

A tribute to the unseen and unheard in science

Canberra, February 27th, 2019

Let me first thank **Peter Bowknegt** for hosting the exhibit, **Pierre Portal** for organizing today's event and **Maca Rojas** for taking care of the logistics. Let me also mention **Noel Matoff**, the photographer with whom we initiated this exhibition back in 2014, and who is following this event from afar. I would like to take this opportunity to thank other protagonists who took part in this adventure, namely **Sara Azzali** (Potsdam), **Magdalena Georgescu** (Israel and Canada) and **Alexandra Antoniouk** (Kiev).

The exhibition consists of 13 portraits of female mathematicians from 13 different European countries. As I just mentioned, the photographs are by Noel Matoff, who also chose the number 13 and Sara Azzali helped me with the interviews, some of which were carried out in the last EWM meeting in Cortona three years ago.

The idea of the exhibition stems from an invitation I received in the autumn of 2013 from **Charu Goel**, a post-doc at the University of Konstanz, who asked me to deliver a talk at the "*Women in Maths*" platform. I was about to decline the invitation, arguing that as a woman of mathematics (see the title of the exhibition), so one who aims at producing mathematics, I am not competent to analyse the question of women in mathematics from a sociological point of view. It then suddenly occurred to me that, as an active actor in the world of mathematics, I could instead propose a subjective outlook on this world. I have often been impressed by the women of mathematics I met throughout the world, and thought I could base my talk on testimonies by ten of them, from different countries (Germany, Austria, Russia, China, Burkina Faso, India, Japan, Australia ...). So I sent these ten women I had in mind a message, amongst whom **Cheryl Praeger** present today, asking them to answer a few questions relative to their career and life paths, and to send me a photographs. This way I gathered ten amazing testimonies which found a very responsive audience when I presented them in various places. Not wanting to leave this precious material at the state of a small booklet (available in a pdf form), I got in touch with a friend film maker **Agnes Handwerk**, who had previously filmed mathematicians, and asked her whether she thought this material could serve as a basis for a more ambitious film project. We were brain storming while leisurely walking back from a maths event in Berlin, when Agnes came up with the idea of turning this project into a touring exhibition in view of the upcoming 2016 ECM meeting in Berlin. I happened to have a friend photographer, Noel Matoff, and thought I would ask her whether she would be ready for this adventure, secretly hoping she would decline my proposal, since I was anticipating the amount of extra work that would come with it. Her positive answer was what launched this adventure.

The exhibition, which is now near to 3 years old, was born in **July 2016 at the ECM** held at the Technical University in Berlin. After a difficult time during its two years' gestation before the opening, in fear of a lack of necessary funding to give it birth, its life has become easier since then. By now, it has visited near to hundred locations in some 20 countries around the world. Starting from Germany, the exhibition first went to Italy, France, England, Bulgaria, Ukraine, Switzerland, Holland, Norway and beyond European borders, to **Australia** (Melbourne in 2017 thanks to **Anita Liebenau**), Cuba, Chile, Colombia, Ecuador, Lebanon and Senegal. It is soon reaching out to Japan, with an opening planned for the month of March in Tokyo. In its short life, this exhibition has met many faces, as illustrated by the photographs you can see on the website of the exhibition under "Locations", which document the various venues. Unfortunately, we have no record of the reactions it has triggered along the way, yet some I can report on since I was present. Let me tell you two anecdotes, which I find moving:

- **Dorcas Addo** from Ghana, a young female participant at a summer school in M'bour, Senegal, coorganised by **Katrin Wendland** (one of the protagonists of the exhibition) last year (in May), asked me whether after the school, she could take Katrin's portrait back home, only Katrin's not the other panels. Wanting neither to deceive her, nor to split the exhibition with some panels here and others there, I hesitated a little and finally opted to send Dorcas the pdf files of the whole exhibition so that she could print them out as she pleased. Yet I doubt whether she had them printed out; it might have been better to just let her take one of the panels back with her. During the meeting in M'bour we had a very lively discussion with participants of the school about the situation of women in mathematics in Africa, and Dorcas, as shy as she might have

looked, sprang up to her feet and spoke aloud when male students from the Ivory Coast, started arguing that academics' wives should surely not as educated as their husbands, and that they were proud that this was the case of their wives and in the natural order of things.

I was happy to meet Dorcas again a few months later (September 2018) in Heidelberg. After the opening of the exhibition during the Laureate Forum, Karin Baur, Dusanka Perisic, both portrayed here, the English to German translator, Maria Hoffmann and myself, gathered at a restaurant. Prior to the opening that day, I had written to Dorcas, suggesting that she join us at the restaurant after the opening. Dorcas had been invited to the Laureate Forum and this was her first trip outside Africa. Heidelberg was of course new to her, yet she eventually made it to the restaurant, after wandering round the streets of Heidelberg, desperately looking for this small Italian restaurant and having landed in Frankfurt only a few hours earlier. It was wet and cold that day, and I have this vivid memory of Dorcas arriving at the end of the meal, wearing an anorak and flip flops on her feet.

- From M'bour in Senegal, let us now skip to Beirut in Lebanon. An Italian colleague of mine, **Paolo Aschieri** had been invited to a conference in Beirut, that Georges Habib, from the Lebanese University in Beirut and myself, organized about a year ago. We had managed to show the exhibition during the meeting in spite of some logistical difficulties due to the lack of support of the University administration. Near to the end of the meeting, Paolo came up to me warning me that he would be asking me a rather weird question, which turned out to be whether he could take the exhibition with him to the next conference in Sofia he was about to attend. I was very pleased that a male colleague should show interest in the exhibition to the point of wanting to present it himself. Also, this was the portable version of the exhibition, which weighs some 8kg, and which otherwise I was deemed to take back to Germany with me, carrying it with me on the plane as I had done on the trip to Beirut. A couple of weeks or so later, I got a message from Paolo asking me whether he could take the exhibition back with him to Italy. There, he had it shown at his son's high school in Torino. A couple of weeks ago, the exhibition was shown in Bratislava, Slovenian Republic, where it was awarded a prize medal, again thanks to Paolo, a very efficient ambassador for the exhibition.

I will soon be able to add a name to the list of **male ambassadors** of the exhibition, **Pierre Portal**, who last June, sent me an invitation to come for a stay at the ANU with the idea in mind to present the exhibition during that time. Little did he know that he was embarking on a wild project which was to include today's ambitious and very successful event, as well as an extension of the exhibition with portraits (by the photographer Michael Wood) of six female mathematicians based in Australia, which I would like to name here: **Rowena Ball**, **Asilata Bapat**, **Joan Lisaca**, **Cheryl Praeger**, **Jacqui Ramagge** and **Katherine Turner**. I would like to thank Pierre most warmly at this point. He has done a marvelous job!

Some of the names you see in the exhibition are well-known mathematicians, whereas others names might not sound very familiar. The mix in the level of scientific recognition is deliberate and so are the geographic and generational mix. It took some resistance on our part not to focus on excellence, a concept nowadays in vogue, a criteria which ensures better funding. Yet we wanted all mathematicians to be able to relate to the portrayed women and not only reach out to an elite. We would have made it difficult for the everyday mathematician to relate to the portrayed women mathematicians, had we chosen to portray only outstanding mathematicians.

The basic concept underlying the exhibition is **subjectivity**, starting from the portraits by a photographer who by the very essence of her art throws a subjective look on the protagonists of her photographs. The excerpts you see on the panels also stem from a subjective pick from the interviews whose questions are geared to trigger subjective answers. The subject, were it the person on the photograph, the mathematician behind this person with her subjective outlook on mathematics, lies at the center of this project.

Putting forward subjectivity when mathematics tends to be viewed as objective while leaving little room for the feelings and emotions of their author, can seem somewhat surprising. Yet in a male dominated mathematics community and as members of a minority, women are inevitably reminded of their gender, which constantly brings them back to their subjectivity. This is reflected in the portraits by the relative position of the subject, the

mathematician standing in the forefront and looking at the viewer, and her mathematics behind her, written on the board in the background.

Also, portraying women while looking at the viewer, enables the photographer to capture the pride and joy on their faces. One common feature of the portraits (in great part thanks to the photographer Noel Matoff) of the exhibition, is a serene and happy look on the faces, which conveys a feeling of satisfaction, confirmed by the interviews you will find in the catalogue, where the portrayed women all without exception, express their joy of doing mathematics. “*Je ne regrette rien*” says Dusanka Perisic, a Serbian mathematician portrayed here, in her interview.

Having privileged subjectivity over excellence, we hope that the protagonists’ professional paths do not feel out of reach to a young woman visiting the exhibition; the mix in age, recognition, topic and geographical location should make it possible for young women to pick out one they could personally relate to. This is what happened to Dorcas when she wanted to take back home with her, the portrait of Katrin Wendland. I suggest each of you pick out one you can personally relate to after this opening talk! For that purpose, you might want to read the interviews in the catalogue which complement the information you will read from the panels.

This exhibition is about women in mathematics where they are still embarrassingly underrepresented. Yet this is not specific to mathematics, underrepresentation of women also characterizes various other scientific disciplines, including theoretical physics and computer science. To this underrepresentation, one should add the **lack of visibility**; the few women scientists who make their way through a male dominated academic world, are often not visible in their full scientific strength as they might stand in the shadow of male colleagues. A lot still needs to be done to counteract what is known under the **Matilda effect**, a bias against acknowledging the achievements of women scientists, whose work is often attributed to their male colleagues.

One 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 peer 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. It is remarkable that she decided to donate the complete prize to help others.

"I don't want or need the money myself and it seemed to me that this was perhaps the best use I could put to it," "I found pulsars because I was a minority person and feeling a bit overawed at Cambridge. I was both female but also from the northwest of the country and I think everybody else around me was southern English," she said. "So I have this hunch that minority folk bring a fresh angle on things and that is often a very productive thing. In general, a lot of breakthroughs come from left field."

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.

Astonishingly, Strickland is only **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** (together with her husband Pierre Curie) won for her work on radioactivity. Yet I believe that little is known about the price Marie Skłodowska had to pay on a personal level for having triply transgressed borders, a geographic border as a young woman emigrating from Poland to France, an intellectual one with her outstanding scientific achievements and ground breaking discoveries and a personal one as an emancipated woman who lived a free life. In 1910, some years after her husband's fatal accident in 1906, a the time when she was applying to enter the Academy of Science, Marie was the victim of a smear campaign by her peers worthy of attacks against witches in the Middle Ages. Marie Curie was not appointed at the Academy and there was talk of sending her back to Poland. Yet a year later, so in 1911 Marie Curie was awarded with a second Nobel prize, for Chemistry for her work on the polonium and the radium.

Going back to Strickland who recently got the Nobel prize jointly with Mourou, it is remarkable that Mourou has had a Wikipedia page since at least 2005 with no single 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 that, 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.

There are only a few examples of outstanding female scientists whose achievements were finally acknowledged and unfortunately not always fully, but there many more, who remaining unseen and unheard, clearly still lack the recognition they deserve. I would like to end this talk by paying a tribute to the *unseen and unheard* female scientists who contributed to our scientific heritage. Inspired by the "Acknowledgement of Country" statement I have only just learned about in the past days and which impresses me, I would like to make the following suggestion:

to encourage University staff to include an Acknowledgement of the "unheard and invisible" at the commencement of all scientific meetings (worldwide) in fields where women and other minorities are traditionally underrepresented, as a way of showing awareness of and respect for the scientists in the field on which a meeting or event is being held, those who have not been payed the tribute they deserved for their contribution to science. It would be a way of recognising the continuing connection of present science to that of all scientists who contributed to the field.

Acknowledgment of the unheard and invisible

We acknowledge and celebrate the pioneering scientists of the past for their outstanding contribution to our scientific heritage, those who have not yet received the acknowledgement they deserve.