

MATHEMATISCHES FORSCHUNGSINSTITUT OBERWOLFACH

Report No. 2/2017

DOI: 10.4171/OWR/2017/2

Mini-Workshop: Women in Mathematics: Historical and Modern Perspectives

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8 January – 14 January 2017

ABSTRACT. The aim of the workshop is to build a bridge between research on the situation of women in mathematics at the beginning of coeducative studies and the current circumstances in academia. The issue of women in mathematics has been a recent political and social hot topic in the mathematical community. As thematic foci we place a double comparison: besides shedding light on differences and similarities in several European countries, we complete this investigation by comparing the developments of women studies from the beginnings. This shall lead to new results on tradition and suggest improvements on the present situation.

Mathematics Subject Classification (2010): 01A55, 01A60, 01A70, 01A80.

Introduction by the Organisers

The aim of the workshop was to build a bridge between research on the situation of women in mathematics at the beginning of coeducative studies and the current circumstances in academia. The issue of women in mathematics has been a recent political and social hot topic in the mathematical community.

“The taking into account of relevant gender and diversity aspects is an essential part of qualitatively excellent research.”¹

¹“Die Berücksichtigung von relevanten Gender- und Diversity-Aspekten ist ein wesentliches Element qualitativ hochwertiger Forschung.” aus: Forschungsorientierte Gleichstellungsstandards der DFG (2008), http://www.dfg.de/download/pdf/foerderung/grundlagen_dfg_foerderung/chancengleichheit\\forschungsorientierte_gleichstellungsstandards.pdf

Besides the *Deutsche Forschungsgemeinschaft (DFG)*, also the *European Union* implemented equality goals into their research support program Horizon 2020. In particular a focus is placed on the analysis of the situation of women in science, whereby the need of a comprehensive research and innovation processes is emphasized.²

And still, besides those political efforts and higher education policy, a great number of women leaves academia after their doctorate. Especially in mathematics women drop out of the career as researchers. This phenomenon is often called “leaky pipeline”. A crucial question for the academic community in all over Europe arises: How can we cope with this effect on women in mathematics? In this framework of a “leaky pipeline” certain aspects have been discussed recently in the mathematical community: shortfalls of female speakers in all areas of science, technology, engineering, and mathematics (STEM), the family-unfriendly conditions of e.g. restricted, frequently changed employment contracts in academia, the lower proportion of accepted and published articles of women mathematicians as well as disadvantages towards female researchers in STEM tenure track hiring policy.³

To approach this debate we placed a double comparison as thematic guideline for the workshop: besides shedding light on differences and similarities in several European countries, we completed this investigation by comparing the development of women studies from the beginnings of coeducative universities in Europe. In open discussions, work-in-progress presentations as well as talks about completed and established research projects, we considered a variety of methodological approaches. Among others, interdisciplinary modern sociological methods were discussed concerning the role of male researchers in the history of Italian universities, the position of the astonishingly few female mathematicians in Denmark or the general question of characterizing a “femme savante” in historiographical debates. This was supplemented by classical and well established approaches from the History of Mathematics. We contrasted the role of famous universities like the University of Göttingen and the Universities of Prague with the situation of the more ordinary University of Würzburg, took into account the phenomenon of couples in mathematics (in particular Grace Chisholm and William Henry Young, Emma and Wladimir Woytinsky, Stanislaw and Otton Nikodym) and discussed the reception and biographies of the female pioneers Sophie Germain, Sofia Kovalevskaja, Christine Ladd-Franklin, Emmy Noether, Rosa Peters and Hilda Geiringer. In addition, we put these topics in relation to current gender issues in the mathematical community, like the images of mathematics in different countries and the role of active organisations like *European Women in Mathematics*, an international association of women working in the field of mathematics in Europe.

²cf. European Commission: Toolkit Gender in EU-funded Research (2011) , <https://web2.infn.it/CUG/images/alfresco/Risorse/EC/2011ToolkitGenderEuFundedResearch.pdf>

³see e.g. Martin, G., *Addressing the underrepresentation of women in mathematics conferences.*, arXiv:1502.06326 [math.HO], 2015 and Agostiniani, V., *Mum and postdoc at Sissa.*, Newsletter of the European Mathematical Society, 2016, issue 9 p.41

The workshop provided a comparison between various international perspectives having experts about the conditions in France, Italy, Denmark, Hungary, Germany, England, Poland and Czech Republic. Women in mathematics need to become visible: this holds for the historical as well as for the current situation. We pointed out that the comprehensive revision of biographies with a focus on the cultural background of the mathematical community may have a guiding influence for the future development of women in mathematics.

Acknowledgement: The MFO and the workshop organizers would like to thank the National Science Foundation for supporting the participation of junior researchers in the workshop by the grant DMS-1049268, “US Junior Oberwolfach Fellows”.

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Abstracts

Introductory talk: Women - Mathematics - Culture?

NICOLA OSWALD

It is generally difficult to define objectives and methods to investigate the role of women in history without simply retelling their biographies. In this contribution we highlight the importance of taking into account sociological aspects about female researchers and outline an approach on how this may lead to methodological ideas for analyzing historical circumstances from a nowadays perspective. The aim is to build a bridge between past and present.

To describe career paths of women in academia the term "leaky pipeline" is often used. It shall explain the sociological phenomenon that the higher the career level of the academic ladder the fewer women can be found. The example of mathematicians in Germany is here remarkable: while there were about 46.6% female students and 26.7% female PhD students of mathematics in 2013, the numbers of around 23.3% female assistant professorships and only 15.9% female full professorships in mathematics in the same year were significantly lower¹. Studying this "akademisches Frauensterben"² in Germany, the sociologist Heike Kahlert took into account the even more precise idea of a so called "cooling out function" (see [2]). Kahlert explains the fact that female members of academic organizations (mostly universities) are so to say "cooled out" at different career levels. She decidedly distinguishes between "hard factors, as for example the stable framework of employment relationships", and "soft factors in the form of profession as well as organization culture" [2, p. 61]. She gives great importance to soft factors and highlights among others the role of the PhD supervisor (resp. post-doc supporter), the importance of a social/professional network, the culture of an institution, role models of men and women as well as the (also already potential) family planning. Remarkably, those influence factors appear to be very similar to those used for studying the situation of women in mathematics at the beginning of the 20th century. One example is given by Renate Tobies's comprehensive introduction chapter *Einflussfaktoren auf die Karriere von Frauen in Mathematik, Naturwissenschaften und Technik* of the book *Aller Männerkultur zum Trotz* [7, pp. 21], which lists and analyzes influence factors on women's careers in mathematics, natural sciences and technology in the late 19th and early 20th century. The historian of mathematics also explicitly states that besides hard factors like education and higher education politics, personal (family) reasons as well as institutional culture and socio-cultural aspects have played a crucial role in the beginnings of women working in natural sciences and mathematics on an university level.

Against this background, we formulate the question: *Can the so called "leaky pipeline" be considered as traditional?*

¹for more details and numbers, we refer to [5, p. 81]

²literally translated: "academic dying of women"; with her choice of words Kahlert refers here to the title of an article of Friederike Hassauer [1].

To illustrate the intention of this question, we present a case example concerning the stigmatization of women in academia and take into account the role of assessing their mathematical skills in correlation to a certain degree of femininity. Therefore we compare contemporary descriptions of well-known female pioneer mathematicians, Sofia Kowalewskaja and Emmy Noether, with comments about the look of Fields medalist Maryam Mirzakhani from 2014. Of course, one has to bear in mind that media possibilities have extremely changed, the intentions might have been and are completely different and certainly those were written against very different backgrounds. However, it is again striking how similar the assumption with male attributes are: while e.g. Kowalewskaja was assumed to have a "male brain" in [4] from 1894, Hermann Weyl speaks in 1935 about "the Noether" using (in German language) the male article [8] and Mirzakhani is in online comments³ considered as belonging more to the male than to the female sex. This indicates a certain sustainability in the last 150 years of what is considered as adequate description of a women being successful in doing mathematics. How could we approach this phenomenon and does this correlate the above mentioned "leaky pipeline"? Following the definition of Guy Rocher from 1968 of "culture [as] an intricate system of more or less formalized ways of thinking, feeling, and acting, which, being learned and shared by a plurality of people"⁴ [6, p. 111], we develop the idea that culture may in particular give room to traditions, respectively patterns, "in which [...] behaviors are valued as normal behaviors" as Francois L e explains [3, p. 276]. We want to investigate that the certainly delicate notion of "culture" (which can be institutional, regional, even family-specific) and in particular its influence on traditions of a collectivity of people, for example the mathematical community and its "leaky pipeline", can provide a methodology of comparable categories and stimulate research approaches.

Recapping that the sociologist Kahlert considered so called soft factors, reflecting (socio)-cultural behavior, as decisive in the career of female researchers, we want to add and underline their seemingly long-lasting and sustaining character. This might provide both, a possibility to compare on a horizontal level, focussing on standards and developments in the mathematical community in different countries or institutions, as also on a vertical level, contrasting historical and present circumstances of women in mathematics in the future.

³We refer here among others to comments from an online article of 12.08.2014 in the section "Wissenschaft" on www.spiegel-online.de, some of the most discriminating ones are fortunately deleted nowadays.

⁴This definition was lately used by Francois L e in 2016, who investigated the notion of "culture" in the context of "geometrical equations", see [3]. We were inspired by his approach.

REFERENCES

- [1] F. Hassauer, *Akademisches Frauensterben: Frauen - Nachwuchs - Romanistik. Zur Situation des wissenschaftlichen Nachwuchses in Deutschland und Österreich.*, in: Seiser, Gertrud; Knollmayer, Eva (Hrsg.): *Von den Bemühungen der Frauen in der Wissenschaft Fuß zu fassen.* Wien (1994), 145–154.
- [2] H. Kahlert, *Nicht als Gleiche vorgesehen. Über das "akademische Frauensterben" auf dem Weg an die Spitze der Wissenschaft.*, *Beiträge zur Hochschulforschung*, (2015), 37(3): 60–78.
- [3] F. Lê, *Reflections on the Notion of Culture in the History of Mathematics: The Example of "Geometrical Equations"*, *Science in Context*, (2016), 29(3): 273–204.
- [4] L. Marholm, *Das Buch der Frauen. Zeitpsychologische Portraits*, Albert Langen, Paris und Leipzig (1894).
- [5] B. Langfeldt and A. Mischau, *Die akademische Laufbahn in der Mathematik und Physik. Eine Analyse fach- und geschlechterbezogener Unterschiede bei der Umsetzung von Karrierewissen*, *Beiträge zur Hochschulforschung*, (2015), 37(3): 80–99.
- [6] G. Rocher, *Introduction á la sociologie géenérale.*, Vol. 1. L'action sociale. Montréal: HMH. (1968).
- [7] R. Tobies, *Aller Männerkultur zum Trotz*, Campus Verlag, 2nd edition, (2008).
- [8] H. Weyl, *Obituary speech of H. Weyl, 18. 4. 1935*, in: Dick, Auguste, *Emmy Noether 1882-1935.* *Elemente der Mathematik / Beihefte 13*, (1970), 53–72.

Placing Sophie Germain within number-theoretical practices of the 19th century

JENNY BOUCARD

In the history of mathematics, Sophie Germain (1776-1831) is recognized for being a woman who succeeded in producing work on the theory of elasticity and number theory. Her work was appreciated and discussed by some of the most eminent geometers of her time. Several aspects of her life have contributed to her image as an iconic symbol for women in mathematics in the 19th and 20th centuries. She was a self-taught mathematician because she could not attend the new *École polytechnique* and her parents refused, at least initially, to let her learn mathematics. She stayed single her whole life and her mathematical contribution was not linked to a husband or a male member of her family. She explicitly refused the status of “femme savante” and she surrounded herself with male mathematicians only. She was the first woman to obtain the Academy of Sciences prize and attend its sessions as a mathematician. She achieved significant results on Fermat’s Last Theorem (FLT), which went almost unnoticed until the early 2000s.

In this paper, I analyse some of these features by focusing on her contribution to number theory in the context of mathematical practices and the social positions of the mathematicians of her time. Even if she published only one short note on number theory in 1831 and one of her contributions — the so-called “Germain theorem” — was integrated in [8], recent analyses of her correspondance with Carl Friedrich Gauss and her manuscripts highlight that her contribution to number theory far exceeds what appears in the publications mentioned above [4, 7].

Let us begin by giving a panorama of number theory from the 1800s to the 1830s. The early nineteenth century was a hinge period for publications. Indeed, in

1805, the available media for mathematical publication for geometers were few and far between. Academic periodicals were difficult to access for non-*académiciens* and scholarly journals such as the *Journal des savants* did not contain any articles on number theory. Books were also expensive to publish and sales depended on limited specialised sellers. For example, the number of publications related to congruences, introduced by Gauss in 1801 in his *Disquisitiones arithmeticae* (*D. A.*) was limited (30 texts between 1801 and 1825). Publications increased from 1825 when new mathematical and scientific journals were created (224 texts between 1826 and 1850, of which only 17 were not included in periodicals) [1]. In fact, Germain was the only woman to publish on number theory in the first half of the 19th century.

At the turn of the 19th century, two treatises on number theory appeared: Adrien-Marie Legendre's *Essai sur la théorie des nombres* [9] and Gauss's *D. A.* [5]. Three points should be highlighted here. Legendre and Gauss had divergent opinions on the definition of number theory. Legendre identified number theory with indeterminate analysis. Gauss explicitly distinguished between these two domains, proposing number theory as being the domain where integer and rational numbers are considered, and not limited to equations. In his book, Gauss gave a coherent presentation of number theory by organizing it around two fundamental objects : congruences and quadratic forms. He gave two different proofs of quadratic reciprocity law and a method to resolve the binomial equation $x^p = 1$ algebraically by reindexing the roots with a primitive root of p , insisting on the links existing between different parts of his work and different mathematical domains, such as algebra and number theory. At the time, French teaching programs were focused on engineering, especially with the *École polytechnique*, and number theory was not taught at all. That is why if someone, male or female, wanted to study this domain, he or she had to read former publications , and especially Legendre's and Gauss's books.

Apart from several memoirs on Gauss sums, reciprocity laws and complex integers published by Gauss after 1801, the *D. A.* were mostly used for the algebraic resolution of binomial equations before 1825. Between the 1820s and the 1860s, new scholars read Gauss' *D. A.* and published arithmetical papers linked to it. In addition, progress in other mathematical areas, such as the use of complex numbers, Fourier analysis or elliptic functions, were used in number theory. A research domain, called *Arithmetic Algebraic Analysis* [6], was then developed by an international network of scholars. But, at Germain's time, the use of analysis in number theory was marginal and Germain's potential weakness in analysis did not constitute a significant limitation. Analysis was taught at the *École polytechnique*, and Germain's weakness in this domain seemed to have been a cause of the errors contained in her early work on the theory of elasticity [3]. Among French number-theoretic production, there was multiform activity based on a strong link between equations and congruences. Specific problems were discussed such as the imaginary roots of congruences (Louis Poincot, Victor-Amédée Lebesgue, Évariste Galois, Germain), the number of integer roots of a congruence (Guglielmo Libri,

Lebesgue) or Fermat's Last Theorem (Legendre, Libri, Germain) [2]. These publications had common roots with Joseph-Louis Lagrange's and Legendre's arithmetical approach and integrated Gauss's objects and methods in a more or less important way.

Germain was precisely one of the first geometers who mastered the contents of Gauss's *D. A.*, as Gauss observed in his correspondance, and who applied the theory of congruences to her number-theoretical work. Moreover, after she impressed Lagrange with her mathematical skills, she became progressively close to geometers such as Gauss, Legendre, Cauchy, Poincot or Libri, who are authors who published on number theory at her time. So if, as a woman, she could not be taught or attend scientific institutions, the marginal status of number theory at the beginning of the 19th century and the fact that it was not taught in *Polytechnique* for example, meant that her gender stigmatized her less than other mathematical domains. Every geometer wishing to study number theory had to study the same texts as Germain (Gauss' and Legendre's writings mostly) and the few enthusiasts in number theory certainly allowed her to have privileged contact with Gauss.

Gauss admired the arithmetic skills of Germain very much and seemed to consider her a full-fledged colleague, although he never had much time to pursue his arithmetical research or to write to her at greater length. From her manuscripts and her letters to Gauss, Libri and Poincot, we know that she studied and wrote to Gauss about quadratic, cubic and biquadratic residues, quadratic forms, cyclotomy and FLT. She proposed new proofs of results, tentative generalisations of methods and theorems contained in the *D. A.*. She also developed conjectures and a tentative program to prove FLT, from her first letter to Gauss then in her ninth, in 1819. She tried to construct a proof for whole families of exponents — contrary to Legendre or Dirichlet who obtained proofs for a single exponent — and she imagined a general plan to prove the FLT in general. In her plan, congruences and roots of unity were fundamental — the consideration of the congruence $x^p + y^p \equiv z^p \pmod{\theta}$, where θ is prime, is central for example — and she used her precise knowledge of Gauss's work. In 1819, she also used Poincot's work to highlight the importance of the ordered way the residues are distributed. But, as Germain soon observed, her plan could not succeed. Nevertheless she showed really impressive skills in calculations in her work, obtained general results on FLT and managed to show that the potential solutions of certain cases should be very big [7]. The only times that Gauss replied to her with some number-theoretical developments was on cyclotomy (to explain one error she made in her previous letter), and on residues (by giving her two theorems to prove). He never made any comment on her proposals for FLT. Gauss was not interested in this "isolated proposition" as he wrote to Olbers in 1816. These different facts underline several interesting points regarding Germain's status in number theory at that time. The content of her work lay both in the line of arithmetic work on indeterminate equations or based on an analogy between equations and congruences published at her time (Legendre, Poincot, Libri), in keeping with the *D. A.* She also had access to some of the latest arithmetical productions, that were yet to be published.

For example, she received Poinsoot's memoir before its publication in the *Journal de l'École polytechnique* [10] and I found notes on one of Gabriel Lamé's paper that were never published in her manuscripts - and that she studied with great attention.

She never directly published her results on FLT. Maybe this was because she knew that she did not succeed in her grand plan. As a woman, she did not have access to some institutions that made it easier to publish mathematical productions. Beyond gender, any male or female mathematician of the time had limited possibilities of publishing an article on number theory in the 1820s, or even in the 1830s. Indeed, another mathematician of Germain's time, Lebesgue, whose work was mainly concerned with number theory but who was neither a polytechnician nor an *académicien*, was only able to regularly publish his arithmetical memoirs from 1836, in the *Comptes-rendus de l'Académie des sciences* and in the *Journal de mathématiques pures et appliquées*, respectively created in 1835 and 1836.

REFERENCES

- [1] J. Boucard & N. Verdier, *Circulations mathématiques et congruences dans les périodiques de la première moitié du XIXe siècle*, *Philosophia Scientiæ* **19** (2) (2015), 57–77.
- [2] J. Boucard, *Résidus et congruences de 1750–1850 : une diversité de pratiques entre algèbre et théorie des nombres*, in C. Gillain & A. Guilbaud (eds), *Les sciences mathématiques 1750-1850 : continuités et ruptures*, CNRS Éditions, Paris (2015).
- [3] L. L. Bucciarelli, *Sophie Germain : An Essay in the History of the Theory of Elasticity*, Reidel, Boston (1980).
- [4] A. Del Centina, *Unpublished Manuscripts of Sophie Germain and a Reevaluation of her Work on Fermat's Last Theorem*, *Archive for History of Exact Sciences* **62** (2008), 349–392.
- [5] C. F. Gauss, *Disquisitiones Arithmeticae*, Fleischer, Leipzig (1801).
- [6] C. Goldstein & N. Schappacher, *A Book in Search of a Discipline (1801 - 1860)*, in C. Goldstein, N. Schappacher & J. Schwermer, *The Shaping of Arithmetic after C. F. Gauss's Disquisitiones Arithmeticae*, Springer, Berlin (2007).
- [7] R. Laubenbacher & D. Pengelley, "Voici ce que j'ai trouvé" : *Sophie Germain's Grand Plan to Prove Fermat's Last Theorem*, *Historia Mathematica*, **37** (2010), 641–692.
- [8] A.-M. Legendre, *Recherches sur quelques objets d'analyse indéterminée et particulièrement sur le théorème de Fermat*, *Mémoires de l'Académie royale des sciences de l'Institut de France* **6** (1827), 1–60.
- [9] A.-M. Legendre, *Essai sur la théorie des nombres*, Duprat, Paris (1798).
- [10] L. Poinsoot, *Mémoire sur l'application de l'algèbre à la théorie des nombres*, *Journal de l'École polytechnique* **11** (1820), 342–410.

Emmy Noether, the Thought Space of the Noether School and the Change of Mathematical Thinking: About Thought Styles, Thought Collectives, and Mathematical Productivity

MECHTHILD KOREUBER

Much has been written about Emmy Noether (1882-1935), but little about the Noether School - a gap in the history of mathematics that needed to be filled, given that Noether and the school she formed have contributed substantively to the introduction of new approaches and methodological concepts under the heading

of “modern algebra” [6]. Modern algebra here should be understood both as a mathematical discipline and as a holistic perspective on mathematics. Noether stands for these methods of working and of thinking developed in the 1920s and 1930s, which have often been called “abstract” or “axiomatic” and were met with skepticism by contemporaries.

Noether’s mathematical expertise was never doubted, yet her biography is marked by professional discrimination, marginalization within her discipline, and late fame. Much can be or has already been said about the visible professional discrimination she experienced in her career, such as during her studies or her habilitation process. I would like to take a closer look at another point: Noether fulfilled the formal requirements for appointment to a professorship, and her mathematical abilities in algebra were undisputed in the late 1920s, yet why did she never receive a professorship, especially when a professorship of algebra in Kiel was sitting vacant? If you look at the letter exchange between the mathematicians Helmut Hasse (1898-1979) in Halle and Adolf Fraenkel (1891-1965) in Kiel in the run-up to the appointment, the discrimination becomes obvious: *There is no doubt that as a man, she would have long since been appointed to a professorship and that despite her lack of talent for teaching beginners, she would be a successful scholar in Kiel. Personally, I imagine working with her must be unbearable. Maybe this shouldn’t be decisive, if it weren’t for the statements made by her (were they serious?) and by others that it seems she would have preferred having a large sphere of influence in Gttingen with a limited circle of students at a small university. Can one be responsible for not putting her on the list - which is what I really want?* [4] Noether was ultimately not appointed. Robert Schmidt (1898-1964), who had been working in Kiel as a private lecturer and had been Fraenkel’s colleague for many years, ended up receiving the professorship.

It is perhaps surprising to speak of disciplinary marginalization against Noether. Today we see the prominent mathematician who reconfigured mathematical images of knowledge and contributed to a significant expansion of the mathematical body of knowledge. Yet doing this collapses 25 years of development - from her PhD in 1908 to her peak during her famous 1932 talk at the ICM - into a single point. For example, Noether proved two theorems in her habilitation *Invariant Variation Problems* that became a central contribution to a mathematical formulation of the theory of relativity. Although there was no doubt in 1918 of the outstanding quality and mathematical relevance of her results/Although her results were unquestionably outstanding and mathematically relevant in 1918, the mathematicians involved did not reference Noether in their subsequent publications, thus marginalizing her accomplishments. Hermann Weyl (1885-1955) also failed to reference Noether in the first edition of his famous book *Raum. Zeit. Materie* [12], which addresses questions on the theory of relativity and later referenced her only in a footnote to a footnote [13]. It took nearly 40 years before they were adopted as “Noether’s Theorems” in theoretical physics. Nonetheless, in the early 1930s, Noether’s mathematical accomplishments were acknowledged,

giving her a late fame. The reports on Noether written in 1933 and 1934 are important documents on how she was perceived; they also document various aspects of Noether's work: her importance to the development of algebra in its modern form, international respect Noether's work had garnered, modern algebra as an understanding of mathematics with full impact in other disciplines, the school that developed around Noether, and the new generation of mathematicians that sees her approaches as new opportunities for the formation of/to shape mathematical thinking.

Noether is often associated with abstract, axiomatic, or modern algebra. Yet these designations are unsuitable for a deeper understanding of Noether's mathematical conceptions. To depart from this, I use the term "conceptual mathematics", which goes back to Pawel Alexandroff's (1896-1982) memorial address on the occasion of Noether's death. Unlike many of her colleagues, Noether did not write any articles reflecting her methods, and a mathematical reading of her publications is hardly helpful in understanding her conceptual view. It is, instead, necessary to shift perspectives and direct attention to the passages that initially seem less mathematically relevant. This amounts to, in a sense, reading against the mathematical grain. In 1921, Noether published the *Theory of Ideals in Ring Domains* [10]. When reading the paper from an epistemological perspective, however, it becomes apparent that Noether is developing her specific conceptual views and methods and novel mathematical images of knowledge on doing mathematics. Retrospectively, we are able to look upon the Theory of Ideals as an introduction to and a lesson in working conceptually. Also we are now able to pin down the following characteristics of Noether's conception ¹.

1. The objects of investigation in conceptual mathematics are the concepts themselves that need to be delineated and the existing relationships between them that need to be conceptually defined. Noether expresses this sharpening of mathematical concepts with the words "strongly generalize" and "further develop". This leads to plumbing the depths of concepts in all directions of their mathematical context and an exchange of mathematical perspectives. 2. Associated with this is an abstractness that is not an abstraction of something but rather, decoupled from any kind of substance, creates mathematical objects as thought constructions. This abstractness is perhaps the essence of the conceptual view, an abstractness that portends concepts not as an abstraction of an arbitrary substantial mathematical object but, instead, as mental constructions that produce something, that is, they produce mathematical objects. In her way of defining concepts, Noether took, among others, an axiomatic methodological approach, yet confining the characterization of her methodology to this alone would be disastrous. While a mathematical item may only be created through formal axiomatic determination, Noether discussed it by mathematically contextualizing it, relating it to other mathematical objects, thus carving out its shape and integration into a mathematical structure. And we can summarize our last point as follows. 3. Conceptual mathematics involves thinking in structures and primed an understanding of mathematics as a

¹See more in [6] and also [7].

structural science. A mathematics that puts concepts, and thus the observation of structures, center stage was suspect to most of her contemporaries: 'too abstract', 'too little substance' were the most common critiques. Doubts were expressed as to whether conceptual mathematics could stand up to the vague but exceptionally effective mathematical criteria of fertility and deepness. One sceptic was Weyl, who explicitly spoke out against the tendency towards algebraization in topology and geometry, which feeds on the methods advocated by Noether: *I should not pass over in silence that today the feeling is beginning to spread that the fertility of these abstracting methods is approaching exhaustion.* [14].

How, under the circumstances of discrimination and marginalization described above, did Noether succeed in forming a school and effectually change mathematical ways of thinking? The oldest reference to the school of Noether is in a review by Hasse of the German edition of Dickson's monograph *Algebras and their Arithmetics*: *One could think, particularly in regards to the German volume, of adopting the ideal theoretical means of expression naturalized by E. Noether and her school in these chapters* [5]. When looking at the formation of research schools, one is inclined to consider people who had a formal connection to the namesake of the school. In Noether's case, however, this includes only a few doctoral students, because she had neither formal habilitation students nor assistants. If you instead follow the many recollections and draw from other sources like PhD files, letter exchanges, and publications, a completely different situation presents itself. A lot of guests have to be considered: students approaching their PhD who used Noether's conceptual methods as well as educated mathematicians who took supplemental courses in Göttingen. On top of that were numerous colleagues abroad as well as students in Frankfurt, Moscow, Bryn Mawr, and Princeton. And of course, her pupils educated another generation of mathematicians, whom I label second-generation doctoral students. These young academics - coming not only from algebra but also from the most varied disciplines such as geometry, number theory, and topology - found they were able to fruitfully apply Noether's views and methodological approaches to issues in their fields.

I would now like to place belonging to the Noether School on its systematic feet, so to speak. Based on Fleck's reflections [9] on "thought style" and "thought collective" I have developed the concept of "thought space". The concept thought space can be defined as the productive collision of various thought styles in a creative, intercollective communication of thought. The thought space allowed for an openness of thinking and fostered conflict between different thought styles with their varied and possibly different research approaches and methods. Noether was able to create this type of space. The concept of the "thought space" as a place of exchange across disciplinary borders, one that broke with old thought commandments, characterizes the Noether School. The openness of thinking attracted the young generation of mathematicians to conceptual mathematics. And it is exactly the specifics of Noether's methods of working and thinking that allowed, encouraged, and even demanded separation from established ways of thinking. Belonging

to this thought space came about not through formal or disciplinary connections, but rather by holding the conceptual image and mastering conceptual methods.

Conceptual mathematics had to do with certain mutually held images of knowledge about mathematics that would prove so influential that they would enable access to mathematics in its entirety. Concluding remarks showed the breadth of the influence of the Noether School in changing the mathematical way of thinking. The Noether School can be understood as part of a cultural movement, whose intention was the modernization of algebra and the algebraization of mathematics. My research results show that the Noether School was more than a place of thought exchange. It illustrates the desire and will of its members to change. 'Modern algebra' was understood as a methodical concept that would become common knowledge among today's mathematicians and would lead to an algebraization of mathematics in its entirety. It is conspicuous that many articles were written from members of the Noether School in the 1920s for renowned mathematics journals in topic areas such as ideal theory, algebra theory, algebraic geometry, and algebraic topology. The situation changes in the first half of the 1930s. Numerous textbooks and reports, (i. e. *Algebren, Idealtheorie, and Topologie*) [2] united these articles, and we can observe the transition from "journal science" to "handbook science", as Fleck would call it. Or, in other words, the Noether School - in keeping with its aim of modernization and algebraization - begins to seize the power to define a new way of mathematical thinking.

One of these books is still famous today, van der Waerden's *Moderne Algebra* [11]. He represents the thought space of the Noether School like hardly any other mathematician, and in his textbook, he assembled the numerous and broadly conceived research results of the Noether School, which was meant to (and ultimately did) shape the future orientation of algebra as a discipline and an approach. Published in the series *Foundations of Mathematics*, the book marks modern algebra's shift from "journal science" to "handbook science". It represents the changes in mathematical conceptions of knowledge as well as a cultural shift in the day-to-day business of doing mathematics, which puts the concepts and, thus, a structural perspective center stage. Emil Artin (1898-1962) and Noether are referenced on the title page, but in an article published later, van der Waerden once again accounts for the breadth of the sources, as he himself calls them - that is, the foundations of this book. Or, in the words of Jean Dieudonné (1906-1992), one of the founders of the Bourbaki Circle: *It is true that there were already excellent monographs at the time and, in fact, the Bourbaki treatise was modelled in the beginning on the excellent algebra treatise of Van der Waerden. I have no wish to detract from his merit, but as you know, he himself says in his preface that really his treatise had several authors, including E. Noether and E. Artin, so that it was a bit of an early Bourbaki* [3]. And so it seems legitimate to also characterize this book, whose fundamentals of algebraic work arose from the thought space of the Noether School, as the School's manifesto.

REFERENCES

- [1] P. Alexandroff & H. Hopf, *Topologie I*, Springer, Berlin (1935).
- [2] M. Deuring, *Algebren*, Springer, Berlin (1935).
- [3] J. Dieudonne, *The work of Nicolas Bourbaki*, American Mathematical Monthly **77** (1970), 134–145.
- [4] A. Fraenkel & H. Helmut, (8.10.1928, 10.10.1928): SUB, Cod. Ms Hasse, 7: H. Hasse 33:2 (Bl. 415-423).
- [5] H. Hasse, *L. E. Dickson, Algebren und ihre Zahlentheorie. Rezension*, Jahresbericht der DMV **37** (1927), 90–97.
- [6] M. Koreuber, *Emmy Noether, die Noether-Schule und die moderne Algebra. Zur Geschichte einer kulturellen Bewegung*, Springer, Berlin, Heidelberg (2015).
- [7] M. Koreuber, *Zur Einführung von Begriffen in die Mathematik. Dedekind, Noether, van der Waerden*, T. In *Berichte zur Wissenschaftsgeschichte* **2/38**, Wiley-VCH, Weinheim (2015), 244–258.
- [8] W. Krull, *Idealtheorie*, Springer, Berlin (1935).
- [9] F. Ludwik, *Entstehung und Entwicklung einer wissenschaftlichen Tatsache, hrsg. von Lothar Schfer und Thomas Schnelle*, Suhrkamp, Frankfurt a. M. (1935).
- [10] M. Noether, *Idealtheorie in Ringbereichen*, *Mathematische Annalen* **83** (1921), 24–66.
- [11] B. Van der Waerden, *Moderne Algebra. 2 Bnde*, Springer, Berlin (1930/31).
- [12] H. Weyl, *Raum. Zeit. Materie. Vorlesungen über die allgemeine Relativittstheorie*, Springer, Berlin (1918).
- [13] H. Weyl, *Space. Time. Matter*, Dover, New York (1922), 322.
- [14] H. Weyl, *Topologie und abstrakte Algebra als zwei wegen mathematischen Verstndnisses*, In Weyl (1968), 348-358.

**Being a Female Mathematician in the 20th century
seen through the eyes of four Danes**

LISBETH FAJSTRUP, TINNE HOFF KJELDEN

(joint work with Anne Katrine Gjerlöff)

In Denmark universities opened to women in the late 19th century, and today (the 2010s) Danish women by far outnumber men in educations at university level. 50% of adult women have a higher education, but only one third of the male population. Except for some fields men still hold more faculty positions, especially professorships. This situation is the perhaps surprising result of a long historical process of discrepancy between the formal acceptance for women in education and the actual possibilities for women at higher education levels. The gender imbalance seems to be especially pronounced in mathematics. The first university degree in mathematics awarded to a woman in Denmark was earned by Thyra Eibe in 1899. However, despite equal access to public high school and universities from around 1900, until late 20th century only a very few women had a research career in mathematics in Denmark. Why is that? Why did/do women not enter into research mathematics in Denmark?

In this project, we want to move beyond the numbers. We want to obtain insights into the experiences of these women who made a research career in mathematics in Denmark in the 20th century. How was it? Why and when did they

choose to become mathematicians? Were they inclined towards mathematics already as children? Were there encouragements from family members, or teachers? How was their way into university positions? What were they motivated by? What drove their interests in mathematics? How and why did they choose their research area? How was the daily life in the math department? Did they have a career strategy? Did they experience gender biases? How did they balance work and family life? What kind of reactions did they experience – being one of the few? These are some of the issues we are curious about.

We are exploring and investigating these questions through semi-structured interviews with the following four mathematicians: Bodil Branner from the Technical University, Inge Henningsen and Gerd Grubb from Copenhagen University, and Eva Vedel from Aarhus University. These four women are representative in several respects: First of all they are the majority of the very few women who made a career as research mathematicians in universities in Denmark in the 20th century. Second, they worked in different institutions. Third, they represent both pure and applied mathematics. Fourth, they represent different areas and modes of research: one went into a well established, hard core area of mathematics, one has been driven by applications in particular in social and societal problems, one was a pioneer in establishing a new field of research in pure mathematics, and one has combined application – and curiosity driven research and established a research group. The narratives of these four female mathematicians will serve as a lens into gender issues, to career opportunities, to balancing family life and careers in mathematics in academia in Denmark in the 20th century. We will be looking for common traits and issues in their personal lives, the mathematical culture of their time, and society at large, which presented barriers and/or opportunities for them to pursue a career as research mathematicians. We have performed a first round of semi-structured interviews about these women's experiences in creating and maintaining a research career in the mathematical sciences in the 20th century, including a gender perspective in relation to the profession, the academic and social environments and opportunities for career development. The interviews have been recorded and transcribed. They will form the core material for our narratives. The interviews have been structured according to four themes:

- (1) Personal background: The importance of education, family and background, the balance between private life and career, zeitgeist etc.
- (2) Subject/career: Why mathematics/statistics, choice of research, issues and approaches, driving forces etc.
- (3) Environment/professional environment: The importance of colleagues, the academic environment and the working environment – globally and locally etc.
- (4) Gender issues: Explicit and/or tacit bias, the cooling out effect, the importance of soft categories etc.

We haven't done a thorough analysis of the interviews yet, so here we will only present some first preliminary impressions. Three of the women scientist interviewed for this study are born around 1940 and attended school in the early

1950s. They are all, with each their individual life story, examples of the educational trends for women in the after-war period. What they have in common is a higher middle class background, a mostly supportive family, which considered education for girls natural, though not necessarily as the foundation of a career. Also none of the women did attend a school in the remote countryside, but all grew up in areas relatively close to Copenhagen, or in the larger cities Aarhus and Odense, where schools were large and the number of specialized teachers much higher than in more peripheral areas of the country, and where high school education was a logistically and financial possibility for those who had the intellectual abilities and the support from their parents.

Many memoirs of dismissive and misogynist male school teachers are recorded from this and earlier periods, however, this element does not feature in any of the interviewees' stories, and is perhaps a partly determining factor in their later choice of education. But, it is also notable that they all, regardless of a passion for school mathematics, mention that mathematics were not necessarily their one and only choice at university: philosophy, languages and other humanities are mentioned as equally interesting and appealing, and mathematics is chosen by chance; the main target was to use ones intellectual abilities, to use logic, to learn. The main interests of the interviewees were not the natural sciences but intellectual analytical sense and challenges. The specific combinations of scientific fields at the university also played a part in their choice, such as Inge Henningsen who chose statistics instead of mathematics, in order not to study physics, which were a part of the primary scientific study at that time, but not at Aarhus University where Eva Vedel mentions that it was possible to study neither physics nor chemistry, while still choosing mathematics.

Even though private and some public daycare and kindergarten existed in the 1950s in Denmark it was not common, and certainly not for the middle class, to let small children be taken care of outside the home. Many mothers were stay-at-home mothers. In 1960 more than 60% of women in the age group 35-44 years were registered as housewives. The four women all describe their different strategies for coping with managing small children and housework: help from relatives, mostly their mothers, or, more alternative lifestyle, like living in a commune where all adults had responsibility for children and housekeeping.

What they all mention is the equal partnership with their spouses, and certainly all of them had support for pursuing their own career, and an ideal of equal responsibility for taking care of the children. But it is also interesting that more than one mention the flexible and relaxed view on them as working or studying mothers at their university departments. From bringing baby prams to the university, to agreements on maternity leave and unofficial agreements on half-time teaching in certain periods of time. It seems that the less rigid rules and the personal contacts between the university colleagues and supervisors have played a major role in this often difficult period for female researchers who wish to pursue a career and have

children at the same time. The very small communities the mathematics departments were in this time period, and the personal contacts between students and professors definitely played a major role in creating this flexible attitude.

One of the perhaps most surprising elements of the four interviews are, that none of the interviewees recall any significant gender discrimination towards themselves from teachers or fellow students during their years of university education. For all of them women were a small minority with only a few women in each class, some of whom did not finish their education. This contrasts with the general perception and other stories from the mid-20th century, where women began to be visible as a group in higher universities in Denmark. And the recollections definitely contrast with the current debates about whether the respectability and scientific level of higher education are threatened by the dominance of female students. Statistician Inge Henningsen suggests a possible explanation in her interview: perhaps the mid-1950's was a narrow window of opportunity where gifted women could go to the university without any social retaliations because they were still too few, and too invisible, to be considered a threat for the traditionally male dominated scientific field? For the First Movers, that these women were, there had not yet been developed a language or a climate of gender differences in this small and exclusive scientific context, even though it still thrived perfectly well in wider society and even manifested itself in the families of some of the interviewees.

REFERENCES

- [1] S. Brinkmann, L. Tanggaard: *Kvalitative metoder – en grundbog*. Hans Reitzels Forlag, 2010.
- [2] B.R. Clark: The “Cooling Out” Function in Higher Education. *The American Journal of Sociology*, LXV, 1959.
- [3] A.K. Gjerløff, and A.F. Jacobsen: *Da Skolen blev sat i system 1850-1920*, Dansk skolehistorie vol. 3, Aarhus University Press, 2013.
- [4] A.K. Gjerløff, A.F. Jacobsen, E. Nörsgaard, and C. Ydesen: *Da Skolen blev sin egen 1920-1970*, Dansk skolehistorie vol. 4, Aarhus University Press, 2014.
- [5] P. Govoni, Z.A. Franceschi: *Writing about Lives in Science (Auto)Biography, Gender, and Genre*, V & R Unipress, 2014.
- [6] H. Kahlert: Nicht als Gleiche vorgesehen. Über das “akademische Frauensterben” auf dem Weg an die Spitze der Wissenschaft. *Beiträge zur Hochschulforschung*, 37. Jahrgang, 3, 2015.

Hearsay, Choice, and Data: Men on Women in Maths and Science, from the Present to the Enlightenment and Back to the Future

PAOLA GOVONI

In order to discuss how the past might be used to understand the present, in my talk at the Oberwolfach Institute I begin with questions such as: What distinguishes countries in which girls perform as well as boys or even better in maths - according to PISA data - from countries in which girls still show persistent difficulties in maths? Do the data allow us to say that, in those contexts in which girls perform at the same level as boys, women in mathematics have the same chances as their male colleagues to reach the top of the university career ladder? The data suggest that many of the reasons for the maths disparity between boys

and girls stem largely from the social context: typically, the more the Global Gender Gap (an index edited by the World Economic Forum) is reduced, the less divergence there is in boys' and girls' performance in mathematics. Yet we know that there are countries in which this rule does not apply, and in view of those cases, social psychology proves useful for understanding these controversial phenomena. Shifting the focus from girls to women in mathematics, the data I presented demonstrate that they likewise face significant difficulty in reaching top career positions in almost every country. In this case, social data and the findings from social psychology need to be contextualized in the long-term history of the relations between women and men in science¹ and research institutions.

Inquiries about the present, which in my professional life I engage in connection with my teaching, are formulated in the service of historiographical questions I pose as a historian of science. One particular question I have asked of late is whether the biographies of successful - or unsuccessful - women in math and science may be useful tools for attracting girls to and sustaining women in science. After several years of research on science and society - and in line with a consolidated historiographical approach - I have concluded that it is simply impossible to craft history without adopting the present as an objective of my research. Incidentally, I am engaged in institutional activities in support of disseminating gender studies and fostering women's careers in science. When educational commitments intertwine with research-related concerns, how can we - as historians - overcome the risk of projecting our political convictions onto the past?

I recently worked on a book about (auto)biography in the history of science [1]. This represented an opportunity to delve a bit deeper into the complexity inherent in working on historical issues that can be traced back to personal matters. Leaving aside attempts between the two world wars, and in particular Virginia Woolf's writings on biography, the biographical genre began to be considered a scholarly writing in the 1960s, following the second wave of feminism discussions of the interrelations between the personal and the social. It was then and following autobiographical endeavours relating to gender that scholars began to ask how a biographer could capture the essence of a creative mind in context. Roughly speaking, this explains why female scholars raise more questions around these issues than men: this is an example of what we call group cultures. All of us decide (or happen) to be part of a group, but when the network in question intersects with that of feminist (women) scholars, we must be careful, because members of other groups tend to naturalize these women's cultural traditions and use them as the basis for marginalization. This is why in the end I decided to shift my initial focus. At first I had planned to delve into long-term history to identify what women who were able to succeed in maths in Italy had in common in the last three hundred years, looking from the Enlightenment times of mathematician Maria Gaetana Agnesi (1718-1799) [4], a fervent catholic from a wealthy but not noble family, to the present of Emma Castelnuovo (1913- 2014)², a Jewish educator, maths

¹By science I mean the sciences, technology, medicine, and, of course, mathematics as well.

²For a biographical sketch in English, see [2].

populariser, and the daughter and niece of famous (male) mathematicians. This has been a classic approach in the sociology of science since the time of Robert K. Merton's (1910-2003) research on the Royal Society. It is helpful for understanding how social and cultural elements become incorporated into science - into scientific facts - through the lives of experts. And of course it is always useful for granting a voice to people who have been forgotten by history. Yet, when those people are women, the research results are "perceived" differently, and there is a tangible risk of offering biased readers evidence that supports the idea that women are "different" from men.

I definitively changed my mind after re-reading an essay that has become a classic of the misogynist history of women in maths, a lecture delivered in 1901 by the Italian mathematician Gino Loria (1862-1954). An interesting point in Loria's analysis is the constant that he identifies in the biographies of those women who earned a place in the history of mathematics. He argues that it can be demonstrated that the few women who (may) deserve a place in the history of mathematics owe this place to their fathers and brothers, or to husbands, teachers and colleagues who helped them in their research. Loria uses this common element to completely demolish the scientific achievements of women in the history of maths, from Hypatia to Kovalevskaia. By themselves, Loria assures us, women could not have achieved anything, because "provident Nature seems to call [women] to other destinies" [3, p. 465.]. Beyond the unfounded allegations that led Loria to assert that all of women's scientific achievements in mathematics must actually be attributed to the men around them, there is a part of Loria's discourse I do fully agree with. Just like men, in order to succeed in science and mathematics women must grow up in a family that - at the very least - does not destroy their potential. In addition or alternatively, they need teachers, friends, colleagues or partners who support them as equals. In other words, women need to be admitted into that select circle that the founders of the Royal Society called the "invisible college". The invisible college is a powerful image, recovered by sociologist of science Derek J. de Solla Price (1922-1983). If you are not accepted into that college or network - which is always personal, institutional, and political at the same time - it is impossible to make science and/or have a place in its history. Roughly speaking, the positive concept of invisible college lies at the origins of the Republic of Letters, a supranational space in which women in the 18th century were able to hold a recognized role. Between the 19th and 20th centuries, however, while the natural philosopher was evolving into the professional scientist, women from the petty and middle bourgeoisie began to access higher education and the labour market and, along with this rise in women's participation, the women-friendly Republic of Letter evolved into the misogynist and still active "old boys network". In Italy, in Loria's time, women and men had begun to compete for the few resources available for research, a competition many men played out using racist and sexist elements supported by hearsay rather than empirical evidence. In my paper, I outlined how in the long run we can say that Loria (and the many Lombrosos) with their uncertain statistical data on women's inferiority won out over scholars such as John

Dewey (1859–1959) who, using equally uncertain statistical data, bet on women and their equality with men. This allowed me to raise and discuss a few questions, the first one being: Why are gender studies and the history of women in maths so rarely used as tools to investigate mathematics as a socially constructed culture? Secondly and shifting the focus from women to men, I tried to answer questions such as: between the nineteenth and the twentieth centuries, what male scholars supported women in education and science, and how and why did they do so? Moreover, I am truly convinced that the troubled relationship between girls and maths is embedded in the idea that science and maths are *special* cultures which, it goes without saying, have to be practiced by special people: in the hearsay culture of today, as well as in that of Loria’s time, those special people are boys.

These questions may be of some interest in relation to contemporary educational strategies: I suspect that to support equal opportunities in science and maths we have to begin by strengthening the image of science as culture and, secondly, to work on boys and men more than girls and women.

REFERENCES

- [1] P. Govoni, *Crafting Scientific (Auto)Biography*, in P. Govoni, Z.A. Franceschi eds. Writing about Lives in Science: (Auto)Biography, Gender, and Genre, V&R Unipress, Göttingen (2014), 7–30.
- [2] F. Furinghetti, *Emma Castelnuovo*, MacTutor History of Mathematics Archive, School of Mathematics and Statistics, University of St Andrews, www.history.mcs.st-andrews.ac.uk/Biographies/CastelnuovoEMMA.html last accessed, January 20, 2017 (2014).
- [3] G. Loria, *Donne Matematiche*, in Id., Scritti, Conferenze, Discorsi sulla Storia delle Matematiche, Padova, Cedam (1936).
- [4] M. Mazzotti, *The World of Maria Gaetana Agnesi, Mathematician of God*, Johns Hopkins University Press, Baltimore (2007).

How do “categories” used in the past to describe women in science influence our view of nowadays female mathematicians?

ISABELLE, LÉMONON

My introductory talk aimed at raising a discussion about the variety of personae involved in the characterization of female mathematicians through history, using the french example. From the *puella docta* during the Humanism period, to the *femme savante* during Enlightenment in France, they have been embedded in these very broad *personae* including as well literary women, poets, multi-language speakers, natural philosophers, chemist... ,corresponding to the male image of the *savant*. The *persona* is here understood as Otto Sibum and Lorraine Daston [4] describe it, as a cultural identity that models both the individual (in body and mind) and creates a collective with a shared and recognizable physiognomy. It is not a presentation of individuals but of species, identifying a class rather than an individual. A nascent *persona* indicates the creation of a new type of individuals whose distinctive traits mark recognized social species, dependent on a specific

context. The *femme savante persona*, incarnated in France by milie du Chtelet (170–1749) is connected to the Enlightenment philosophy, and one may wonder whether a new *persona* appeared in France during the 19th century, to describe female scientists such as mathematicians, as they got access to the universities (at the end of the 19th century), and since the Enlightenment ended. This period is also marked by the multiplication of dictionaries ¹ of women, which serve still nowadays to historians to study these women. Then, one may ask how the selection of these women made in dictionaries biases our view about women in science in the past, and also about the present “woman of science” or “female mathematician” we (historians of mathematics or science) regard nowadays, and the public imagine.

The discussion highlighted a gap in the *persona* used to describe women having a scientific activity during the 19th century, where both the *femme savante* term and the professional denomination, raised by the opening of universities to women, were used. For those women who did not have access to universities, but carried out activities in mathematics, only a few of them, like Sophie Germain (1776–1831), were called in dictionaries “mathematicians” by the end of 19th century. It appeared that using these books as a base of a research about women in mathematics is more meaningful about the 19th century’s way of defining a “professional” mathematician, than about identifying women practicing mathematics. So, how could we find out these women, excluded from any institutional positions, universities but who had a private mathematical practice ? The social network study of male mathematicians, and a close look at their private correspondences might be a lead to reach these “lost” women.

It also pointed out that scientists, such as mathematicians or physicians, during this period had trouble in naming women in their own field. For example, in the case of Sofia Kovalevskaa (1850–1891), Lazarus Fuchs (1833–1902), a German mathematician, wrote to her as *Frau Collega* ², avoiding maybe that way the ambiguity of the phrase Frau professor which means as well *wife of a male professor as female professor* in German. Also in Italy, the word *Medichessa* ³ used by Anna Kuliscioff (1857-1925), a Russian physician, for female medical doctor is not the common construction (which would be *medico* or *dottore*, even for a woman). *Medichessa* brings a positive stress on the gender of the physician in an activist way (like Kuliscioff used it), but it can sometimes be used in a negative way as *Femme savante* in French.

The discussion ended with interrogations about the categorization of women in science: Should we use categories such as *personae* to fill the gap of the 19th century? What do we learn from them? What about using categories based on scientific practices, as during this period women had no access to diploma or positions in science, which would have enabled us to characterize them?

¹Dictionaries such as [3] or [2].

²Institut Mittag-Leffler Archives. I want to thank Eva Kaufholz-Soldat for this example and the reference of this quotation.

³I thank Paola Govoni for this other illustration about the difficulty of naming women in science in Italy. [1]

REFERENCES

- [1] A. Kuliscioff, *Il sentimento nella questione femminile*, *Critica Sociale*, **9**(2) (1892), 142–143.
- [2] J. M. Qurard, *La France littéraire ou dictionnaire bibliographique des savants, historiens et gens de lettres de la France, ainsi que des littérateurs trangers qui ont crit en franais, plus particulirement pendant les XVIIIe et XIXe sicles*, Didot (1842).
- [3] A. Rebière, *Les femmes dans la science: notes recueillies*, Nony & C, Paris (1897).
- [4] H. O. Silbum & D. Lorraine, *Scientific Personae and Their Histories*, in *Science in Context*, 1, Cambridge University Press, Cambridge (2003).

**'[...] the first handsome mathematical lady I've ever seen!'
On the Role of Beauty in Portrayals of Sofia Kovalevskaya.**

EVA KAUFHOLZ-SOLDAT

For more than a century, the life of the Russian mathematician and author Sofia Kovalevskaya (1850-1891) has fascinated scholars and laymen alike. At a time when women were not admitted to institutes of higher learning in most countries of the world, Kovalevskaya studied mathematics, first with a special permit at the university of Heidelberg, then as a private student of Karl Weierstra in Berlin, obtaining her Ph.D. in absentia with three theses on complex analysis from Göttingen University in 1874. It was not until 1883, however, that Gösta Mittag-Leffler, by that time an up-and-coming mathematician in Scandinavia, was able to secure her a position at the newly founded Högskola in Stockholm. There she taught higher mathematics, first as a docent, later on as a regular professor until her untimely death.

Transcending the boundaries imposed on the female gender in the nineteenth century, Kovalevskaya already attracted a good deal of attention during her lifetime. It was not until the middle of the 1890s, and thus a few years after her death at the age of only forty-one, that a number of biographical accounts appeared and her sudden rise to real fame began. And with it came a significant interest in her physical features, or rather, in appraising them, as the focus was typically on establishing, whether Kovalevskaya was beautiful or not. Interestingly enough, there was no general agreement with regard to this question. Nevertheless, a striking dichotomy emerges when comparing the views expressed during the two distinct phases of intense interest in her biography. Hereby, a striking correlation between the central themes during these time periods, as well as respective assumptions about women in science can be established.

While only few of the accounts published about Kovalevskaya before her death pay any attention to her physical features at all, it was always in a strictly positive light if they did.¹ This view stands in stark contrast to the typical pictures that was painted of Kovalevskaya soon after her death, when her fascinating life aroused considerable interest.

¹As an exemple see “Frau von Kowalewsky” in: *Berliner National-Zeitung* (January 5th, 1889), by Paul du Bois-Reymond. A facsimile of this article can be found in [2, p. 504].

Unlike most publications about famous mathematicians, the authors now writing about Kovalevskaya nearly ignored her scientific achievements, while centering the discussion on one central question: whether her life as a mathematician had made her unhappy as a woman. Three publications – Kovalevskaya’s autobiography about her childhood, the second part of her biography written by her friend and then well known author Anna Charlotte Leffler [6], and Laura Marholm’s highly disputed *Buch der Frauen* [7] – proved to be instrumental in establishing this debate. Their portrayal gave rise to the narrative of the sad female mathematician, who, in spite of her unprecedented career led an unhappy life, because she was emotionally crippled by her unfulfilled longing for love.²

Intentionally written for a broad audience, all three of these books enjoyed a wide circulation that largely shaped popular images of Kovalevskaya at the turn of the century. They also played a decisive role in establishing the picture of the gifted female mathematician who was physically unattractive, a theme that was easy to conciliate with this image, but could also be connected to contemporary theories routed in biological determinism, according to which only men had an innate aptitude for mathematics.

Sometime between the admission of women to institutions of higher learning throughout the Western World and World War I, the fascination with the life of Sofia Kovalevskaya began to fade until it almost ceased completely. But by the 1930s a new interest in her came to the fore, and along with it a completely different perception of the female mathematician. In contrast to the depictions from around the turn of the century, authors now began to describe Kovalevskaya not only as beautiful, but often as stunningly so. Peaking around the 1980’s, this new wave of publications both in Western and Communist countries presented a far more complete and holistic,³ revealing a multi-talented mathematician with wide ranging interests in social, political, and literary affairs. Motivated to one degree or another by the modern feminist movement and communist ideology, which also stressed equality between men and women, both strands of reception strove to present a new image of the female scientist. In what could be interpreted as an indirect confutation of prejudices about woman’s ineptitude for science and more importantly, the attitude that women who take up mathematics are likely to lead unhappy lives, Kovalevskaya was stylized as a role model whose story served to encourage women to enter scientific or technical professions.

Ever since the early 1980s, the number of publications about Kovalevskaya has grown steadily. She has become the subject of countless articles and books by scholars and laymen alike. Unfortunately, this flood of new publications has also

²Cf. eg. the newspaper article by an unknown author about the ‘sad fate of the gifted Russian girl’, who may have been ‘one of the greatest mathematicians’, but, even though ‘the world’s honors were heaped upon her [...] died a heartsick, disappointed woman’. Published in the *Lewiston Teller* on October 24th, 1895.

³[3], [4], to name just two of the most important publications.

given rise to a disproportionate glorification and heroization⁴ of her, traces of which could already be seen at the turn of the century, though to a lesser extent. In this new and more progressive atmosphere, one could point to the careers of Madam Curie and others as proof that women could succeed in scientific fields. This alone no longer sufficed to distinguish Kovalevsakya as an exemplary role model for women. But she was more than a mere scientist, and for those who raised her on a pedestal she became, not necessarily on a conscious level, a liberating figure, one who defied all the standard prejudices about women and science, including the assumption of the ugly learned woman.

But along with the new image of Kovalevskaya that had emerged, came another interesting shift with regard to her love life. Kovalevskaya, who had so often been described as a heartbroken woman before, now became stylized as a *femme fatale*, who supposedly had broken the heart of her male colleagues; rumors, which even though completely unfounded, have proven to be rather pervasive.⁵ Without doubt, all these unsubstantiated allegations were influenced by Kovalevskaya's singular status as a woman in an exclusively male domain. But even more surely, they were enhanced by her reputation as a beautiful woman who knew how to exploit her feminine charms. Yet this image of Kovalevskaya is a strictly modern phenomenon. None of these rumors about her exploits as heart-breaker can be found during the first wave of reception, during which she was at times even considered to be ugly.

In conclusion, both the notion of the unsightly and the beautiful Sofia were easy to reconcile with the general image of a female mathematician painted during the respective phases of her reception. As such, her alleged beauty or lack thereof serve as indicators for central themes that accompanied particular images of her at different times. Moreover, these assessments also serve as a window on changing views about women in mathematics in general and reflect various ways in which the life of Sofia Kovalevskaya has been instrumentalised.⁶

REFERENCES

- [1] M. Audin, *Remembering Sofia Kovalevskaya*, Paris: Springer, (1993).
- [2] B. Reinhard ed, *Briefwechsel Karl Weierstra-Sofja Kowalewskaja*, Berlin: Akademie Verlag, (1993).
- [3] A.H. Koblitz, *A convergence of lives: Sofia Kovalevskaia; scientist, writer, revolutionary*, 2nd edition, Boston: Birkhäuser, (1993).
- [4] P. Kochina, *Love and Mathematics: Sofya Kovalevskaya*, Moskau: Mir Publishers, (1985).

⁴As an example see Michčle Audin's short, yet poignant and very true dissection of the commonly found claims that Kovalevskaya was either the first woman to obtain a Ph.D. with a mathematical thesis or a professorship, both of which are obviously not true. [1, p. 1.]

⁵As an example see [5, p. 220.]

⁶An article, based on this talk, will be appearing in a forthcoming issue of the BSHM Bulletin.

- [5] S. G. Krantz, *Mathematical Apocrypha Redux. More Stories and Anecdotes of Mathematicians and the Mathematical*, Washington, D.C.: Mathematical Association of America, (2005).
- [6] A. K. Leffler, and S. Kovalevsky, *Sonya Kovalevsky; a biography, and Sisters Rajeovsky; being an account of her life by Sonya Kovalevsky*, London: T. Fisher Unwin, (1895).
- [7] L. Marholm, *Das Buch der Frauen. Zeitpsychologische Porträts*, Paris: Albert Langen, (1984).

Grace Chisholm Young, William Henry Young, their results on the theory of sets of points and a controversy with Max Dehn at the beginning of the 20th century

ELISABETH MÜHLHAUSEN

In “Jahrbuch über die Fortschritte der Mathematik” in 1903 a publication by the English mathematician William Henry Young (1863–1943) “On the analysis of linear sets of points” was reviewed. The critical remarks of Max Dehn (1878–1952) on the work of her husband motivated the mathematician Grace Chisholm Young (1868–1944), to get into contact with him. That was the beginning of an interesting correspondence, which was not only about mathematics. Grace Young finally gave up writing to Dehn because she was disappointed by his replies to her questions. She passed a copy of this correspondence on to Giulio Vivanti (1859–1949), an Italian mathematician in Messina, whom she knew from her research period in Italy and asked him for his opinion on the matter.

With this we have introduced the main actors. All of them had already published on set-theoretic problems, Max Dehn on applications of set-theory to elementary geometry, Giulio Vivanti on the theory of sets per se and on the historical development of set-theory. Otherwise he was mainly concerned with analysis. The Youngs had written by far the most set-theoretical papers, all of them worked out together but published only under W. H. Young’s name. Vivanti was able to smooth things over with constructive suggestions. Those involved became less emotional. Grace wrote from Göttingen to her husband in Liverpool: “After all what we want is not to prove the argument in the Analysis [of linear sets of points] right, but to find out the truth.”

In 1903 Grace and William Young concluded a contract with Cambridge University Press to publish a textbook on set-theory that introduced this new field to the UK. They had been busy publishing their results in this field; about 20 papers appeared between 1900 and 1905. One of these publications was the one criticized by Dehn and was already included word for word on the pages 52 to 63 of the book. The Jahrbuch with that review appeared, as was usual at that time, two years later, that is at the end of the year 1905, and when William Young learned of it, he was very upset. He himself did not contact the reviewer but left this to his wife. In January, 1906 she wrote a letter to Max Dehn demanding that he explain the reasons for his critical remarks. Dehn answered that he could not give precise information as the journal with the publication was not accessible to him,

but he repeated his objection. So Grace Young send him an offprint. The following correspondence shows in detail how lively, intense and emotional the further development and application of Cantor's set theory was. The controversy ended in May, 1906 and the Young's joint book "The Theory of Sets of Points" was published in the same month. Grace Chisholm Young had proved the results of the paper in discussion again, her mathematical friend Giulio Vivanti also couldn't find any mistakes, so nothing had to be altered, except that a long explanatory footnote was added.

My main object in this talk was to find out more about the details of how the Young-couple worked together, she living with the children in the world center of mathematics at that time, in Göttingen, and he abroad as a lecturer and examiner in Cambridge and Liverpool. They had an intensive mathematical correspondence and even more intensive discussions when they were together in Göttingen or elsewhere.

Emma S. and Wladimir S. Woytinsky – An unusual couple in statistics

ANNETTE B. VOGT

In the history of science in the mid 1990s the concept of Couples in Science was developed first by Helena M. Pycior, Nancy G. Slack, and Pnina G. Abir-Am [1]. They distinguished married scientists who were working together and (at least partly) publishing together - the Couples in Science per definition -, and they were asking for more research on mixed couples in laboratories who were not married. In their case studies, published in 1996, couples in sciences were especially studied who became famous and were awarded with the prestigious Nobel Prize, like Marie and Pierre Curie (in 1903) and Irène and Frédéric Joliot-Curie (in 1935). 16 years later another volume was published [2] where the authors tried to develop further the concept on Couples in Science on the one hand, and on the other hand new case studies were discussed. This is an ongoing process, research and investigations has to be done on couples in science in all fields of mathematics and sciences, humanities and social sciences, technology and medicine. Inspired by the two volumes, my "definition" of Couples in Science is then: both had studied science (or technology, medicine, humanities), both had finished their study with an academic degree, at least partly because of the long history of the exclusion of female students from university studies and examinations. The significant element is the fact that both are working and publishing together, i.e. they are collaborating and publishing together. In contradiction to the Couples in Science we have to distinguish the Couples of Scientists in history of science and mathematics. Both had studied science (or technology, medicine, humanities), both had finished their study with an academic degree, at least partly, but they are working in different fields, they are not working together, and they are not publishing together. These Couples of Scientists became more important when research on history of science and mathematics is done in the 20th century until recent time.

First, I discussed the concept of Couples in Science respectively Couples in Statistics as well as the concept of Couples of Scientists. Statistics means the field between statistics as the science of the state and economic statistics as well as mathematical statistics.

Second, I gave an overview on the life and activities - politically and scientifically - of Emma S. (1893-1968) and Wladimir S. (1885-1960) Woytinsky (also Vojtinskij). Both were socialists and political activists and Russian Jews. Because of political circumstances they had to live in exile from 1920 onwards, first in Germany, then in France, and from 1935 on in the USA. Whereas Wladimir S. Woytinsky belongs to the very known active participants in three Russian revolutions (in 1905 as well as in 1917 in February and in October/November), the political activities of Emma S. Woytinsky are much less known. She herself had covered most of all details of her life before 1916. From 1917 on, after their marriage, both were living mostly together, they were working together, travelling together, and they were both very active in socialist movement. Thanks to her both escaped the Nazi persecution in 1933, and thanks to her again they emigrated to the USA already in 1935.

Emma S. Woytinsky, born in Witebsk in 1893, attended a girl's school (comparable with a gymnasium) in Polotsk (not far from Witebsk), and she finished this school in about 1912/13 with a Gold Medal. As a Jewish college girl this Gold Medal allowed her to attend further academic courses. Emma became a student of the famous Bestuzhev Courses (Higher Women's Courses) in St. Petersburg. From about 1912/13 to 1916/17 she studied literature, modern languages (German and French especially), but also mathematics and sciences like physics and geography. The Higher Women's Courses possessed an excellent library, a chemical laboratory, and an observatory. The teachers were mostly professors and Privtadozent from the Imperial University St. Petersburg. It was probably in St. Petersburg when Emma also became involved in political activities, i.e. she became interested in socialist ideas and participated in circles to study Marxist literature and to help political prisoners and exiled social democrat's in Siberia. Thanks to her study in St. Petersburg Emma Woytinsky got an excellent academic education, including some courses and training in mathematics. After receiving the certificate (the diploma) she was working as a teacher, and after her marriage (in July 1917 in Irkutsk, Siberia) she was always together with Wladimir S. Woytinsky - partly working with him, and being his secretary, translator and "guardian angel", and last but not least being always his comrade.

Compared with her academic education, his study and education was complicate. Born in St. Petersburg in an intellectual family (his father was an engineer) he studied law and economics at the University of St. Petersburg. But he wasn't able to finish his study with a diploma or another academic degree because of his participation in the first revolution in Russia in 1905. He became a member of the Russian Social Democratic Party and worked illegal until he was arrested in 1908, he was in prison from 1908 to 1912, and in 1912 he was sent to Siberia where he was living in exile near Irkutsk. When he was in exile he studied like many other

revolutionaries, i.e. he studied classical literature on history, law, and economy, and all classical Marxist literature. Without regularly courses he became a highly educated scholar.

From their educational background it became clear that they were unusual statisticians because of the lack of continuous academic training in this field before 1924. Why then they became important statisticians and well acknowledged among statisticians and researchers in the world? To answer this question, I have to explain their special education and training as statisticians by a system like “learning by doing” and first and foremost thanks to the support of and the private courses on statistics offered by Ladislaus von Bortkiewicz (1861-1931) - one of the leading statisticians at this time [6], [7] and [8]. The first result of this close collaboration on statistics was the publication of seven volumes “Die Welt in Zahlen“ (The World in Figures), published in the Mosse publishing house in Berlin between 1925 and 1928. As author was stated only Wladimir S. Woytinsky, the editor of the series was Ladislaus von Bortkiewicz, and each volume was dedicated “Meiner Frau, der treuen Mitarbeiterin und Weggefährtin” (To my wife, the true collaborator and comrade).

In 1933 Woytinsky’s had to go into exile immediately because they were active socialists and Jews. After the victory both became free lance scholars and were financed by grants of different organisations. Between 1947 and 1959 another period of close collaboration on statistics followed. Now they were working together and publishing together. They did famous and highly acknowledged work compiling large data collections on statistics on world population and production, and on world commerce and trade. These two volumes are comparable to the seven volumes in the 1920s, again with a special focus on the development of economics and society from an international perspective. And one has to have in mind that this work was done without modern computers. Furthermore, they spent together lecture and research tours.

Third, I had to investigate their practices as statisticians, their collaboration, and the division of labour in their work in the 1920s in Berlin as well as their collaboration in the 1950s in the USA. In contrast to the years in Berlin where they collaborated together but didn’t published together (see [9], 7 vols., with a dedication to her in each volume), in the USA they were working together, collaborating together and publishing together all in all four books [10], [11], [12] and [13]. Wladimir Woytinsky as well as Emma Woytinsky have described their collaboration, i.e. how they were working together, how they shared common views on the role of statistics, and how they organised the division of labour in detail in their autobiographies (see [14, 16]). It was quiet remarkable that Woytinsky’s synthesised with their volumes a product of data collections which is still valuable - as a source as well as a type of data collections which is still actual.

Finally, I analysed and I compared the different circumstances and their working conditions in Berlin and in Washington, and I discussed why Emma S. and Wladimir S. Woytinsky were so unusual - as a couple and as a couple in statistics. They contributed to the development of statistics in the 20th century in three

directions: they contributed to statistics thanks to their publications (the 7 vols and the 4 vols); they were an unusual couple in statistics, because she received a diploma (i.e. an academic degree) while he didn't received any academic degree; and they contributed to the development of statistics because of their approach and their three-dimensional perspective. They prepared the data compilations first from a socialist (or marxist) perspective, i.e. economics is the most important factor; second, they produced the statistical data compilation from an international perspective - the "world in figures" as the title in the 1920s clearly announced; third, they prepared the statistical data compilation from a historical perspective, i.e. a long-durée perspective. And their aims were always to understand the development and to predict, to forecast the future.

REFERENCES

- [1] H. M. Pycior, N. G. Slack & P. G. Abir-Am (eds.), *Creative Couples in the Sciences*, New Brunswick/New Jersey: Rutgers University Press (1996).
- [2] A. Lykknes, D. L. Opitz, B. van Tiggelen (eds.), *For Better or for Worse? Collaborative Couples in the Sciences*, Heidelberg, New York and London: Birkhäuser (2012).
- [3] N. L. Johnson & S. Kotz (eds.) *Leading Personalities in Statistical Sciences: From the Seventeenth Century to the Present*, New York: Wiley (1997).
- [4] C. C. Heyde, E. Seneta (eds.), *Statisticians of the Centuries*, New York et al: Springer (2001).
- [5] X. Lin et al. (eds.), *Past, Present, and Future of Statistical Science*, Boca Raton, London, New York: CRC Press (2014).
- [6] E. J. Gumbel, *Nachruf auf Ladislaus von Bortkiewicz*, Deutsches statistisches Zentralblatt **23**(8) (1931), 231–236.
- [7] E. J. Gumbel, *Bortkiewicz, Ladislaus von*, International Encyclopedia of the Social Sciences, New York: Macmillan Publishers, Vol. 2 (1968), 128–131.
- [8] W. K. Härdle & A. B. Vogt, *Ladislaus von Bortkiewicz – Statistician, Economist and a European Intellectual*, International Statistical Review **83**(1) (2015), 17–35.
- [9] Wl. Woytinsky, *Die Welt in Zahlen*, 7 Bände. Berlin: Rudolf Mosse Buchverlag, (1925-1928).
- [10] W. S. Woytinsky & E. S. Woytinsky, *Employment and wages in the United States*, (1943).
- [11] W. S. Woytinsky & E. S. Woytinsky, *World Population and Production: Trends and Outlook.*, New York: Twentieth Century Fund (1953).
- [12] W. S. Woytinsky & E. S. Woytinsky, *World Commerce and Governments: Trends and outlook*, New York: Twentieth Century Fund (1955).
- [13] W. S. Woytinsky & E. S. Woytinsky, *Lessons of the Recessions*, Washington, D. C.: Public Affairs Institute (1959).
- [14] W. S. Woytinsky, *Stormy Passage. A Personal History Through Two Russian Revolutions to Democracy and Freedom: 1905-1960*, New York: The Vanguard Press, Inc (1961).
- [15] E. S. Woytinsky, *Su Much Alive. The Life and Work of Wladimir S. Woytinsky*, New York: The Vanguard Press, Inc. (1962). [with a detailed Bibliography of Woytinskys Writings, pp. 229-263]
- [16] E. S. Woytinsky, *Two Lives in One*, New York, Washington: Frederick A. Praeger Publ. (1962).

A mathematician and a painter Stanisława Nikodym and her husband Otton Nikodym

DANUTA CIESIELSKA

Stanisława Dorota Nikodym *neé* Liliental (1897-1988) was born in Warsaw on July 2. She was brought up in the family of Polish speaking assimilated Jews Regina *neé* Eiger (1877-1924) and Natan (1868-1927). Regina was doing pioneering studies about folklore and literature of Polish Jews. Stanisława's brother Antoni (1908-1940) was a chemist. He worked at the Warsaw Polytechnic. He was also an officer of the Polish Army (killed by Soviets in Katyń in 1940). She was educated in Warsaw, where she studied for 6 years in Helena Saley's¹ school, and for 7 years in the private Polish school for young women. In 1916 Stanisława started studying at the University of Warsaw under: Stefan Mazurkiewicz (1888-1945), Zygmunt Janiszewski (1888-1920), Waclaw Sierpiński (1882-1969) and others. During her studies she started her artistic career. She was a talented painter and writer (more in [21]).

Otton Marcin Nikodym (1887-1974) was born in Demycze, the suburb of the small Galizien city Zablotov (now Zablotiv, Ukraina) in the family of European intellectuals (his grandparents were of French, Italian, Czech and Polish origin). His parents died when he was very young and Otton was brought up by his grandparents. He graduated from the University in Lvov (Lemberg) where he attended Sierpiński's seminar in mathematics and Smoluchowski's² seminar in physics, he was a friend of Franciszek Leja (1885-1979). In Kraków during WWI he was discussing mathematical problems with Stefan Banach (1892-1945) and Witold Wilkosz (1891-1941), but they never published any joint paper. He was interested in measure theory and he is best known for the Radon-Nikodym Theorem [6] (known also as Vitali-Nikodym Theorem or Lebesgue-Nikodym Theorem).

In 1924 Stanisława and Otton got married and she moved to Kraków where Otton was a school teacher and delivered lectures at the Jagiellonian University. On June 26, 1925 they obtained PhDs from the University of Warsaw [2]; she was the first woman in Poland with PhD in mathematics. Stanisława wrote thesis *O rozcinaniu płaszczyzny przez zbiory spójne i kontinua* [*On disconnecting the plane by connected sets and continua*] (published: [11]) supervised by Mazurkiewicz. Otton's supervisor was Sierpiński (thesis published: [4]). She was young, just 27, he was much older, aged 37. Did Otton encourage her? Or was it she who encouraged him? It is commonly believed that it was Sierpiński who forced Otton to do PhD. However, I am not sure that he, since he was living in Warsaw, could do it effectively, and in my opinion it was Stanisława who had much more impact on his husband.

¹Helena Saley *neè* Skłodowska (1866-1961) was a sister of Marie Curie, she was running a private school for young Polish girls in Warsaw.

²Marian Smoluchowski (1872-1917) is known from: Einstein–Smoluchowski relation, Feynman–Smoluchowski ratchet.

Stanisława was interested in the theory of continua as her professors were. In 1913 Janiszewski proved two theorems³: *Janiszewski's First Theorem* states that if the intersection of two planar continua, neither of which disconnects the plane, is connected, then their union also does not disconnect the plane, and *Janiszewski's Second Theorem* states that the 2-dimensional sphere is a Janiszewski space⁴. In her PhD thesis Stanisława proved:

Theorem 1 (S. Nikodym 1925, [11]). *If C is a bounded continuum, S is connected, \overline{S} and C disconnect the plane, then the following conditions are equivalent*

- 1) $S \cup C$ cuts the plane between external points of $(\mathbb{R}^2 \setminus S) \cup C$,
- 2) $\overline{S} \cap C$ is disconnected.

In the last paragraph she gave a very interesting illustration to the answer of the problem: S is a sum of two connected sets, none of which disconnects plane; T is homeomorphic to S , but S disconnects the plane, whereas T does. This papers was also cited by Charatonik in the extended historical studies on the history of continuum theory⁵.

In 1926 John R. Kline (1891-1955) visited the Jagiellonian University and communicated the problem "Find a necessary and sufficient condition for proper subcontinuum C of jordanian continuum J to be a jordanian. This condition should use only the set $J \setminus C$ ". In 1926 they obtained a government found for the studies at the Sorbonne and in two years she answered Kline's problem:

Theorem 2 (S. Nikodym 1928, [15]). *A proper subcontinuum C of the jordanian continuum J is jordanian iff any point of the set $C \cap \overline{J \setminus C}$ is accessible by proper arc in C from $J \setminus C$.*

Stanisława also gave a generalization of the results of Kuratowski and Knaster on jordanian continua, giving the proposition:

Theorem 3 (S. Nikodym 1928, [13]). *If the sum and intersection of two closed sets A and B are jordanian continua, then so A and B are.*

Stanisława and Otton participated in many international congresses (IMC Bologna 1928, talks: [14], [5]). In 1929, during the Congress of Mathematicians of Slavic Countries in Warsaw, Otton Nikodym asked if a decomposition of an open disc into open arcs is possible. Stanisława in [12] positively answered the question. In 1930 the couple moved to Warsaw, where Stanisława received job at Warsaw Polytechnic as an assistant of Leja. In 1936 Leja left from Warsaw to Kraków and as a result Stanisława lost her job. Until 1939 she published 7 papers

³A strengthening of these theorems was proved in the middle of the forties by R.H. Bing *Generalisation of two theorems of Janiszewski*, Bull. Am. Math. Soc. **51**(1945), 954–960; **52** (1946), 478–480. He cited Stanisława's paper [11].

⁴A locally connected continuum X having the property that for every two of its subcontinua A and B with non-connected intersection there exist two points in X which are separated in X by the union $A \cup B$ is called *Janiszewski space*.

⁵J.J. Charatonik, *History of continuum theory*, [in:] *Handbook of the History of General Topology*, vol. 1 (eds. C.E. Aull, R. Lowen), Springer, New York – Berlin 1987.

and 3 books, he published 33 papers and 4 books ([10] was a joint work of the couple). During WWII they stayed in occupied Warsaw and lost their belongings, among them unpublished results in mathematics, in the Warsaw Uprising (August 1 – October 2, 1944). After WWII Otton was appointed to the Polytechnic in Gliwice but in 1946 the couple went for a congress on applied mathematics in Belgium and they never returned to Poland. He delivered lectures in Paris, London and Rome but finally they moved to the USA. He got a position at Kenyon College in Gambier, Ohio. After WWII they published two joint papers [7, 8]. He died in 1974 in Utica and is buried in Doylestown in Pennsylvania. More about him: [1, 3, 19, 20]. Stanisława visited Poland in 1970's and 1980's. She died⁶ in Poland in 1988.

REFERENCES

- [1] A. Derkowska, *Otton Marcin Nikodym (1889-1974)*, Wiad. Mat. **25**(1983), 75-88.
- [2] *Księga dyplomów doktorskich* [Book of the doctoral diplomas], Archive of Warsaw University, *Stanisława Nikodym* KDD/WF-89, *Otton Nikodym* KDD/WF-90.
- [3] L. Maligranda, *Otton Marcin Nikodym*, MacTutor. Available at <http://www-groups.dcs.st-and.ac.uk/history/Biographies/Nikodym.html>
- [4] O. Nikodym, *Sur une propriété de l'opération A*. Fun. Math. **7**(1925), 149-154.
- [5] O. Nikodym, *Sur le fondement des raisonnements locaux de l'analyse classique*, Atti del Congresso Inter. dei Mathem. Bologna, vol. 3, Bologna 1930, 215-222.
- [6] O. Nikodym, *Sur une généralisation des intégrales de M. J. Radon*, Fund. Math. **15**(1930), 131-179.
- [7] O.M. Nikodým, S. Nikodým, *Sur l'extension des corps algébriques abstraits par un procédé généralisé de Cantor*. Atti Accad. Naz. Lincei, VIII. Ser., Rend., Cl. Sci. Fis. Mat. Nat. **17**(1955), 334-339.
- [8] O.M. Nikodým, S. Nikodým, *Some theorems on divisibility of infinite cardinals*. Arch. Math. **8**(1957), 96-103.
- [9] *Stanisława Liliental*, Archive of Warsaw University, student's personal file no. 1583.
- [10] O. Nikodym & S. Nikodym, *Wstęp do rachunku różniczkowego*, Nasza Księgarnia, Warszawa 1936, second edition, Księgarnia W. Wilaka, Poznań 1947. 62 pp.
- [11] S. Nikodym, *Sur les coupures du plan faites par les ensembles connexes et les continus*, Fund. Math. **7**(1925), 15-23,
- [12] S. Nikodym, *Sur la décomposition du cercle ouvert en arcs simples ouverts*, Fund. Math. **15**(1930), 263-270, *Sur la décomposition du cercle ouvert en arcs simples ouverts II*, Fund. Math. **16**(1930), 7-16.
- [13] S. Nikodym, *Sur une condition nécessaire et suffisante pour qu'un sous-continu jordanien et plan soit lui-même jordanien*, Fund. Math. **12**(1928), 160-187.
- [14] S. Nikodym, *Sur une propriété topologique du plan euclidien*, Atti del Congresso Inter. dei Mathem. Bologna, vol. 2, Bologna 1930, 229-2-35.
- [15] S. Nikodym, *Sur quelques propriétés des ensembles partout localement connexes*, Fund. Math. **12**(1928), 240-243.
- [16] S. Nikodymowa, *Matematyka*. [in:] *Materjały do bibliografji piśmiennictwa kobiet polskich (do roku 1929): nauki matematyczno-przyrodnicze i nauki stosowane*, M. Loriowa (ed.), Oddział Lwowski Polskiego Stowarzyszenia Kobiet z Wyższym Wykształceniem, Drukarnia Polska, Lwów 1934.
- [17] S. Nikodym, *Une propriété topologique de la surface partout localement homeomorphe au plan Euclidien*, Mathematica, Cluj **9**(1935), 103-109.

⁶Szymański [20] claimed that it was before Easter (April 3-4, 1988) but I was not able to confirm this information.

- [18] S. Nikodym, *Wzory i krótkie repetytorium matematyki*, Księgarnia W. Wilka, Poznań 1948. 65 pp.
- [19] W. Piotrowski, *Jeszcze w sprawie biografii Ottona i Stanisławy Nikodymów*, *Wiad. Mat.* **50**(2014), 69-74.
- [20] W. Szymański, *Who was Otto Nikodym?*, *Math. Intell.* **12**(1990), no. 2, 27–31.
- [21] B.E. Wódz, *Sandomierskie w szkicach malarskich Stanisławy Nikodymowej z Lilientalów*, *Zeszyty Sandomierskie* **20**(2014), 38, 32–36.

A History of Configurations: Tracing the work of three women

SIMA FAGHIHI

A *configuration* is a finite set of points and lines (or planes) that have a homogeneous incidence structure in projective geometry. The formal study of configurations was initiated by Theodor Reye in 1876, in the second edition of his book *Geometrie der Lage*. In his book Reye also introduced the notation n_k for a planar configuration of n points and lines, k of which are incident. Soon afterward various geometric configurations in the plane or space were investigated by S. Kantor, Martinetti, Reye, Schönflies, Segre, Veronese, Steinitz and others.

Some specific configurations had been discovered well before Reye presented his definition. For instance, the Möbius configuration for two mutually inscribed and circumscribed tetrahedra in space has the symbol 8_4 , or the Hesse configuration for the nine inflection points of a cubic curve lying on twelve lines in the complex projective plane has the symbol $(9_4, 12_3)$. Two classical examples in the plane are: 1) the Pascal configuration (9_3) , and 2) the Desargues configuration (10_3) .

Some investigations of configurations were undertaken by women, three of whom will be considered here.

Christine Ladd-Franklin (1847–1930) was the first woman in the United States to complete the work for her doctorate, but she was not allowed to receive the degree. However, in 1926 Johns Hopkins University officially awarded her a Ph.D. 44 years afterward. She was a leader for women’s education and a notable figure in the early women’s movement.

In 1879 Ladd-Franklin published an article on “The Pascal Hexagram” when she was studying at Johns Hopkins for her doctorate. By Pascal’s theorem, six arbitrary points on a conic section lead to three additional points that lie on a Pascal line. All the points and lines of this figure form the Pascal configuration. In the nineteenth century, several additional lines and points were associated with the Pascal hexagram by Kirkman, Steiner, Cayley, Plücker and Salmon. In her article, Christine Ladd-Franklin proposed a new notation that showed how these various lines and points connected with the Pascal hexagram were interrelated.

Hazel E. Schoonmaker (Wilson) (1888-1988) was a student of Virgil Snyder at Cornell University and received her Ph.D. in 1927 with geometry as her major field. She taught in fourteen distinct universities, colleges and high schools until her retirement in 1964; three of these colleges specialized in training women. Among the four articles which she published, the article from 1931, coauthored with H. C. Shaub, was entitled “The Hessian Configuration and its relation to the group

of order 216.” This analyzes the inflection point configuration of cubic curves by means of the Hessian group, the collineations in the complex plane that leave the configuration invariant.

Sister Mary Petronia Van Straten (1914-1987) was raised in a large Catholic family of eight children. Among the six girls in the family, five became school sisters of Notre Dame in Wisconsin.

Van Straten entered Notre Dame University and wrote her doctoral thesis on the “Menger graph,” which was a graph associated with a given configuration. This construction was proposed by Karl Menger and first studied in 1949 in Van Straten’s doctoral thesis entitled “The topology of the configuration of Desargues and Pappus.”

Van Straten taught in Wisconsin schools and Mount Mary College for 46 years until her death. After her death, Mount Mary College issued an award in her memory for excellence in teaching mathematics and physics.

REFERENCES

- [1] H. S. M. Coxeter, *Self-dual configurations and regular graphs*, Bull. Amer. Soc. **56** (1950), 413–455.
- [2] H. S. M. Coxeter, *Configurations and maps*, Reports of a Mathematical Colloquium **2** vol. 8 (1948), 18–38.
- [3] J. Green; J. LaDuke, *Pioneering Women in American Mathematics: The Pre-1940 PhD’s*, (History of Mathematics 34). American Mathematical Society/London Mathematical Society (2009).
- [4] D. Hilbert & S. Cohn-Vossen, *Anschauliche Geometrie*, (History of Mathematics 34) Springer.
- [5] C. Ladd-Franklin, *The Pascal Hexagram*, American Journal of Mathematics **2** (1879), 1–12.
- [6] K. H. Parshall & D. E. Rowe, *The Emergence of the American Mathematical Research Community 1876–1900: J.J. Sylvester, Felix Klein, and E. H. Moore*, (History of Mathematics 8). American Mathematical Society/London Mathematical Society (1994).
- [7] M. W. Rossiter, *Women Scientists in America Struggles and Strategies to 1940*, The Johns Hopkins University Press/Baltimore and London (1982).
- [8] H. C. Schaub; H. E. Schoonmaker, *The Hessian configuration and its relation to the group of order 216*, Am. Math. Mon. **38** (1931) 388–393.
- [9] E. Stenitz, *Konfigurationen der projektiven Geometrie*, Encyklopaedie der mathematischen Wissenschaften mit Einschluss ihrer Anwendungen **3** (Geometrie), Part IIIAB5a, (1910), 481–516.

Internationality: Women in Felix Klein’s Courses at the University of Göttingen (1893–1920)

RENATE TOBIES

Renowned for his achievements in mathematics and its applications, Felix Klein (1849–1925) was also instrumental in spearheading the reform of mathematical education. From the early stages of his career, he was internationally oriented and supported mathematically gifted students regardless of their sex, religion, and nationality. The focus of this paper is Klein’s role as one of the foremost promoters of women studying mathematics. In these efforts, of course, he was

not alone. Klein cooperated with a number of international colleagues who likewise supported women mathematicians, including Gaston Darboux (1842–1917) in France, Luigi Cremona (1830–1903) in Italy, Arthur Cayley (1821–1895) in the United Kingdom, Hieronymus G. Zeuthen (1839–1920) in Denmark, and James Joseph Sylvester (1814–1897). Since the 1890s, when he founded the acclaimed international center of mathematics at the University of Göttingen, Klein admitted not only male mathematicians from abroad into his courses but non-German women as well. The goal of this contribution is to evaluate previous scholarship on the beginning of women's study of mathematics at German universities and to analyze the special efforts of Felix Klein to advance this cause. It will also be shown when the first female mathematicians joined the German Mathematical Society, which was founded in 1890, and when female authors first published in the journal *Mathematische Annalen*, the chief editor of which was Felix Klein. My study is based on materials from Klein's archive in Göttingen, especially on the lists of students enrolled in his courses and on the protocols from his mathematics seminars.

The University of Würzburg as a Case Study for University Education of Women in Mathematics in Germany in the First Half of the 20th Century

KATHARINA SPIESS

At the turn of the century, women were allowed to enroll at universities in many European countries, with France and Switzerland taking the lead. In 1900, Baden became the first state in the German Empire to open its doors for women. Three years later, Bavaria followed suit, with three universities at that time: Munich, Erlangen and Würzburg.

An association by the name of *Frauenheil* had been formed in Würzburg in 1898 by women from the wealthier part of society. The aim of this association was to help women get a better education. One of the members of the *Frauenheil* association was Amalie Lehmann, whose husband, Karl Bernhard Lehmann, was a renowned professor of medicine in Würzburg. He was the first to give special extramural courses for this association and he also strongly supported the idea of giving women the opportunity to study at universities. Like many men who supported women's education, he was motivated by his wife and daughters who were willing to study.

In 1899, there was an important precedent in Bavaria when the professors of medicine in Würzburg accepted a young woman by the name of Jenny Danziger as an auditor in their lectures; she was from Bavaria, had already taken her A-levels and wanted to study medicine. Before her acceptance in Würzburg, Danziger's application to study at the university had been rejected by Munich and Erlangen. After this event, many women from the *Frauenheil* association followed suit and applied as auditors at the university as they now saw an opportunity there. It is interesting to note that in the early years of the 20th century, there were far

more female auditors at the University of Würzburg than there were in Munich. However, all these women were merely accepted as auditors, and not as enrolled students. Finally, in September, 1903, the prince regent of Bavaria, Luitpold, allowed women to enroll at the Bavarian universities, as long as they had their A-levels. This was probably influenced by the overall positive opinion which the members of the University of Würzburg had conveyed to the minister of cultural affairs of Bavaria, while the other two Bavarian universities were a bit more divided.

The first woman who was definitely enrolled in mathematics at Würzburg was Olga Sauer from Lauf, who enrolled in Würzburg for the winter semester of 1912-13. Unfortunately, no information about her life could as yet be found. One possibility is that she married and changed her last name, which makes it hard to trace her. What is definitely known is the fact that she was enrolled at the mathematical faculty of the university. Most likely, she studied to become a teacher and finished with the state examination as this was the common academic degree in mathematics at that time, even among the male students. Graduating with a doctorate in mathematics and then pursuing an academic career was not typical.

A closer look at the situation in Würzburg shows the reason why there were very few enrolled female students as compared to Munich. The school situation was way better in Munich, so more females had the chance to take their A-levels and were able to study. In Würzburg, there were only very few schools for girls. As there were so few women who met the requirements for enrollment, female students were still lone fighters there. Furthermore, - even though the attitude towards women at the universities of most of the professors in Würzburg was very positive - there were a lot of male students who were hostile to women.

Regarding the situation in mathematics in Würzburg, there were two tenured professors, Georg Rost and Eduard von Weber and one non-tenured professor, Emil Hilb, in the time period from 1910 to 1929. There is no known statement in relation to women's education from these professors, which is one possible reason why not that many women studied mathematics there. In addition to this, Würzburg was not as prestigious in mathematics as Göttingen or Berlin. There were even very few male students who graduated with a doctorate in Würzburg as most of the mathematics students became teachers. This is another reason why there were no women obtaining PhDs in mathematics prior to 1938.

The aftermath of World War I led to difficult situations at German universities: When the male students, who had fought in the war, returned home, an enormous battle over university places started. The female students became scapegoats, and even though it was not that bad in Würzburg, there were still some denunciations of women. The mathematics student Alma Wolffhardt stood up against those accusations and even founded an organisation for female students in Würzburg in order to give women a better voice on the academic level. Wolffhardt had studied to become a teacher in mathematics but gave up her career after getting married. In 1930, the mathematician Otto Volk (who seemed rather liberal in his attitude

towards female students) came to the Würzburg University as a non-tenured professor and in 1935 gained a tenured professorship. One year later, he became the supervisor of the first woman ever to graduate in mathematics with a PhD in Würzburg, Maria Knoll. Knoll, born in Nuremberg-Eibach in 1912, had originally finished her studies with the state examination in mathematics to become a teacher; she started writing her doctoral thesis shortly after that and submitted it in 1936 in order to obtain her doctorate two years later. Her motivation for this is unknown, and after graduating, she did not pursue an academic career as far as we know.

REFERENCES

- [1] G. Kaiser, *Spurensuche. Studentinnen und Wissenschaftlerinnen an der Julius-Maximilians-Universität Würzburg von den Anfängen bis Heute*, Max-Schimmel-Verlag, Würzburg, 1995.
- [2] H. Hessenauer, *Etappen des Frauenstudiums an der Universität Würzburg.*, Degener, Neustadt/Aisch, 1998.
- [3] R. Tobies, *“Aller Männerkultur zum Trotz”: Frauen in Mathematik und Naturwissenschaften*, Campus-Verlag, Frankfurt/Main, 1997.
- [4] R. Tobies, *Biographisches Lexikon in Mathematik promovierter Personen WS 1907/08 bis WS 1944/45*, Rauner Verlag, Augsburg, 2006.
- [5] A. Abele, H. Neunzert, R. Tobies, J. Krüsken *Frauen und Männer in der Mathematik - früher und heute*, Mitteilungen der Deutschen Mathematiker-Vereinigung, Vol. 9(2), 2001.
- [6] H.-J. Vollrath, *Würzburger Mathematiker, Aus der Geschichte der Julius-Maximilians-Universität*, Verlag Königshausen & Neumann GmbH, Würzburg, 2010.
- [7] Gleichstellungsstelle für Frauen der Stadt Würzburg (Hrsg.), *Frauen in Würzburg: Stadtführer und Lesebuch*, Echter Verlag, Würzburg, 1996.
- [8] H. Häntzschel, H. Bußmann, *Bedrohlich gescheit. Ein Jahrhundert Frauen und Wissenschaft in Bayern*, C. H. Beck Verlag, Nördlingen, 1997.
- [9] M. Knoll, Flächen mit einer Schar geodätischer Krümmungslinien und Flächen mit einer Schar kongruenter Krümmungslinien, Dissertation, Universität Würzburg, submitted on 8. May 1936.

Women and mathematics at the universities in Prague (from 1900 until 1945)

MARTINA BEČVÁŘOVÁ

It seemed that there was no obstacle for women to study at a university because in 1878, the Ministry of Education and Enlightenment of Austro-Hungarian monarchy issued a decree which allowed women to attend all “university lectures suitable for women”. The reality was however quite different. The first five graduates of *Minerva* (the first secondary school for girls in Prague) who applied for admittance to the Faculty of Medicine in Prague were refused by the professors. In 1895, the Faculty of Philosophy of the Czech University in Prague admitted six *Minerva* graduates as the so-called visiting students, which means on probation. In the same year, the Faculty of Medicine of the German University in Prague allowed studies of the first three *Minerva* graduates. In 1896, also the Faculty of Medicine of the Czech University in Prague allowed that women could be admitted to study

as visiting students. From 1897, all the faculties of philosophy of the monarchy admitted women to regular studies without obstructions and under the same conditions as men. Three years later, women had the right to study at all faculties of medicine in the whole monarchy. In 1900, eight women completed their studies at the Faculty of Philosophy of the Czech University in Prague, where they prepared for the profession of secondary-school teachers. In 1901, the first two female doctors graduated at the Faculty of Philosophy of the Czech University in Prague and one year later, first female doctor graduated at the Faculty of Medicine of the Czech University in Prague. The German University in Prague was more open with regard to women studies, but more conservative with regard to female doctorates; the first women were awarded doctorate at the Faculty of Philosophy of the German University in Prague as late as 1908. At the time of the World War First, the number of studying women increased. Women filled up openings left by men-soldiers. In 1918, *Washington Declaration* adopted a principle that women are equal to men with regard to politics, social and cultural matters. In 1918, independent Czechoslovak Republic was formed, which, among others, gave women suffrage and the right to study also at faculties of law. The Section 106 of the new *Czechoslovak constitution of 1920* declared that no sex is privileged. Since 1920s, women could study all university subjects (except for theology).

From the year 1882 until the year 1945 at the *German University in Prague* (GU), there were 43 doctorate degrees awarded in mathematics (including those by three females, resp. ten foreigners). All theses were written in the German language. From 1882 to 1939, the doctoral candidates at the *Czech Charles-Ferdinand University* (CU), resp. *Charles University* (CHU), submitted 159 doctorate theses in mathematics (including twelve females, resp. eight foreigners), 150 doctorates were awarded. All the theses, except for two, were written in the Czech language. We give a brief summary of doctoral procedures in mathematics, undergone in the years 1900 till 1945 (resp. 1952) by twelve successful women.

Saly Ruth Ramler (1894–1993) defended her PhD thesis in 1919 at the GU under the guidance of Georg Alexander Pick (1859–1942). In 1923, she married the famous Dutch-American mathematician Dirk Jan Struik (1894–2000) and immigrated to the USA. Most of her active time, she took care for her family (three daughters Ruth Rebekka (born 1928), Anne (born ?), Gwendolyn (born 1932)). She was interested in the history of mathematics, she wrote three mathematical articles.

Hilda Falk (1897–1942) defended her PhD thesis in 1921 at the GU under the guidance of G.A. Pick. She never married and became a professor of mathematics and physics, resp. a director of the famous girl secondary school in Prague. In 1942, she was murdered by fascists in the Jewish ghetto in Riga.

Josefine Mayer born Keller (1904–?) defended her PhD thesis in 1934 at the GU under the guidance of Arthur Winternitz (1893–1961). She made his PhD thesis as a mother of two small children. Firstly, she married Jan Jindřich Frankl (1900–?), secondly Ernst John and thirdly Alfred Maria Mayer (1899–?), a famous Prague newspaper owner and publisher. During the World War Second, they had

to emigrate from Czechoslovakia to save their lives. She never had to work because she came from very rich Prague family. She had two children (Sofie (born 1925) and Petr (1930–1938)). We have no information about her fate in the USA.

Marie Fabiánová (1872–1943) defended her PhD thesis in 1901 at the CU under the guidance of František Josef Studnička (1836–1903). She was the second woman which obtained her PhD degree at the Faculty of Philosophy of the Czech University in Prague. She never married and became a professor of mathematics, physics, geometry and German language, resp. a director of famous girl secondary school in Prague. She wrote one short non-mathematical article.

Miluše Jašková (1905–1975) defended her PhD thesis in 1928 at the CHU under the guidance of Karel Petr (1868–1950). Later, she married Russian engineer Vsevolod Grečenko (1898–1948). She never worked regularly and took care of her only son Alexander (born 1930) who became a professor of machine engineering.

Helena Navrátilová (1907–?) defended her PhD finished 1932 at the CHU under the guidance of Emil Schoenbaum (1882–1967). Maybe, she became a professor of mathematics and gymnastics at the secondary school. We have no information about her personal fate.

Jarmila Šimerková (1910–1975) defended her PhD thesis in 1933 at the CHU under the guidance of Miloš Kössler (1884–1961). In 1931, as a student, she married Bořivoj Iglauer (1901–?), a clerk at an insurance company in Prague. She only took care of her family, her daughters Pavla (born 1932) and Jana (born 1936).

Věra Čechová (1910–1990) defended her PhD thesis in 1933 at the CHU under the guidance of E. Schoenbaum. Later, she worked as a specialist in the insurance company in Prague. In 1946, she married her schoolmate Dr. Otta Fischer (1909–1975), a Czechoslovak mathematician – specialist in statistics. She worked all her life as an insurance specialist and took care of her family. Her son Jan (born 1951) became a specialist in statistics, an economist and important Czech politician.

Ludmila Illingerová (1908–1974) defended her PhD thesis in 1934 at the CHU under the guidance of Václav Hlavatý (1894–1969). She became a professor of mathematics, drawing and descriptive geometry at the secondary school. She taught in many places of the Czech lands as well as in Slovakia. In 1935, she married Alois Městka (1904–?, a teacher at the industrial schools in many places of the Czech lands). During the war period, they separated. Ludmila Illingerová-Městková worked as a director of a secondary school in Prague and took care of her son Ivo (1936–1972). She published five short mathematical articles.

Jiřina Frantíková (1914–2000) defended her PhD thesis in 1937 at the CHU under the guidance of E. Schoenbaum. She had the special graduation ceremony attended by the President of the Czechoslovak Republic. She worked as financial specialist in the Ministry of Finance (on the issue of formation of the state budget, pensions and insurance) and collaborated with E. Schoenbaum as the scientific secretary of the journal *Aktuárské vědy. Pojistná matematika. Matematická statistika*. In 1948, she married František Chytil (1908–1987), a doctor of laws. She

worked all her active life at the ministry and she also took care of her only son Ivo. She published two short mathematical articles.

Libuše Kučerová (1902–1987) started her PhD procedure in 1937 at the CHU under the guidance of V. Hlavatý. Thanks many problems during the WWII and post-war changes in Czechoslovak society, she successfully finished her procedure in 1952. She was a teacher at secondary schools. She taught mathematics, drawing and descriptive geometry in many places of the Czech lands. In 1943, she married an engineer Josef Tuháček (1903–?), her schoolmate from the Czech Technical University in Prague, who became an officer of the Czechoslovak army. They had no children. Libuše Kučerová wrote three mathematical articles.

Only one female doctor candidate in mathematics was unsuccessful. Her name is **Věra Kofránková** (1909–1996) finished her PhD thesis in 1937 under the guidance of V. Hlavatý but she never passed her major examination in mathematics. She married Czech mathematician Zdeněk Pírko (1909–1983), her schoolmate. Later they divorced. Kofránková worked as a professor at the secondary schools in Prague. She taught mathematics, drawing and descriptive geometry. During all her life she took care for her only daughter Ivana (born 1945) who became a gynecologist. Věra Kofránková wrote one short mathematical article.

REFERENCES

- [1] M. Bečvářová, *Women and mathematics at the universities in Prague in the first half of the 20th century*, *Antiquitates Mathematicae* **10** (2016), 133–167.
- [2] M. Bečvářová, *Matematika na Německé univerzitě v Praze v letech 1882 až 1945* [Mathematics at the German University in Prague from 1882 until 1945], Karolinum, Praha, 2016 (Czech with extended English summary).
- [3] M. Bečvářová, *Česká matematická komunita v letech 1848–1918* [Czech mathematical community from 1848 until 1918], Edition *Dějiny matematiky*, volume 34, Matfyzpress, Praha, 2008 (Czech).

Hilda Geiringer (1893-1973) – the overall successful development of a female mathematician under male dominance and in spite of conditions adverse to women’s emancipation

REINHARD SIEGMUND-SCHULTZE

Hilda Geiringer came from a German-Jewish family in Vienna and showed early signs of independence. Her brother Karl, the musicologist, wrote in his memoirs of 1993:

“My sister, Hilda, was probably the most strong-minded of the four of us. She frequently had more-or-less serious arguments with my parents, and usually in the end she did things her own way.”
[1, p. 25]

Geiringer studied at the University of Vienna and took a doctorate with W. Wirtinger in 1918 with a paper on trigonometric series in several variables, which was published in the *Monatshefte für Mathematik und Physik*. She then went to Berlin and became assistant to Leon Lichtenstein at the editorial office of the

“Jahrbuch über die Fortschritte der Mathematik.” Since the last years of the war she had been politically active for women’s questions and for adult education. In 1922 she wrote a book entitled “Die Gedankenwelt der Mathematik (The mathematical world of thoughts)”, where she supported various leftist and reformist educational positions drawing on Marxist, Machian and Freudian ideas. One year before Geiringer had become assistant to Richard von Mises (1883-1953) at the new Institute for Applied Mathematics at the University of Berlin. In his institute, von Mises had to be wary about the recognition of his area among the “pure” mathematicians. In 1926/27, the habilitation procedure for his assistant Hilda Geiringer was disputed by his colleagues and the permit to teach restricted to expressly “applied mathematics” while the “pure mathematicians” reserved themselves the right to teach about everything. There were antifeminist, anti-Semitic and other political motives involved. (For details see [2]). Nevertheless, Geiringer gradually became an internationally recognized specialist in statistics and plasticity. However, in 1933 she and von Mises had to leave Berlin due to their Jewish origin. Both went to Istanbul, where a reform of the university was under way due to the influence of Atatürk. However Geiringer received only a subordinate position which was cause to much frustration on her part and even conflict with von Mises. After Atatürk’s death in 1938 and in view of the imminent war von Mises and Geiringer felt unsafe in Turkey and fled to the United States in 1939. While von Mises first had to accept an unpaid position at Harvard, it was only due to frantic efforts on the part of von Mises that Geiringer got a visa to the U.S. and a temporary position at the women’s college Bryn Mawr in Pennsylvania (For details [3]). After Geiringer and von Mises married in 1943 she moved to a position at the women’s undergraduate college Wheaton about 60 miles from Harvard. She taught there until von Mises died in 1953. Geiringer then retired from Wheaton and moved to Cambridge, Mass. There she took care of von Mises’ Nachlass. She was the guiding spirit in the publication in 1963/64 of two volumes of “Selected Papers” by von Mises and several books from his Nachlass.

Summed up:

Geiringer’s close and in some respect one-sided human relationship with the pioneer of modern applied mathematics, Richard von Mises, was beneficial to her development as a mathematician and as a teacher. In both respects Geiringer was near to topics pursued and taught by von Mises (statistics and theory of plasticity), and she supported his career substantially; her research found recognition in the international community of mathematicians as well. Geiringer’s emotional and idolizing relationship with one Mises let her forget about or at least let her tolerate the specific conditions adverse to women’s emancipation. The latter included some traditional male-chauvinist positions and prejudices on the part of von Mises, but also the conditions of emigration (Turkey, U.S.) which were particularly disadvantageous for female scientists. In spite of some subliminal but outwardly covered conflicts between the two, the overall outcome of the collaboration of the mathematicians’ couple was positive, both on the individual, subjective side and with respect to the development of applied mathematics as a whole.

REFERENCES

- [1] K. Geiringer, *This is I remember*, Santa Barbara (1993).
- [2] R. Siegmund-Schultze, *Hilda Geiringer-von Mises, Charlier Series, Ideology, and the Human Side of the Emancipation of Applied Mathematics at the University of Berlin during the 1920s*, *Historia Mathematica* **20** (1993), 364–381.
- [3] R. Siegmund-Schultze, *Mathematicians fleeing from Nazi Germany: Individual Fates and Global Impact*, Princeton and Oxford: Princeton University Press (2009).

**Rózsa Péter – a mathematician between research, teacher training
and popularization of mathematics**

KATALIN GOSZTONYI

Rózsa Péter (1905–1977) ¹ is a Hungarian mathematician internationally recognized for her research on recursive functions. But for the non-specialists, she may be known even more for *Playing with infinity*, her book popularizing mathematics written in 1943, still regularly published and translated in at least 12 languages. In my presentation, I tempted to present interferences between the political context, her personal and professional relationships and her multiple interests for research, teaching and popularizing mathematics. Born in a Jewish family and graduated at the University of Sciences of Budapest in 1927, she didn't obtain any permanent position between the two world wars. She worked as teacher in different middle- and high-schools while she maintained also a research activity. It was her classmate and friend, László Kalmár who drew her attention to recursive functions which become her main research topic. She gave several talks about this subject at international conferences in the 1930s: in 1932 in Zürich and in 1936 in Oslo. She survived the last years of the Second World War first in the ghetto, then in hiding with false papers in Budapest. Her book popularizing mathematics, *Playing with infinity*, written during the war, was printed out in 1943 but could not be diffused before the end of the war. This book is clearly alimented by her mathematical culture and her scientific researches, but also by her teaching experience and her interest for the arts, especially for literature: this richness of sources and motivations certainly contributed to the long-lasting success of this book, as well as to the fact that it is used until today not only as a book for popularisation but also as a resource for teaching ². Péter's personal and professional situation took an important turn after the war. She obtained her first regular position at the Budapest Teacher Training College, later integrated into the Eötvös Loránd University. She published her monograph on Recursive Functions in 1951. She became full professor at the Eötvös Loránd University in 1955 and corresponding member of the Hungarian Academy of Sciences in 1973, as the first female member of the Academy. While she was well recognised in scientific life, she always kept

¹I am grateful to Béla Andrásfai who gave me access to the unpublished personal documents of Rózsa Péter.

²I heard not only from Hungarian but also from French teachers that they found inspiration in this book to plan their teaching.

interest in mathematics education: she gave lectures in teacher training, published a textbook-series with colleagues for high-schools [2], and actively supported the reform movement of mathematics education led by Tamás Varga during the 1960s and 1970s. In addition, she was engaged to reinforce links between the “two cultures”, mathematics and arts: she discussed this subject in numerous lectures and publications (e. g. [8]). She died in 1977, only some months after the death of her life-long colleague and friend, László Kalmár. The interpretation of her life and career raises several questions. Why she didn't obtain an academic position before the war? What could be the role of her Jewish origin and of the fact that she was a woman? How the communist turn influenced her career? What was the role of Kalmár in her career and who else exerted important influence on her? Her engagement for teaching and her popularizing activity is simply a result of her multiple interest, or a logical continuation of her activities between the two world wars? Rózsa Péter's life is an interesting example not only of a female career in 20th century's Hungarian scientific life, but also of a scientific career during the multiple turns of 20th century's Hungarian (and more generally Eastern-European) history.

REFERENCES

- [1] Á. Császár, *Péter Rózsa*, *Matematikai Lapok* **25**(3–4) (1977), 257–258.
- [2] T. Gallai & R. Péter, *Matematika a középiskolák I. osztálya számára*, Tankönyvkiadó, Budapest (1949).
- [3] K. Gosztonyi, *Mathematical Culture and Mathematics Education in Hungary in the XXst century*, in B. Larvor (Ed.), *Mathematical Cultures*, Springer Birkhäuser, Basel (2016), 71–89.
- [4] K. Gosztonyi, *Playing with infinity of Rózsa Péter. Problem series in a Hungarian tradition of mathematics education*, in L. Radford, F. Furinghetti & T. Hausberger (Eds.), *International Study Group on the Relations between the History and Pedagogy of Mathematics. Proceedings of the 2016 ICME Satellite Meeting, Montpellier, France, 18-22 July 2016* (2016), 687–693.
- [5] M. Halmos & T. Varga, *Change in mathematics education since the late 1950's – ideas and realisation, Hungary*, *Educational Studies in Mathematics* **9**(2) (1978), 225–244.
- [6] A. Máté, *Kalmár László és Péter Rózsa – matematikusok a filozófiáról*, in P. G. Szabó (Ed.), *Kalmárium II*, Polygon, Szeged (2008), 56–71.
- [7] R. Péter, *Playing with Infinity*, (trad. by Z. P. Dienes), Dover Publications, New York, (1961). (Originally published in 1944 as *Játék a végtelennel*, Dante Könyvkiadó, Budapest.)
- [8] R. Péter, *Matematika és művészet - nem két ellentétes pólus*, in S. Róka & D. Valcsicsák (Eds.), *A jövő a számtantudósoké. Magyar szerzők írásai a matematikáról*, Noran, Budapest (2004), 195–213.

The image of mathematics – cultural differences?

ANDREA BLUNCK

This presentation was intended to start a discussion on the image of mathematics in different cultures and how it is connected to the gendering of mathematics and the fact that in many parts of the world mathematics still is a male domain.

First, I showed some “pictures of mathematics”, taken from a seminar for prospective mathematics teachers which was created in a research project conducted together with Anina Mischau (Berlin), Sabine Mehlmann (Osnabrück) and Bettina Langfeldt (Hamburg) ([4], see also [1]).

These pictures taken as a starting point, the participants discussed their own views of mathematics.

Then I reported on some results about mathematical beliefs obtained by researchers from mathematics education. Moreover, I made some remarks on the gendered image of mathematics, its historical roots, and today’s schoolchildrens way to “draw a mathematician” (i.e., mostly white middle-aged men with bald head or messed-up hair). See, e.g., [2], [3], [5] (for more references, cf. [4]).

Among other things, we discussed how mathematicians (male or female) are presented in schoolbooks and how they should be presented.

REFERENCES

- [1] A. Blunck, A. Mischau, S. Mehlmann, *Gender Competence in Mathematics Teacher Education*, in: W. Ernst, I. Horwath (eds.), *Gender in Science and Technology. Interdisciplinary Approaches*, transcript Verlag, Bielefeld (2014), 235-257.
- [2] P. Ernest, *Values, Gender, and Images of Mathematics: A Philosophical Perspective*, *International Journal of Mathematical Education in Science and Technology* **26 (3)** (1995), 449-462.
- [3] A. Felbrich, C. Schmotz, G. Kaiser, *Überzeugungen angehender Primarstufenlehrkräfte im internationalen Vergleich*, in: S. Blömeke, G. Kaiser, R. Lehmann (eds.), *Professionelle Kompetenz und Lerngelegenheiten angehender Primarstufenlehrkräfte im internationalen Vergleich*, Waxmann, Münster (2010), 297-326.
- [4] A. Mischau, S. Mehlmann, A. Blunck, B. Langfeldt, *Mathematik, Schule und Geschlecht: Konzeption einer Lehrveranstaltung zur Vermittlung von Genderkompetenz in der ersten Phase der Lehramtsausbildung für das Unterrichtsfach Mathematik*, IFF-Forschungsreihe, Bielefeld (to appear).
- [5] S. Picker, J. Berry, *Investigating Pupils’ Images of Mathematicians*, *Educational Studies in Mathematics* **43** (2000), 65-94.

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