

Emmy Noether's Habilitation

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1 Introduction

The following is mostly based on texts by [Cordula Tollmien](#). I thank [John Bamberg](#) for his assistance, and Cordula Tollmien and [Cheryl Praeger](#) for their helpful comments on earlier drafts of this text.

[Emmy Noether](#) is one of the most influential mathematicians of all time and one of the shining examples of the mathematics department at the [Universität Göttingen](#) during its glory days in the first third of the 20th century. Her most important contributions are in invariant theory with the celebrated [Noether's theorem](#) in her habilitation and the invention of [modern algebra](#) in a series of publications in the early 1920s. This text focusses on the context of her [habilitation](#).

One hundred years ago, on the 4th of June 1919, Emmy Noether's habilitation was accepted. A habilitation is a German academic degree after a PhD. At the same time, a habilitation meant the acceptance into the faculty. Until 2002, only with a habilitation were you allowed to teach students, supervise PhD theses, and give classes at German universities. In particular, a habilitation was also the entrance into the exclusive circle of university teachers. This double function of the habilitation is crucial for the strong resistance against Noether's habilitation. Originally, I intended a shorter post for this event, but then I realised that Cordula Tollmien, a German historian, worked extensively throughout her life on the history of Emmy Noether's habilitation. She provides a CV of Emmy Noether on her [homepage](#) and wrote an [extensive article on Noether's habilitation](#) in 1990. In the near future, Tollmien plans to publish an extended version of her article on [www.emmy-noether.net](#), a homepage dedicated to Emmy Noether which is currently under construction (in German). These are the most detailed

descriptions of Noether's PhD that I am aware of, but they are all written in German, so with Cordula Tollmien's permission the following translates parts of the [online CV](#) and Tollmien's first article on Noether's habilitation into English.

The sources for the original text can be found in "Sind wir doch der Meinung, daß ein weiblicher Kopf nur ganz ausnahmsweise in der Mathematik schöpferisch tätig sein kann..." – eine Biographie der Mathematikerin Emmy Noether (1882–1935) und zugleich ein Beitrag zur Geschichte der Habilitation von Frauen an der Universität Göttingen. In: Göttinger Jahrbuch. Band 38, 1990, ISSN 0072-4882, S. 153–219.

We also give a short summary of a typical career in mathematics in the first half of the 20th century. This is not covered by Tollmien's texts.

Quotes are translated as literally as possible. Names of institutions are given in German if sufficiently short and translated with the original German name in parentheses if longer. We provide links to the German original on [Tollmien's homepage](#).

There are several good English references for Noether's life in general. Here we will limit ourselves to a very short summary of her life up to her first habilitation attempt. Emmy Noether, was born on 23 March 1882 in Erlangen, a city in the German state of Bavaria, into a Jewish family as the daughter of the mathematician [Max Noether](#) and his wife Ida Noether (nee Kaufmann). She had three brothers, Alfred (28/3/1883 – 13/12/1918), [Fritz](#) (7/10/1884 – 10/9/1941) and Robert (15/11/1889 – 4/6/1928). As it was common for Jewish families in Germany at the time, her parents invested into an excellent education for Emmy Noether. Just like her brother Fritz, she studied mathematics in Göttingen and Erlangen. In 1907 she obtained her PhD under [Paul Gordan](#) in Erlangen on invariant theory ([Über die Bildung des Formensystems der ternären biquadratischen Form](#), Journal für die reine



Figure 1: Emmy Noether, probably around 1900 at the beginning of her studies. Occasionally dated to the time after her PhD (1907), see the [discussion on Tollmien's homepage](#) (in German).

und angewandte Mathematik, 134, 23–90). From 1907 till 1915 she worked primarily with [Ernst Fischer](#), who introduced her to abstract algebra, at the mathematical institute in Erlangen (Mathematisches Institut der Universität Erlangen). In April 1915, she moved to Göttingen.

2 The Academic Career at the Ordinarienuniversität

Up until the mid 20th century, German universities were organised as Ordinarienuniversität. In essence, they consisted mostly of professor positions (Ordinarien). Professors had very large degrees of autonomy and could decide the fate of the university on their own. This is in contrast to the modern German university, which also involves scientific staff, non-scientific staff, and students in the decision making process. It is also in contrast to the influence of the management of many modern universities world-wide.

We will give [Hermann Weyl](#), three years younger than Emmy Noether, as an example for a typical career in German academia in the relevant time period:

- Born in 1885.
- 1904: Finished school with *Abitur*. Abitur is a special degree required to go to university. Even nowadays, only vaguely half of all German school students obtain Abitur.
- Studied in Göttingen and, for one year, in Munich.
- 1908: Obtained his PhD in Göttingen. This was the first degree in mathematics at the time.
- 1910: Obtained his habilitation in Göttingen. This was required to teach at German universities. This was also called *venia legendi* (permission to teach, lit. permission to read).
- Worked as a [Privatdozent](#) in Göttingen (private lecturer, adjunct professor). Each semester, he was paid for teaching specific classes. There is also the title of außerplanmäßiger Professor (exceptional professor). This is essentially the same, but back in the day, far more prestigious.

Both titles were only honorific and did not imply any income on their own.

- 1913: Was appointed professor in Zürich. There is no differentiation between different levels of a professor. In the modern US system, one might say full professor.
- 1913–1930: Professor in Zürich.
- 1930–1933: Professor in Göttingen. Successor of Hilbert. Resigned in 1933.
- 1935–1951: Professor in Princeton at the Institute for Advanced Study.

One title, which Weyl never had, was that of an honorary professor (Ehrenprofessor). An honorary professor was, as the name says, just an honorary title without any financial implications.

3 Women at the Universität Göttingen

Noether tried three times to obtain her habilitation. Each time at the mathematics department of the Universität Göttingen. Education is till today the responsibility of the individual German member states. As Göttingen was part of the German state of [Prussia](#), let us start with some context on women in Prussian academia. Prussian universities were, at least by modern standards, very centralised and under the Prussian ministry for spiritual, educational and medical affairs (Ministerium der geistlichen, Unterrichts- und Medizinalangelegenheiten, in the following just “the ministry”).

The Universität Göttingen only allowed women to attend lectures as guests – and only since 1893 was this so. Obtaining Abitur was relatively rare and often complicated for women. A woman, who wanted to attend classes, needed permission by the ministry and each professor whose lecture she wanted to attend. Beginning in 1895, women could occasionally obtain permission to pursue a PhD at Göttingen. It was not until 1908 that Prussia allowed women as regular students. For comparison: France allowed women to study in 1863 (exception: theology), Switzerland in 1873, Norway in 1882, and the German state of Baden (with the universities of Freiburg and Heidelberg) in 1900. In Noether’s home state, Bavaria, it was allowed in 1903.

In 1907, one year before allowing women to study, the ministry asked the Prussian universities if women should be allowed to obtain a habilitation, in order to teach and to be appointed a professor at Prussian universities. This was brought on by an instance of a woman at the Universität Bonn intending to obtain a habilitation. The responses were mixed. Only slightly more than half of all ca. 100 academic institutions in the survey were against women's habilitations. The other provided differentiated and sometimes positive statements. Back then this was not known, as the survey was never made public by the ministry. Instead, the ministry declared that the responses were overwhelmingly negative. Göttingen was most likely evenly divided on the topic. The mathematicians [Hilbert](#), [Klein](#), [Minkowski](#), and [Runge](#) (together with the historian [Lehmann](#), the physicists [Voigt](#) and [Wiechert](#), and the chemist [Tamman](#)) voted in support of women's habilitations, while others rejected the idea. The historian [Brandi](#) wrote, in a very long piece and with elaborate language, that he was already disturbed by the very presence of women at the university. The philosopher [Husserl](#) used a more abstract, but circular argument. He argued that there are currently no female researchers, whose research is good enough to teach at a university, so there is no need to allow women to become researchers in the first place.

As a consequence, the ministry issued the decree of 29th May 1908 that the Universität Bonn is not allowed to let a woman habilitate. The given reason was that the vast majority of Prussian professors reject the idea. This decision was the obstacle for all of Noether's habilitation attempts for which we provide a timeline in the following.

4 First Attempt

13 July 1915. Emmy Noether gives a talk in front of the mathematical society of Göttingen (Göttinger Mathematische Gesellschaft) on questions of finiteness in invariant theory. This talk convinced the mathematicians in Göttingen of the quality of her work. See: Der Endlichkeitssatz der Invarianten endlicher Gruppen, *Mathematische Annalen*, 77, 89–92, 1915.

20 July 1915. Emmy Noether applies at the Department of Mathematics and Natural Sciences of the faculty of philosophy of the Universität Göttingen (Mathematisch-naturwissenschaftliche Abteilung der Philosophischen Fakultät der Universität Göttingen) for admission to habilitation. Her habilitation thesis was on fields and systems of rational equations, see [Körper](#)

und Systeme rationaler Funktionen, *Mathematische Annalen*, 76, 161–191, 1915.

Up to 8 August 1915. The members of Noether’s habilitation commission submit their reports. The members of the commission included [Constantin Carathéodory](#), [Peter Debye](#), [Johannes Hartmann](#), David Hilbert, Felix Klein, [Edmund Landau](#), Carl Runge, and Woldemar Voigt.

Only Hartmann spoke clearly against the habilitation of Noether. All other referees, except for Hilbert, argued against the habilitation of women in general, but recommended an exception for Noether due to her exceptional mathematical abilities. Even Klein, who was a major supporter of women’s right to study at Göttingen university, argued in his report against habilitation rights for women in general. This might have been a tactical argument as Klein expected resistance from the ministry. Hilbert was the only referee who did not discuss the issue of women’s habilitations in his report. He strictly focused on Noether’s mathematical abilities and put her research into the context of his own work.

Klein pointed out that the previously mentioned decree of 29th May 1908 by the ministry forbids women to habilitate. Therefore, it seemed necessary to apply for an exemption.

An excerpt from Hartmann’s [\(negative\) report](#):

If Germany is now capable of successfully standing up against a world of enemies, then we have to thank, for a large part, our German women and mothers who brought up a strong cohort of sons. Every step that extends the equality of the woman and facilitates her independent demeanour and lifestyle, brings certain dangers to the family life, for those tasks of the woman which no one else can do become uncomfortable to some women when they get interested in scientific work.



Figure 2: Emmy Noether, [probably 1915](#). The picture is part of a photo album which was gifted to David Hilbert on the occasion of his 60th birthday on the 23rd January 1922.

In particular, it seems impossible to reconcile uninterrupted academic teaching with the responsibilities of a married woman. It is definitely not in the interest of our youth when, in particular, the intellectually specially talented women are drawn away from the family life.

He continues by pointing out that one should not let women occupy jobs which can be filled with returning soldiers after the war.

Let us move on to the positive reports. For instance [Landau wrote](#):

How simple the thing might be for us if it would be a man with exactly the same publications, the same talent to lecture, and the same serious ambition. I would prefer it very much if we could extend our curriculum without the therewith required habilitation of a lady. [...]

Until now, I have only made the most negative experiences regarding the productive achievements of studious ladies and I consider the female brain incapable of mathematical production; I consider Miss Noether one of the few exceptions.

Carathéodory [also focused](#) on the claim that Noether is extraordinary:

According to me, it is not to be expected that there exists anyone else in the whole world who is accessible to us and who could substitute for Miss Noether. The way things are, Miss Noether is a singular phenomenon who can be beneficial to the further scientific development of the university, and this is the main reason why I, ignoring everything else, approve of the admission for the other parts of the habilitation.

Only Hilbert, who did not address the issue of women's habilitations, [focused on the work itself](#):

The submitted habilitation thesis distinguishes itself as a successful execution of a part of the large program that I stated with respect to questions of finiteness. [...]

The candidate demonstrates her versatile finesse in her recently finished work on completely transcendental numbers, as well as further currently incomplete investigations, by applying form-theoretical methods to seemingly very remote questions.

29 October 1915. Noether's habilitation commission votes on applying for an exemption. All members except Johannes Hartmann vote in favour.

6 November 1915. The Department of Mathematics and Natural Sciences votes on asking the ministry for an exemption for Noether's habilitation: 10 are in favour, 7 against, 2 abstentions. The defeated side announces a written statement on their voting behavior.

10 November 1915. The Department of History and Philosophy (Historisch-philologische Abteilung) meets. "Considering the fundamental importance of the presented case, which would create a total novelty of highest importance for life at German universities", they demand that the complete faculty votes on the matter. This was uncommon as usually the departments could decide on their own who to habilitate. The Department of History and Philosophy states this in their demand, but also points out that members of the Department of Mathematics and Natural Sciences share this wish.

18 November 1915. Meeting of the faculty. There were two votes. The first question was "who, under all circumstances, is against the admission of women to habilitations". 17 in favour, 14 against, 1 abstention. Strangely, while rejecting women's habilitations in general, the faculty still voted for a recommendation to the ministry that it should **not** make an exemption for Noether. The result was 14 in favour and 14 against. The head of faculty, Landau, had the decisive vote and voted against the proposal, so the faculty did not recommend against habilitating Noether.

The Department of History and Philosophy decides to take no further measures against Noether's habilitation. Meanwhile, the Department of Mathematics and Natural Sciences approves the application for an exemption by the ministry: 10 in favour, 6 against. The application is written by Carathéodory, Hilbert, Landau, Klein, and Runge.

There is a minority report signed by seven members of the faculty. It [includes sentences](#) such as:

But, in particular, a woman is totally unsuited for the uninterrupted teaching in front of our students due to the phenomena related to the female organism.

In general, the minority report does not dispute Noether's abilities, but argues with general principles:

It is fully in line with the matter at hand, when our objection is not focused on the vote of the representatives of the profession on the mathematical knowledge of the applicant, but solely based on the hard social and academic concerns and consequences which speak against an admission of women to habilitations.

The faculty meeting must have been heated. The philologists [Richard Reitzenstein](#) and [Max Pohlenz](#) complained about Hilbert's behaviour during the faculty meeting. Hilbert might have accused them of not arguing scientifically, but in their political interests. As a consequence, Hilbert had to apologise to them. In this context Hilbert almost surely said that he could not understand that the sex of a candidate plays a role as they are at a university and not a community swimming pool.

26 November 1915. The department applies for an exemption from the decree from 1908 for Emmy Noether.

4 December 1915. Hilbert writes to the ministry and asks for a personal conversation with the minister about Noether's habilitation.

9 December 1915. Ernst Osterath, the representative of the ministry at the university (Kurator), forwards the application to the ministry. He adds a negative recommendation to the letter, despite both faculty and department voting in favour of granting the exemption.

Sometime 1916. Personal conversation between Hilbert with the minister in the presence of Debey and Voigt. They ascertained that the ministry had no objections against other ways that enabled Noether to work at the department. The compromise was that Noether is allowed to teach seminars in Göttingen that are offered under Hilbert's name. In the winter semester the following was announced: "Mathematical-physical seminar, invariant theory: Prof. Hilbert with support by Miss Dr. Noether, Monday, 4–6pm, [attendance is] free." (Mathematisch-physikalisches Seminar, Invariantentheorie: Prof. Hilbert mit Unterstützung von Frl. Dr. Nöther, Montag 4–6 Uhr, gratis.). Similar announcements were made in the following semesters.

5 Second Attempt

14 June 1917. No official decision regarding Noether's habilitation has been passed yet. The Department of Mathematics and Natural Sciences decides

to ask the ministry again. According to the letter to the ministry, the Universität Frankfurt asked Emmy Noether to habilitate herself, so that they can hire her. While Frankfurt was also part of Prussia, the letter claimed that the Universität Frankfurt was confident in obtaining an exemption. The university in Frankfurt was founded in 1914 and was, unlike most Prussian universities, not financed by the state, but by a public not-for-profit organisation (Stiftungsuniversität). Furthermore, the letter points out that Emmy Noether would be very interested in taking up the offer and that Göttingen would not want to lose her. Therefore, they would like to obtain the permission to habilitate Noether.

20 June 1917. The ministry replies that they will not make an exception for the Universität Frankfurt and that the position of the minister is that he will, as his predecessor, not allow women's habilitations.

5 November 1917. The minister [officially rejects](#) to exempt Emmy Noether from the ban on women's habilitations:

There are still severe concerns in academic circles regarding the admission of women to habilitation as private lecturers [Privatdozenten]. As the question can only be decided generally, I can not permit exemptions. Even if this causes certain hardships in individual cases. If the fundamental statements by the faculties, which are the basis for the decree from 29 May 1908, change, then I will gladly reexamine your request.

6 Third Attempt

27 December 1918. The initiative for the third attempt to habilitate Emmy Noether comes no longer from inside Göttingen, but [Albert Einstein](#). He [writes](#) to Klein:

When I received the new work by Miss Noether, I considered it a great injustice that she is denied the *venia legendi*. I would very much favour that we take an energetic step at the ministry. If you do not consider this to be possible, then I will try it on my own. Sadly, I have to travel for a month. I very much ask you to send me a short reply for when I return. If anything has to be done earlier, then please have disposal over my signature.

5 January 1919. Klein writes to the ministry. Now, after the revolution, it is renamed to Ministry of Science, Art, and People's Education (Ministerium für Wissenschaft, Kunst und Volksbildung). He enquires how the ministry would decide on an exemption now, given the different political circumstances.

18 January 1919. Again, Noether applies for admission to habilitation.

31 January 1919. The department decides to apply again for Noether's habilitation at the ministry.

15 February 1919. The department applies for an exemption for Noether's habilitation. For the first time in German history, women could vote in the election of the German national assembly on 19 January 1919. But their equality to men was only formally established when the constitution of the Weimar Republic came into force on 14 August 1919. Women's habilitations were only officially allowed with a decree on 21 February 1920. Hence, the department still had to apply for an exemption.

The letter to the ministry states:

The changed political circumstances, which resulted in a far-reaching extension of women's rights, provide the hope to the local mathematicians (hiesige Fachvertreter der Mathematik) that an application in this direction might be successful now. Their wish, to renew the previous rejected application, was supported by the Department of Mathematics and Natural Sciences with an overwhelming majority in its meeting on 31 January 1919, and they, therefore, renew their application of the 26th November 1915 to allow Miss Dr. Emmy Noether to exceptionally habilitate.

Even now, the department does not wish to trigger a general decision on allowing women a career as lecturers, but, as before, it only justifies its application with the exceptionally high mathematical talent and scientific performance of the applicant. During her time here, Miss Noether did not only satisfy our hope on her effectiveness, but surpassed it. Now she is, due to a series of rapidly produced publications, which we hand over in the attachment, undoubtably in the first grade of scientifically producing mathematicians and she has made, through her teaching and per-

sonal relationships, a highly valuable stimulating influence on the whole circle of mathematicians in Göttingen.

The letter continues that if this application is rejected, then the department asks the ministry to appoint Emmy Noether as an honorary professor.

8 May 1919. The Minister of Science, Art and Education replies that he has no objections against Noether's habilitation.

11–21 May 1919. The reply of the minister reaches the Universität Göttingen. The Faculty of Philosophy is informed on the 13th. The Department of Mathematics and Natural Sciences on the 21st.

28 May 1919. Habilitation colloquium for Emmy Noether. Her paper "[Invariante Variationsprobleme](#)" is accepted as her habilitation thesis (published in: Nachrichten der Königlichen Gesellschaft der Wissenschaften zu Göttingen, Math.-phys. Klasse, 1918, 235–257). There she proved Noether's theorems, a theorem highly important to theoretical physics as it, in a unified way, implies conservation laws such as the conservation of energy, impulse, and angular momentum.

4 June 1919. Public meeting of the department with a trial lecture by Emmy Noether. The department decided unanimously to admit her as a private lecturer (Privatdozent).

7 Future Life

Now that we have covered Emmy Noether's habilitation at length, let us provide a short summary of her remaining life. In 1922, Noether obtained the title of "außerordentlicher Professor". This meant that she could officially call herself a professor, but it did not include any financial gain and she remained a private lecturer (similar to an adjunct professor) for her whole career in Germany. Her income was far lower than that of her colleagues, for instance [Paul Bernays](#) had a yearly income of 4000M in 1924, while Emmy Noether's yearly income at that time was only 3000M. Her scientific contributions remained outstanding and she had several highly talented students such as [van der Waerden](#).

As a direct consequence of the Nazis ascension to power, on 7 April 1933, the "[Law for the Restoration of the Professional Civil Service](#)" (Gesetz zur

Wiederherstellung des Berufsbeamtentums) came into effect. It removed all civil servants of “non-Aryan descent” from their jobs.



Figure 3: Emmy Noether, [October 1933](#), Göttingen train station, shortly before her emigration to the USA.

For instance on 13 May 1933, the [Manchester Guardian](#) published a list of 194 dismissed professors. In early summer of 1933, the University of Oxford, the women’s liberal arts college of Bryn Mawr, and colleagues in the Soviet Union tried to fund a position for Emmy Noether. She emigrated to the USA in October 1933, taught at Bryn Mawr, and gave talks at the Institute for Advanced Studies in Princeton. On 14 April 1935 she died of the consequences of an operation that she had had four days earlier.

In 1933, 20 out of 94 full mathematics professors (Lehrstühle/Ordinarien) at German universities were occupied by Jewish mathematicians or mathematicians who were considered “half-Jewish” by the Nazi (for instance due to a Jewish father). Göttingen was particularly effected by this. Besides Emmy Noether, Paul Bernays, [Felix Bernstein](#), [Stefan Cohn-Vossen](#), [Richard Courant](#), [Willy Feller](#), [Werner Fenchel](#), [Hans Heilbronn](#), Edmund Landau, [Hans Lewy](#), [Kurt Mahler](#), [John von Neumann](#), [Alexander Ostrowski](#), [Wilhelm Prager](#), and [Olga Taussky](#) worked in Göttingen there during the time of the Weimar Republic, many of them up until 1933 (see p. 44, “Jüdische Mathematiker in der deutschsprachigen akademischen Kultur”, Birgit Bergmann and Moritz Epple, Springer, 2009; there is also an [English version](#) of this book).

News about the dismissal of large parts of German academia spread rapidly.