

To the Beat of Her Own Drum
by Sophie Usherwood

Almost everyone had left, roused and angry. Carolyn Gordon stood up quietly from her seat and walked to the podium, her heart pounding rapidly like a hollow drum. She looked down on the nearly empty auditorium that had been full moments ago, before the previous presenter had offended the audience. Slightly breathlessly, Carolyn began her talk on geometrical studies, halfway through, the auditorium door creaked open slowly, and a stranger stepped in. The geometer in the grey suit was Rich Millman, and this encounter was to change the course of Carolyn's life. She was transformed into a leading female mathematician who would eventually become an Ivy League professor.

Rich Millman told her of a math problem called "Can you Hear the Shape of a Drum?" In the problem, there is a vibrating membrane, for example a drum, and it makes a fundamental tone and infinite but discrete sequences of overtones. The question asks, "If you know the sound frequencies, would you know the shape of the drum?" At the time, it was assumed that each different shape of drum made a unique pattern of sound waves, so you would know the shape. But Gordon's fascination and creativity enabled her - with her husband David Webb and her colleague Scott Wolpert - to discover two differently shaped drums that resonated the same way, disproving the earlier assumption. For this discovery, she won the prestigious Mathematical Association of America Chauvenet Prize, and this achievement opened up an opportunity to be a math professor at Dartmouth College.

When Carolyn Gordon was a young girl, she remembers her mother saying "*Wouldn't it be exciting to be married to a professor!*" Well, now she actually is one herself! Her mother's comments may sound unusual nowadays, but Carolyn grew up in a time when women became housewives with a family, or "old maids" with a career. She probably never would have been exposed to math if her older sister, Marsha, hadn't always told her that math was an intricate puzzle right at their fingertips. Her sister's message reverberated in Carolyn's head, and she became fascinated by the idyllic virtual world of mathematics that she could sink into for solitude. She felt her power to guide a sparkling wave of mathematical ideas, to transform theoretical misconceptions into the truth.

Gordon's passion for seeking the truth took her to Purdue University in the 1970s, where she earned her undergraduate mathematics degree. She was one of only a small number of women there, but Carolyn was not the type to be deterred. Her older sister, who had been a math major, had warned her to expect male domination. Gordon reflected that because she was expecting it, the sexist situation was much easier to deal with. Unfortunately, the situation was even worse at Washington University graduate school, where she was the only woman out of the seven people

in the entering class. Despite this, she said, *“It was a very congenial class. We all worked together, it was a really nice atmosphere, and I felt totally accepted.”*

At Washington University, geometry was a prerequisite course, and Carolyn was immediately drawn to it. This was surprising, because in high school, Gordon had a geometry teacher who treated his students so badly that they developed a dislike for geometry. Gordon went to lengths to avoid all geometry classes during her undergraduate education. But at graduate school she encountered a snare - she could not avoid geometry any longer. Much to her surprise, after taking the course she realized it was what she wanted to pursue.

During graduate school, Gordon had the opportunity to attend the annual Joint Mathematics Meetings. As she entered the room where the Association for Women in Mathematics was holding a meeting, her jaw dropped. In rows upon rows of tall chairs sat female professors and female mathematicians. Even though she knew the meeting was to support women - so naturally there would be many women there - Carolyn had never seen a female professor in person before, and to see hundreds of them in the same room hit her like a boom of a bass drum. It was at that moment that Carolyn realized that she unconsciously felt the absence of women. She hoped with all her heart that one day she would join the ranks of these distinguished women.

Even today, math is a male dominated field, so many females devalue their own talent in math. Gordon says, *“We’re not really capable of judging ourselves objectively.”* She says it is easy to think that someone who gets the instant gratification of finding the answer is “smarter”, but this is a hollow aspect of math. The person who gets the answer quickly in a perfunctory manner might not be prepared for research where one must be patient and thorough. Gordon says, *“If you start comparing, you miss where your own talents are.”*

Professor Carolyn Gordon uses her talent of perspicacity to tap deeper into the mathematical world today. Her ideas resonate as they always have done to young women pursuing mathematics. She is a quintessential influential woman who has made a powerful impact on the growing body of mathematical knowledge, sending vibrations of inspiration in all directions. She has won many awards, such as in 1999 she made a joint invited address for AMS-MAA, and in 2010 she was a selected Noether Lecturer. She has also been elected as a fellow of many important mathematical institutions. In 2012, she became a fellow of the American Mathematical Society, and a fellow of the American Association for the Advancement of Science. Most recently in 2017, she was selected as a fellow in the inaugural class of the Association for Women in Mathematics. For all of these prominent awards, she was so humble that she didn’t even mention them to me when I interviewed her. With her humility and her talent, Carolyn Gordon is at the forefront of the marching band, pounding on her drum and leading the way into

the future of mathematics, a glowing role model for the next generation of women who aspire to pursue math.

Bio:

Sophie Usherwood is a freshman at Hanover High School. Her favorite subjects are Pre-calculus, English, and Biology. Sophie has won writing awards from Scholastic Art and Writing, and her work has been published in her local newspaper many times. She plays the flute and the piccolo, and she scored first piccolo in New Hampshire's All-State High School Competition. Sophie also plays the piano, and she's currently working on Chopin's Fantasia Impromptu and Debussy's Clair de Lune. She is an avid origami folder, and she has won a place in OrigamiUSA's Origami By Children Exhibition for the last 3 years. She enjoys teaching senior citizens how to fold origami, to engage their focus and brighten their day. She also leads an origami club at her high school, and teaches workshops at the local library after her origami work is exhibited there each year. Sophie is currently working on a scientific paper with two PhD students about origami spring structures at Dartmouth College.