

MATH OUTSIDE THE BUBBLE



One Spark Is All You Need: Germain Gets the *Hamilton* Treatment

Sophia D. Merow

“Nothing stopped Sophie” reiterates the refrain of Cheryl Bardoe’s award-winning¹ picture-book account of French mathematician Sophie Germain’s persistence in the face of obstacle after societally erected obstacle. *The Limit*, a pop-rock musical that debuted at London’s VAULT Festival in March, likewise highlights Germain’s tenacity in the pursuit of mathematical knowledge.

Taken with mathematics after reading about the death of Archimedes in J. E. Montucla’s *Histoire des Mathématiques*, Marie-Sophie Germain (1776–1831) weathered the French Revolution holed up in her father’s library poring over Newton and Euler, Bézout and Cousin—despite parental disapproval of such an unladylike fascination. Though the newly opened École Polytechnique denied women entrance, Sophie obtained lecture notes and submitted work under the name of sometime student Antoine-Auguste Le Blanc. Germain would go on to correspond with

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¹Nothing Stopped Sophie: The Story of Unshakable Mathematician Sophie Germain, written by Cheryl Bardoe and illustrated by Barbara McClintock, won the 2019 Mathical Book Prize in the ages 5–7 category. See <https://bit.ly/2GBFBN8>.

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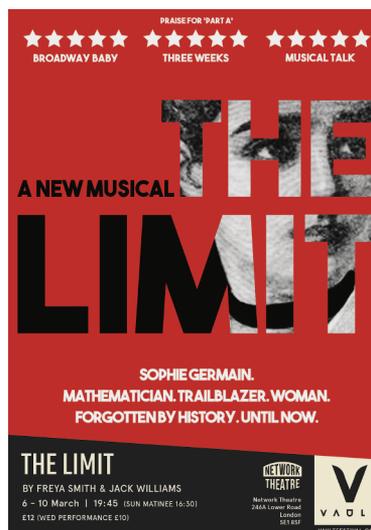


Figure 1. *The Limit* premiered at London’s VAULT Festival in March.

Lagrange, Legendre, and Gauss; make pioneering contributions to elasticity theory; and tackle Fermat’s Last Theorem. Even after she became the first woman to win a contest sponsored by the Académie des Sciences, Germain could not attend the society’s sessions. She published her prize-winning essay at her own expense.

Freya Smith of Bottle Cap Theatre first learned of Germain on an AskReddit thread titled “Who’s the most badass woman in history?” (<https://bit.ly/29jcY1z>). *Hamilton* had sold Smith on sourcing storylines from history, but Lin-Manuel Miranda’s resurrection of America’s first Secretary of the Treasury from the dustbin of history left her keen to identify a female figure ripe for a similarly rousing encore. Germain struck Smith as a prime candidate. “Her story really stood out to me as

something that would lend itself to a theatrical retelling," she recalls.

Smith and Bottle Cap co-founder Jack Williams have a fresh take on the musical genre. "We want to change the minds of people who believe musicals are not for them," the pair writes on their website. They "want to show that musicals can educate and politicise." In addition to the modern-day relevance of its heroine's struggles against gender-based discrimination, Smith recognized in Germain's story moments of comedy. Disguise, for instance, is a trope Shakespeare often used to comic effect. "It throws up lots of ideas on identity and how it can shift or be manipulated," explains Smith. Comedic elements also enabled Williams and Smith to retain a light touch. "It was really important for us to create something that didn't feel preachy," Smith says. "We want our audiences to learn and be moved, but we also want them to feel entertained."

In adapting Germain's biography for the stage, Bottle Cap elided parts of the historical narrative and invented others (as was explained on a fact sheet distributed to audience members). While history tells us only that Germain adopted Le Blanc as a nom de plume, in *The Limit* Sophie is introduced to Antoine-Auguste as a potential suitor and subsequently impersonates him to attend lectures. In reality Germain entered the Académie des Sciences contest (see Figure 2) three times before being awarded the prize; in *The Limit* she prevails after entering twice. "With only papers and letters to go on, I think it's inevitable that parts [of Germain's story] will be fictionalised, embellished, and simplified," says Durham University mathematician Jack

The Limit's opening number, "Sparks," follows Sophie as she enters her father's library for the first time and falls in love with mathematics and learning. An excerpt:

HERE WE HAVE THE SCIENCES, I GUESS
I'LL TAKE A PEEK
JEAN-ÉTIENNE MONTUCLA'S *HISTOIRE*
DES MATHÉMATIQUES

FINDING OUT THE STORY OF THOSE
WHO CAME BEFORE ME
CURIOSITY WILL LIGHT THE WAY!

'CAUSE ALL IT TAKES
IS A SINGLE SPARK
AND THE WORLD GROWS BRIGHTER
ONE FLAME'S ENOUGH TO NAVIGATE
THE DARK
TO TAKE THE LEAD
ONE SPARK IS ALL YOU NEED

Shotton, who served as Bottle Cap's mathematics consultant. "But personally I don't think that is a problem."

Neither Smith nor Williams has a maths degree—they studied English and law, respectively—but the pair wrote the play's mathematical content themselves, quoting Germain's own work directly whenever possible and enlisting Shotton to check the draft script for any anachronisms, errors, or infelicities. While mathy language ("including some dreadful puns featuring Leonhard Euler and Blaise Pascal," Williams warns) pervades the show, Germain's

work on the vibrations of elastic plates and Fermat's Last Theorem (FLT) are the mathematical stars. "The wonderful thing about Fermat's Last Theorem," explains Williams, "is that although the maths that went into trying to solve it is incredibly complicated, the basic theory that Fermat proposed is one that most people are able to grasp quite easily."

To help the audience grasp the mathematics, Bottle Cap makes it performative, seen as well as heard. Sophie gives a mathematics lesson on the FLT material near the end of the show, walking listeners through the definition of a Sophie Germain Prime

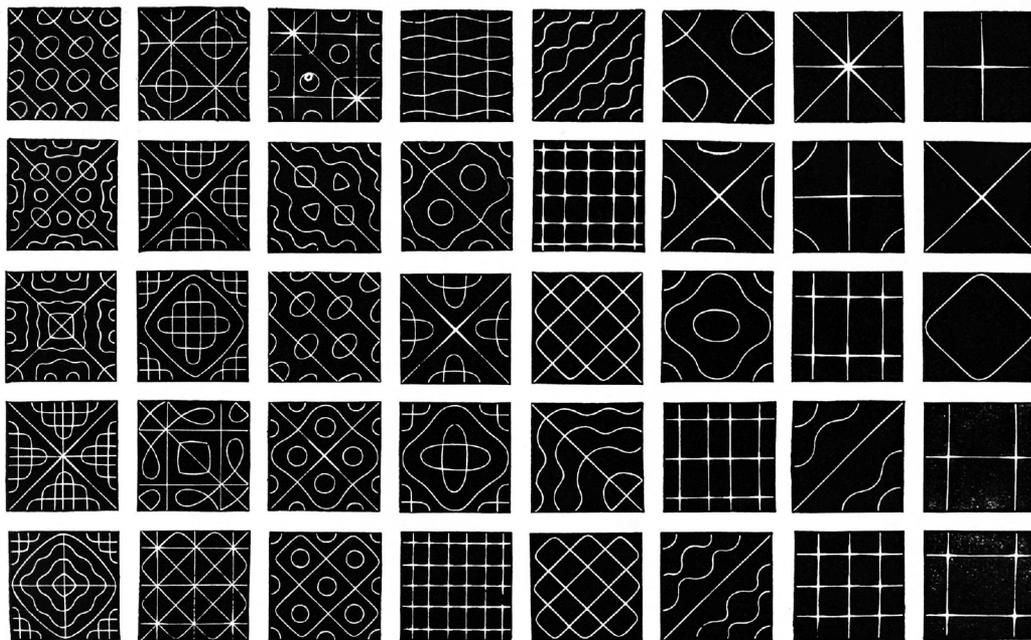


Figure 2. The above shows some of the patterns that emerged during vibrating plate experiments conducted by Ernst Chladni. The related Académie des Sciences contest challenged mathematicians to "formulate a mathematical theory of elastic surfaces and indicate just how it agrees with empirical evidence."

while chalking equations on the stage. Nicola Bernardelle, who played Sophie during *The Limit's* VAULT run, credits this scene with clarifying her own understanding of Germain's achievements. "I found it useful to have this visual element as a way of illustrating such a crucial part of her work and legacy," she says. Smith, for her part, particularly likes how choreographer Alfie Taylor-Gaunt deployed a movement sequence with books to accompany Germain's presentation of her theory on elasticity. "The explanation itself is quite dense," Smith says, "so this sequence provides visual cues for the audience."



Figure 3. The cast of *The Limit*—Kayla Carter as Lagrange, Rachel Delooze as Marie-Madeline Germain, Nicola Bernardelle as Sophie, Jamal Franklin as Poisson, and George Naylor as Le Blanc—salutes the VAULT audience.

The Limit sold out four of five shows at the VAULT Festival (which bills itself as "London's biggest, boldest and bravest arts and entertainment festival") and won both the Origins Award for Outstanding New Work and the People's Choice Award. Reviewers called the show's scripting "sharp and clever," its songs "witty" and "classy as hell," its timing "impeccable." They appreciated the show's color- and gender-blind casting (which had Poisson played by a Black man and both Lagrange and Laplace played by women) and its effortless feminism.

The mathematics made out pretty well too. Maths ed-technologist Alex Cutbill praises *The Limit* for communicating Germain's passion for mathematics and presenting some mathematical details of her work while avoiding

inaccuracies that might offend the sensibilities of mathematically meticulous viewers. "And I generally consider myself to be pretty pedantic in this respect," he says. Even as theatergoers felt the show equipped non-mathematicians to appreciate Germain's accomplishments, they left curious to learn more. As Annie Percik put it on *FringeGuru*, "Maths has never been so exciting, or so vibrant."

Smith and Williams have used *The Limit* in musical theater workshops with inner-city girls at London's Baytree Centre and are developing and extending the script. They are also working to produce the soundtrack VAULT viewers have been requesting since the March premier. And of course, says Smith, they hope to stage future productions. "We want to share Sophie's story with as many people as possible!"

Interested in supporting *The Limit* or being involved in its future life? Contact Freya Smith at bottlecapttheatre@gmail.com.



Sophia D. Merow

Credits

Figure 1 is courtesy of Bottle Cap Theatre.
Figure 2: *Popular Science Monthly* Volume 3 [Public domain], via Wikimedia Commons.
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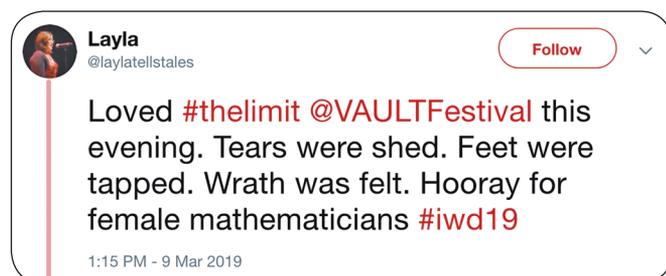


Figure 4. *The Limit* elicited a range of emotions.