW YORK, NY

As we grow up, it becomes increasingly natural for the people around us to lose contact with the hobbies that were once so dominant in their lives. And eventually, the same may be true for us as well. While this is painful to accept, this new reality becomes the norm for some of us as we face new academic, adult, and career responsibilities.

I've been dancing since I was four and plan to continue dancing in college. However, I've always feared that dance would fade out of my life after college and become just a brilliant memory of my childhood. But what if this didn't have to be the case?

After learning about Sommer Gentry's story from the Association for Women in Mathematics PlayingCards project, I am convinced that through constructing an interdisciplinary path between dance (or any of my non-academic interests) and my academic passions, there is a way for me to keep both equally important parts of my future life as well.

Sommer Gentry, previously a mathematics professor at the U.S. Naval Academy and a coach at the Naval Academy's Swing Dance Club, is currently a faculty member at the Department of Surgery and Population Health at NYU Grossman School of Medicine. Gentry and her husband, whom she met through swing dancing, also started a swing dance community in Baltimore to introduce non-dancers to the craft.

I LOVE THAT SHE FOUND DELVING INTO HER ACADEMIC INTERESTS IN STEM DOES NOT MEAN LETTING GO OF HER OTHER NON-ACADEMIC ONES

In a 2004 interview for the Massachusetts Institute of Technology, Gentry said teaching inspired her "to view dancing from an engineering point of view. 'I realized it was an engineering question: How do you dance well with someone? It would be great to give people mathematical and engineering proofs of why they have to dance the way I say.'" According to ScienceDaily, while she was a graduate student at MIT, Gentry investigated the "complex haptic communication behind the often-improvised moves in swing dancing" and showed that two beings could move in coordination with pure haptic communication. Roderick Murray-Smith, a researcher who collaborated with her, said, "'Sommer is entering an exciting area of research which is between engineering, psychology, and human motor-control studies. It could be of importance for sports training or rehabilitation engineering — the study of how to use technology to help humans overcome disability or injuries.'" It's incredibly inspiring that Gentry was able to intertwine her academic work with her passion for dancing. Gentry says that by "melding her hobby with her work...means that even when I'm out dancing, I'm thinking about my research project."

I love that she found that delving into her academic interests in STEM did not mean letting go of her other non-academic ones. Instead, she fully embraced both and found a way to incorporate both into her professional life. Just like me, Gentry is a mathematician and a dancer; thus, her story resonates strongly with me, and I aspire to be like her in the future. ◆

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