

A muse in the boy's club

Belonging to the mathematics community

Let me first thank Prof. Dr. Arnd Poetzsch-Heffter, vice-president for research and technology, for his words of welcome. I am very grateful to Dr. Michael Kunte for all the time and energy he put into the preparation of this exhibition. The presence of many colleagues here today speaks for the success of this ambitious project of extending the exhibition to seven new portraits. Thank-you to Cornelia Rövekamp for her valuable help with the interviews on which the text of the panels is based. I would also like to express my special thanks to the photographer Noel Matoff, without whom this exhibition together with its extension to the seven new portraits would not be here today. Last but not least, thank you to the seven protagonists of the new portraits, Dr. Niamh Farrel, Prof. Dr. Caroline Lassueur, Prof. Dr. Hannah Markwig, Prof. Dr. Gabriele Nebe, Prof. Dr. Alicia Niemeyer, Prof. Dr. Eva Zerz with special thanks addressed to the seventh portrayed mathematician, Prof. Dr. Gabriele Weitze-Schmidthüsen for her kind words of introduction.

Originating in Greek mythology, Muses were goddesses credited with bestowing inspiration for literature, science and the arts onto ancient societies. In recent years, the term has been used to describe those—mostly women— who delight the imagination of artists, musicians and writers, enabling them to produce some of their greatest works.

Famous artists are often associated with a female muse, some of whom were themselves artists, yet often shadowed by their husband, to name a few: Clara Schumann for Robert Schumann (Clara is the author of some 40 pieces), Camille Claudel for Auguste Rodin (Camille died in a psychiatric hospital where she was placed by her mother and spent the last 30 years of her life), Paula Modersohn-Becker für Otto Modersohn (Paula fled to Paris where she felt free to become an artist), Lou-Andreas Salomé for Paul Maria Rilke (who was her lover for three years but their friendship lasted until Rilke's death), this extends to famous scientists such as Mileva for Albert Einstein (at their divorce in 1919, they decided that the money of the Nobel prize would be given to Mileva, which confirms her substantial scientific contribution to his achievements) and to famous thinkers such as Jenny Marx for Karl Marx (not only did Jenny, who herself wrote poems, stand at Karl's side to support the family in very difficult living conditions with hardly no income, but she also copied out some of his writings, this together with her daughters) .

So women serve as muses, and amongst these muses were artists and scientists but “Why Have There Been No Great Women Artists?” you may ask, as Linda Nochlin does in her essay in *Women, Art and Power and Other Essays*, Westview Press, 1988 pp.147-158 where she writes:

Women do not have the golden nugget theory of artistic genius. If Giotto, the obscure shepherd boy, and van Gogh with his fits could make it, why not women? [...] The question "Why have there been no great women artists?" has led us to the conclusion, so far, that art is not a free, autonomous activity of a super-endowed individual, "influenced" by previous artists, and, more vaguely and superficially, by "social forces," but rather, that the total situation of art making, both in terms of the development of the art maker and in the nature and quality of the work of art itself, occur in a social situation, are integral elements of this social structure, and are mediated and determined by specific and definable social institutions, be they art academies, systems of patronage, mythologies of the divine creator, artist as he-man or social outcast.

As an experiment, let me swap the word art for the word mathematics:

The question "Why have there been so few great women mathematicians?" can lead us to the conclusion, that mathematics is not a free, autonomous activity of a super-endowed individual, "influenced" by

previous mathematicians, and, more vaguely and superficially, by "social forces," but rather, that the total situation of producing mathematics, both in terms of the development of the mathematician and in the nature and quality of the scientific work itself, occur in a social situation, are integral elements of this social structure, and are mediated and determined by specific and definable social institutions, be they scientific institutions or funding systems... to which I add that they are mediated and determined by the codes and practices of the mathematics community, a concept that as such probably has no counterpart in the arts.

Let me quote from Niamh Farrell's interview; for those of you who might not know her, she is a post doc at the University of Kaiserslautern working on modular representation theory of finite groups.

To *whether she came across obstacles while embracing the career of a mathematician*, Niamh answers:

I was worried that I would find the maths world too closed and impersonal. Luckily this was not the case – I have made some great friends in maths, but at the end of my undergraduate studies I could see was dusty old male lecturers and a world where you either get things right or wrong, and if you are wrong, then you are stupid. I was scared of how black and white things can be in maths, and wasn't sure that it was an environment I would be very happy in. [...] This was the biggest obstacle - it was not that somebody was stopping me from joining the maths world, it was just that I wasn't convinced I wanted to join it. [Yet] the choice to join the world of maths, [is] a choice I made with my eyes [wide] open. The work drew me in because I love the way it makes me think, and [I now realize I was] was wrong about the environment - the world of representation theory is very open and I have made some great friends.

One speaks of the mathematics community, which comprises smaller communities, such as that of representation theory, containing even smaller ones such as that of representation theory on finite groups.

According to the online Etymology Dictionary, the word "community" derives from the Old French *comunité*, which comes from the Latin *communis* "shared in common". *Commūnis* comes from *cum munus*, a group of people (« *cum* » which means with) who share something (« *munus* » which means employment, office, service; burden, duty, obligation). In the Oxford Living dictionary on line, one reads that community is *the condition of sharing or having certain attitudes and interests in common as illustrated by 'the sense of community that organized religion can provide'*.

The word community indeed has a religious connotation and one might think of entering the mathematics community as stepping out of the contingent world to enter a closed religious community. A step by which one gives up earthly pleasures and material goods, to join a cold and silent world of worship. Yet surely, a closed up community creates strong bonds between its members, even more so if they speak a language different from that of the outside world. So what one might view as cold and silent from the outside, may once inside, create a strong sense of bond, warmth with a specific language, specific habits and ways of thinking.

Undoubtedly, since mathematics requires time and serious dedication, embracing a mathematical academic career goes with some renouncement. Especially since mathematics is a difficult language to master (can we ever master it?), for it is an ever growing language to whose construction one can hope to contribute after some years.

Here is a quote from an entry in Wikipedia about the "language of mathematics".

*The language of mathematics is the system used by mathematicians to communicate mathematical ideas among **themselves**. This language consists of a substrate of some natural (for example English) using technical terms and grammatical conventions that are peculiar to mathematical discourse (see Mathematical jargon), supplemented by a highly specialized symbolic notation for mathematical formulas. Like natural languages in general, discourse using the language of mathematics can employ a **scala of registers**. Research articles in academic journals are sources for detailed theoretical discussions about ideas concerning mathematics and its implications for society.*

To complement this Wikipedia definition which I guess was not written by a mathematician, since it misses one important characteristic of the language of mathematics, let me quote a conversation between J.-P. Changeux, a French neurologist and A. Connes, a French mathematician, which carries the title *Conversations on Mind, Matter and Mathematics*, Princeton University Press, 1995, p. 10.

Changeux: *Mathematical language is plainly an authentic language. But is it therefore the only authentic language?*

Connes: *It is unquestionably the only universal language.*

Like any language, mathematics goes with its own way of thinking, which might differ if you are a topologist, an algebraist or a number theorist, since every subject develops its own thinking habits, its own ways of building up intuition behind the words.

In the above quote, Niamh says that “*The work drew me in because I love the way it makes me think.*”

Indeed, doing mathematics requires an intensive intellectual activity which is bound to model your brain, making you think “like a mathematician”. One can often spot out a mathematician in a discussion amongst academics involving non mathematicians, typically on an interdisciplinary board of professors. Mathematicians tend to be less outgoing (less boisterous?), listening first and waiting for the propitious moment to intervene, with a short rational argumentation. They tend not to hold radical positions but rather to defend a rather mild “reasonable” middle position. Something in their behavior often betrays their belonging to the mathematics community, which shows how much one is forged by the habits one develops in doing mathematics.

I claim that one can sometimes even spot out a mathematician on a plane. First of all, there is a good chance that there might be a mathematician on the flight since mathematicians have a rather nomadic professional life, travelling across the world to discuss a result with a colleague. Secondly, they have some common characteristic traits, they might either look rather dreamy, looking up in the air inspired by an idea for the missing proof of a result they have in mind, or very busy, frantically typing some results into their computer.

Now, does “being a mathematician” mean “feeling like a mathematician”, does it mean feeling that one “belongs to the community of mathematicians”? According to David W. McMillan and David M. Chavis (1986), sense of community *is a feeling that members have of belonging, a feeling that members matter to one another and to the group, and a shared faith that members’ needs will be met through their commitment to be together* (McMillan, 1976).

Yet you can formally belong to a community with a constant feeling of not being fully part of it, and this I fear is what happens to many female mathematicians. Recently, at the 18th European Women in Mathematics (EWM) meeting in Graz, as we were informally discussing exclusion mechanisms in mathematics in a small group of women, Shiri Artstein-Avidan, a mathematician working in Tel Aviv on asymptotic geometric analysis, told us that she didn’t enjoy conferences since she didn’t feel part of them. She has a rather outgoing and amenable personality, which makes it difficult to imagine her wanting to escape company in a conference, yet this is what happens she told us. At conferences, she often feels ill at ease when having to converse at a dinner table, with men only. It makes her feel isolated and as a result, makes her resent having to attend conferences. Since it is still male dominated, the maths community looks like a boy’s club to the rare women allowed in, making it very difficult for them to feel part of it.

As much as a female mathematician formally belongs to the mathematics community, she might not feel she belongs to the community of (male dominated) mathematicians; by the way, the German mathematics society is called Deutsche Mathematiker Vereinigung and unfortunately not Deutsche mathematische Vereinigung. Only reluctantly did I recently become a member when I was asked to chair a session at the last DMV meeting in Paderborn, resenting having to join what I view as a German boy’s club. I found

very few mathematics societies around the world whose name involves mathematicians and not mathematics:

- Union of Bulgarian Mathematicians (since 1971)
- Society of Mathematicians, Physicists and Astronomers of Slovenia (since 1949)
- Association of Nepalese Mathematicians in America (since 2010)

All the others I found are called mathematics society or mathematics union.

Interestingly mathematics associations primarily involving women use the wording “Women *in* or *and* mathematics”, CWM is the *Committee for women in mathematics*, EWM stands for *European women in mathematics*, AWM for *Association for women in mathematics*, similarly for the French association *Femmes et mathématiques* ...expressing the need to make it explicit that they are addressed to women, even if they might remain open to men.

In contrast to a usual conference, I feel and probably so does Shiri, that an EWM meeting conveys a sense of being part of it...but maybe not to the few men present who might feel somewhat out of it! At the last EWM meeting in Graz, a sociologist Naomi Ellemers reported on a transsexual who having recently become a woman, felt she had achieved her goal when, at a male dominated meeting, her intervention was ignored. Since women’s opinions in a meeting often remain unheard and are not taken into account, her being ignored meant that she had at last been perceived as a woman. Her new transparency in the company of men made her feel like a woman.

You might think that as one of the rare women in a boy’s club, a female mathematician should be all the more visible. And yes indeed, she is looked upon as a woman, yet that does not mean that she is seen as a pair and her voice as a scientist might remain unheard. There are various cases of women scientists who remain invisible and whose scientific voices remain unheard as illustrated by the following three cases:

- **Lise Meitner** (7 November 1878 – 27 October 1968) was an Austrian-Swedish physicist who together with Otto Hahn led the small group of scientists who first discovered nuclear fission of uranium; the results were published in early 1939 but Meitner did not share in the 1944 the Nobel Prize in Chemistry for nuclear fission that was awarded exclusively to her long-time collaborator Otto Hahn. In the 1990s, the records of the committee that decided on that prize were opened. Based on this information, several scientists and journalists have called her exclusion "unjust", and Meitner has received a flurry of posthumous honors, including naming chemical element 109 meitnerium in 1992.
- **Marthe Gautier**, a French hospital practitioner, now age 93, whose decisive role in the discovery fifty years ago, of the trisomy 21 chromosome in the Down syndrome has not yet been acknowledged. The praise, honours and related professional recognition went to Jérôme Lejeune, then an assistant of their joint boss Prof. Turpin. The polemic is still vivid.
- **Rosalind Franklin**, who died of cancer in 1958 at the age of 39, was an English chemist and X-ray crystallographer, who did pioneering research for the understanding of the molecular structures of DNA, on the grounds of which after her death, Francis Crick and Maurice Wilkins shared the Nobel Prize in Physiology or Medicine and her team member Arron Klug who continued her research after her death, won the Nobel Prize in Chemistry in 1982.

This is slowly changing, as exemplified by the first Fields medal ever awarded to a woman, Maryam Mirzakhani in 2014. Very sadly, Maryam died of cancer soon after. Yet no Abel prize up to this day! Let me mention another encouraging example, that of **Jocelyn Bell Burnell** an Irish astrophysicist, now age 75, who in the late 60’s was a PhD student at the University of Cambridge, UK, under astronomer Antony Hewish. She was analysing hundreds of metres of chart paper with data collected by the radio telescope in Cambridge when she noticed some mysterious recurring smudges and was able to characterize these as signs of radio pulses emanating from a spinning star: the pulsar. In 1974, her former PhD adviser Antony Hewish (then aged 50) shared the Nobel Prize in Physics with fellow radio astronomer Martin Ryle, for

pioneering research in astrophysics. Hewish was cited for his “decisive role in the discovery of pulsars” — while Bell Burnell, then his student was overlooked. The encouraging piece of news: for this ground breaking discovery, on September 6th, Bell Burnell was awarded the prestigious Breakthrough Prize allotted with a 3 Million Dollar sum.

On October 2nd 2018, the Nobel prize in physics was awarded to three scientists — including one woman — for advancing the science of lasers and creating extremely useful tools out of laser beams; the winners include Arthur Ashkin, 96, a retired American physicist who worked Bell Labs; Gérard Mourou, 74, now at the École Polytechnique in France and University of Michigan; and **Donna Strickland**, 59, now at the University of Waterloo in Canada. These scientists are responsible for two important inventions. One is laser tweezers, which allow scientists to manipulate microscopic particles (often viruses and bacteria) within a laser beam. The second is a technology that led to the rapid increase of laser beam intensity, which has allowed for myriad laser-based tools, including the beams commonly used in laser eye surgery.

The scientists realized that, through a series of steps that involve stretching, amplifying, and then compressing the beams, they could greatly increase their intensity. The breakthrough, called *chirped pulse amplification* (CPA), was published in 1985 and was Strickland’s first published scientific work. Though Mourou was Strickland’s PhD advisor at the time, they are co-credited with the discovery. “The CPA-technique invented by Strickland and Mourou revolutionized laser physics,” the Nobel Committee writes in a press release.

Astonishingly, Strickland is just the third woman to have ever won the Nobel Prize in physics. The prize had not been awarded to a woman since 1963 when Maria Goeppert-Mayer won for her work on atomic structure, which was 55 years ago! The only time a woman was awarded the prize before that was in 1903 when **Marie Curie** won for her work on radioactivity.

It is remarkable that Mourou has had a Wikipedia page since at least 2005 but there was no entry on Strickland’s accomplishments until October 2nd 2018. Following the journalist’s report (Brian Resnick for Vox) on this rather embarrassing anomaly, a Twitter user pointed out that articles on Strickland had been drafted on the online encyclopedia before, in May 2018 — but the draft was rejected by moderators. “*This submission’s references do not show that the subject qualifies for a Wikipedia article,*” the moderators wrote, despite the fact that the original author linked to a page that showed Strickland was once president of the Optical Society, a major physics professional organization and publisher of some of the field’s top journals.

These outstanding female scientists have definitely stepped out of the status of being a mere “inspiring muse” and paved the way into the scientific community. Yet only rarely are their achievements fully acknowledged and they clearly still lack the visibility they deserve. Whether they have a feeling of belonging to the scientific community, which is still very much a boy’s club, is difficult to tell. Yet when you see the video that Gérard Mourou, one of the three afore mentioned Nobel prize winners (with Donna Strickland), once made to promote a project he was submitting to get funding from the CNRS (before he got the prize), you may wonder.

<https://www.youtube.com/watch?v=k6i7A8Plqb8>

A detailed critical analysis of this video could be the start for another talk...

To end with a positive note, here an audiovisual promenade, inspired by women’s history made by Jacinta Torres and Claire Glanois (both post docs in mathematics) for the opening of the exhibition two years ago in Bonn:

<https://www.youtube.com/embed/zKshoPsqo4>

Thank you very much for your attention.