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Women and mathematics at the Universities in Prague in the first half of the 20th century¹

Abstract. This study is focused on lives of twelve women who prepared their doctorates in mathematics at the Faculty of Philosophy of the German University in Prague in the years 1882–1945, respectively at the Faculty of Science of the Czech University in Prague in the years 1882–1920 and 1921–1945 (known as Charles University in Prague in the latter period). In the first part, a short description of the historical background about women’s studies at the universities in the Czech lands and a statistical overview of all PhD degrees in mathematics awarded at both universities in Prague is given for a better understanding of the situation with women’s doctoral procedures. In the second part, a description of the successful doctoral procedures in mathematics of three women at the German University in Prague and of eight women at Charles University in Prague, as well as one unsuccessful doctoral procedure, are presented.

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1. Introduction: A brief description of women’s studies at the high schools and universities in the Czech lands in the 19th century and the first half of the 20th century. It was not easy for women in the Czech lands to study at a university. In the first half of the 19th century, higher education of girls and women was almost unheard of. The reason is that a woman was supposed to be a good wife, mother and patriot – she should bring up children with care, responsibility and in the spirit of patriotism, thereby ensuring public respect for her family. If necessary, she should help her husband to run his trade. Public educational institutions for women as well as private ones (mostly religious and aristocratic) were rare and conformed to the above idea of women’s

mission. The only exception was the Prague school Budeč, which was opened by Karel Slavoj Amerling (1807–1884) in the year 1842. The school was intended for all women, from any level of society. The emphasis was placed on general education. Thanks to Amerling, it was even possible for women in 1844 to attend lectures at the Faculty of Medicine of Prague University as auditors. However, in 1848 Budeč school was terminated. Starting from the 1840s, women more and more engaged in public life, at first only as hostesses or participants of sessions in salons, in which literature, science and arts were discussed.²

A more significant change happened in the early 1860s, when activities of associations started to develop after the downfall of Bach's absolutistic government and the network of schools of all types and grades began to expand. In 1865, an entrepreneur, mecenas of science and philanthropist Vojtěch (Vojta, Adalbert) Náprstek (1826–1894, original name Fingerhut) founded, in his house "U Halánků" situated on the Bethlem Square in Prague, American Ladies' Club [*Americký klub dam*], which became the oldest women's organization on the territory of the Austrian monarchy. It was a center where women, especially those from the middle class, were educated. Women could use the library, listen to lectures in natural sciences, mathematics, medicine, philosophy, history, arts, politics and also technology. The lecturers were Czech scientists, travellers, writers, artists, politicians and others. The club members made visits to various factories, hospitals, social care institutions, astronomical observatory and so on. Activities of the club were very popular and trendy at that time.

In that period, some women in wealthy families understood that without education and opportunities for a professional employment women would not find jobs, and so they would be dependent on their parents, husbands or families. In the year 1865, as a result of an initiative by Eliška Krásnohorská (1847–1926, original name Alžběta Pechová), Sofie Podlipská (1833–1897, née Rottová), Johanna Mužáková (1830–1899, née Rottová, alias Karolina Světlá) and Marie Riegrová (1833–1891, née Palacká), the first Czech Manufacturing Association [*Český výrobní spolek*] was established, followed by a technical school for girls, which was transformed into Women's Manufacturing Association [*Ženský výrobní spolek*] in 1871. Within the framework of the asso-

²Significant women engaged in social life included the sisters Bohuslava Rajská (1817–1852, original name Antonie Reissová, married name Čelakovská), Johana Terezie Carolina Fričová (1809–1849, née Reissová), Karolina Staňková (1813–1867, née Reissová), as well as Františka Svatava Amerlingová (1812–1887, née Michalovicová), Honorata Zapová (1825–1856, née Wiśniowských).

ciation women could attend educational courses (in modern languages, economics, economy and civil service, drawing, engraving, nursing and others) and prepare themselves for practical employment.

The first higher school for girls [*Vyšší dívčí škola*], which was intended mainly for girls descending from middle and higher social levels, was opened in Prague in the year 1863. It provided secondary education, however without the possibility of passing a graduation examination. Four years later, the school gained a building in Vodičkova Street, became popular and was attended by many students. Among others, the school was attended by renowned representatives of Czech culture (painter Zdenka Braunerová (1858–1934), writer Helena Malířová (1874–1940, née Nosková), soprano Ema Destinová (1878–1930), actresses Hana Kvapilová (1860–1907) and Růžena Nasková (1884–1960, née Nosková)).

The *American Ladies' Club* and *Women's Manufacturing Association* gave rise to an initiative to promote the right of women to study at a university. In the mid-1870s, the first three women, young members of the American Ladies' Club (Anna Bayerová (1852–1924), Bohuslava Kecková (1854–1911) and Julie Kurková) left for Switzerland in order to pursue their studies because women were not allowed to study at a university in the Austro-Hungarian Empire.³ After much trouble, the first two completed their studies of medicine in Bern (1881), resp. Zurich (1880), the third one died shortly before the completion of her studies of philosophy. After their return to Bohemia, the young female physicians were not allowed to open their practices. Their lives and activities were observed with empathy and hope by the Czech public.⁴

An important year with regard to women's education was the year 1878, when women gained the right to pass a graduation examination at classical gymnasiums for boys. However, there did not exist any school to prepare them for this examination. In addition, women with secondary-school education had limited possibilities of employment in the monarchy.

Emancipation of women with regard to education was not easy. In the year 1890, E. Krásnohorská founded the Minerva association, which had a clearly defined goal – to open a gymnasium to prepare girls for university studies under the same conditions as boys. After many petitions, interventions and lobbying, in September of 1890, the Empire Council

³Let us mention that in Switzerland, university studies of women were permitted already in the 1860s (e.g. at the Technical School and University in Zurich since the year 1864). See [26] and [28].

⁴For more information see [26].

in Vienna amended the obsolete legislation and approved Minerva – the first gymnasium for girls in the Middle Europe. In 1892 the first gymnasium for girls in Vienna was established, inspired by the Prague gymnasium for girls.⁵ The first students of Minerva graduated already in the year 1895 at the Academic Gymnasium (for boys) in Prague. The examinations were more strict and demanding for girls than for boys.

It seemed that there was no obstacle for women to study at a university because in 1878, the Ministry of Education and Enlightenment 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 who applied for admittance to the Faculty of Medicine in Prague were refused by the professors. Complicated negotiations were necessary with the aim to enable the women to study. In 1895, the Faculty of Philosophy of the Czech University in Prague⁶ 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 Prague⁷ 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. Starting from that year, the Austro-Hungarian Empire began to recognize foreign diplomas of women, who however had to undergo a demanding international recognition at a university of the monarchy. From 1897, all the faculties of philosophy of the monarchy admitted women to regular studies without obstructions and under the same conditions as men.⁸ 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

⁵Let us mention that the first gymnasium for girls in Germany was opened in Karlsruhe in 1893.

⁶In the years 1882–1920, the university used the name *Česká Karlo-Ferdinandova univerzita v Praze*. The university used the name *Univerzita Karlova* from the year 1920, when the act “Lex Mareš” was passed, codifying the mutual relationship of the two Prague universities. Further on we will use the abbreviated form Czech University.

⁷In the years 1882 till 1919, the university used the name *Německá Karlo-Ferdinandova univerzita v Praze*, from 1920 *Německá univerzita v Praze*, from 1939 *Německá Karlova univerzita v Praze*. Further on, we will use the abbreviated form German University.

⁸It is interesting that the professors of mathematics and natural sciences at both universities in Prague (for example F.J. Studnička, G.H.W. Kowalewski) were not conservative: they supported women and helped them to study at the secondary schools and they arranged that women could attend their lectures as visiting students.

the Czech University in Prague, where they got prepared for the profession of secondary-school teachers in various subjects of humanistic and natural sciences (mathematics, physics, geography and history).⁹ Some of them gained a position at the Prague Minerva or the Girl's Lycée of the Vesna association in Brno.¹⁰ In 1908, the first eight women completed their studies of pharmacy and in the same year, *Association of Academically Educated Women* was established. In 1901 the first two female doctors – Marie Zdeňka Baborová-Čiháková (1877–1937, zoology) and Marie Fabiánová (1872–1943, mathematics)¹¹ graduated at the Faculty of Philosophy of the Czech University in Prague. In 1902, Albína Honzáková (1875–1940) graduated at the Faculty of Medicine of the Czech University in Prague.¹² The German University in Prague was more open with regard to women studies, but more conservative with regard to female doctorates; the first women, Hedwig Fischmann (1885–?) and Charlotta Weil (1886–?), were awarded doctorate at the Faculty of Philosophy of the German University in Prague as late as 1908 (the former in the subject of the German language and litera-

⁹Women were permitted to pass examinations of teaching proficiency since the year 1904. Until the end of the World War I, they were however allowed to teach at secondary schools for girls only. After the formation of the Czechoslovak Republic, they could teach at secondary schools of all types.

¹⁰The *Vesna* association was established in 1870 in Brno as the so-called singers' union. Later on, it was changed into an educational and manufacturing association for women. In 1886, thanks to Eliška Machová (1858–1926), association activist and teacher, the association established a Czech school for continued education of girls. This school soon changed into a technical school and "literature school," which was gradually expanded to a higher school for girls. In 1891, the number of the schools increased since a classic boarding-school for girls was established. In 1901, the school system was reorganized to a great extent and the following structure became standard: six-class public lycée (preparation for university studies), technical school (preparation for practical life, including one-year department and two-year department, offering a special course for teachers of women's works at public schools, course for nurses in nursery schools, course for cooks and housewives; further occasional courses of lacemaking, embroidery, hat-making, ironing, evening courses for female workers and servants), higher school for girls (preparation of administrative workers, clerks, home teachers etc., offering education in trade, languages, music and economy) and a boarding-school for girls. To support this structure, Vesna maintained its steady teaching staff, consisting of 39 internal and 18 external male and female members. The schools resided in two modern buildings, and the boarding-school also occupied two buildings. They were financed from the state and regional subsidies, school fees and contributions from the Vesna association. For more information, see e.g. [19].

¹¹See [25] and [2].

¹²See [1].

ture, the latter in chemistry).¹³ At the time of the World War I, 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. In the same year, the Czech Technical University in Prague admitted the first twenty regular female students. Since 1920s, women could study all university subjects (except for theology). Women gradually gained positions of assistants at clinics (Božena Nevšimalová-Fialová (1885–1957) at a Czech clinic in 1908), honorary doctorates (E. Krásnohorská at Charles University in 1922), associate professors (Milada Paulová (1891–1970) at Charles University in 1925 in history),¹⁴ professors (M. Paulová at Charles University: extraordinary professor in 1935, regular professor in 1939, however, she could take the post only in 1945).¹⁵

It is natural that women with university education found employment mainly as physicians or teachers. Only few of them had the opportunity and courage to embark on an academic career. Many of them,

¹³See [26]. Problems of education of German women in our lands are briefly dealt with in the article [14].

¹⁴Before 1939, the Faculty of Philosophy of Charles University in Prague awarded the title of associate professors to four women – M. Paulová, Flora Kleinschnitzová (1891–1946) in 1929 in history of Czech and Slovak literature, Růžena Vacková (1901–1982) in 1930 in classical archaeology, Drahomíra Stránská (1899–1964) in 1932 in ethnography. Before 1939, the Faculty of Science of Charles University awarded the title of associate professors to only two women – Albína Dratvová (1892–1969) in 1932 in philosophy of exact sciences and Julie Moschelesová (1892–1956) in 1934 in anthropogeography (the present-day socio-economic geography). In the interwar period, the Faculty of Medicine of Charles University awarded the title of associate professors to two women. Vlasta Říhová-Knappová (1890–1960), née Moučková, obtained the title of associate professor in 1932 in dermatology and venerology and Olga Valentová (1900–1981), married name Deningerová, obtained the title of associate professor in 1933 in the same field. In the pre-war period, the Faculty of Law of Charles University did not award the title of associate professor to any woman. In 1926, the Faculty of Medicine of the German University in Prague awarded the title of associate professor to Hedwiga Langecker (1894–1989) in experimental pharmacology, who in 1935 was appointed an extraordinary professor. In 1936, Maria Schmidt, née Mittelbach (1900–?), obtained the title of associate professor in anatomical pathology and in 1942 was appointed an extraordinary professor; however, shortly afterwards, she was forced to take a “holiday.” For more information see [26].

¹⁵For more comparison with the situation in Europe or USA, see [3], [29] and [13].

even after the completion of their demanding studies, got married and devoted themselves to their families rather than their professional careers. At that time, the society did accept university studies of women and tolerate women with university education in some professions (teachers, physicians, pharmacists, notaries), but was not able to get rid of usual stereotypes. The situation was aggravated by the economic crisis in the years 1929–1933, when women were regarded as undesirable competitors of men for jobs. It was only in the late 1930s that the society started to get accustomed to the idea that women would gradually take up positions traditionally reserved for men.¹⁶

1.1. Doctorate degrees awarded in mathematics at the German University in Prague in the years 1882 till 1945.¹⁷ From the year 1882, when the German University in Prague was established, until the year 1945, when it was terminated, there were 43 doctorate degrees awarded in mathematics, 39 doctoral theses were defended (including those by three females, resp. ten foreigners), three doctorates were internationally recognized, one international recognition was conditioned on passing an additional PhD main examination in mathematics, three candidates did not obtain the doctorate, one candidate was rejected in the first stage of the proceedings (however, three years later, he submitted a new thesis and was successful), and five international recognitions were denied for formal reasons.

In the years 1882/1883 till 1912/1913, the Faculty of Philosophy of the German University in Prague awarded 395 doctorates in philosophy, six of which, i.e. 1.5%, were in mathematics. There was no female among those who were awarded doctorates because even at the beginning of the 20th century, the German professors of mathematics held very conservative opinions about awarding doctorate degrees to women. In the years 1882/1883 and 1906/1907, two mathematicians applied for international recognition of their foreign doctorate diplomas: one was refused, the other was approved, although both diplomas were issued by the same German university (Erlangen), which made the two cases quite identical (they both graduated from a so-called real school, without proper graduation from a classical gymnasium, which disqualified them as candidates for doctorate at a university in the Austro-Hungarian Empire.

¹⁶For more information see [26].

¹⁷The analysis is based on the studies of various “fonds” of the Archive of the Charles University in Prague.

In the academic years 1912/1913–1919/1920, the Faculty of Philosophy of the German University in Prague awarded 230 doctorates. Only four candidates, including one female, defended the doctorate in mathematics, which is 1.7%.

In the academic years 1920/1921–1938/1939, the Faculty of Science of the German University in Prague awarded 773 doctorates, including 25 doctorates, i.e. 3.2%, in mathematics, including two females. One of the candidates however obtained the degree only in the second, remedial, procedure. The other two candidates failed because they did not submit their doctoral theses.

The 1930s, as Germany was becoming fascist and the German intelligentsia of Jewish origin or anti-fascist orientation was forced to emigrate, brought on an increase of number of applications for international recognition of diplomas and studies in foreign countries, shortening of obligatory studies, acceleration of PhD proceedings at the Faculty of Science of the German University in Prague. It is interesting that the German mathematicians in Prague recommended, without any problems, to grant requests submitted by their regular as well as extramural students, which enabled them to complete successfully the doctoral procedure in a shortened time. However – at the same time – the German mathematicians did not support international recognition of the diplomas already awarded. In the period 1920/1921–1938/1939, seven applications for international recognition were submitted: three of them were probably denied, three were approved, in one case an additional doctoral examination was ordered.

In the years 1939/1940–1944/1945, the Faculty Science of the German University in Prague awarded 88 doctorates, including four in mathematics, i.e. 4.5 %. One applicant did not – even at the third attempt – pass a subsidiary PhD examination in theoretical physics and the doctorate proceedings were officially stopped. Let us remark that there was no female among the candidates for doctorates in mathematics, which is not surprising when considering the Nazi conception of women's role in the society.

It may appear strange that the number of doctorates in mathematics awarded at the Faculty of Philosophy of the German University in Prague was less than two per cent, resp. at the Faculty of Science of the German University in Prague three to five per cent, notwithstanding the fact that mathematics was very important at that time and professors of mathematics did not lack quality and talented students. The explanation of this seemingly paradoxical phenomenon is relatively simple.

The doctoral candidates in mathematics usually thought about an academic career, resp. career of a university pedagogue. The corresponding positions at the Austro-Hungarian universities were however few since every greater university or technical university had two, or maximally three, positions of regular or extraordinary professors of mathematics, and one or maximally two, positions of regular or extraordinary professors of descriptive geometry. There did not exist any research institutions focused on mathematics and its classical applications, some quality doctors of mathematics found their employment in the financial sector (especially in insurance business), state administration (especially in national economy statistics), army (especially as teachers of mathematics) or at secondary schools, which however did not require a doctoral degree.

The lower interest of the German-speaking doctoral candidates of mathematics in the German University in Prague may also have its source in the fact that in the 19th century, this university was not the only institution where a candidate could submit a doctoral thesis in mathematics in the German language and pass the PhD examinations in the German language.¹⁸ Moreover, many mathematicians regarded Prague only as a “provincial university,” with only a relatively small community of German mathematicians intending to find their employment rather outside the Czech region.

The increase of the number of doctoral candidates in mathematics at the German University in Prague after the year 1920 (when the new Czechoslovak constitution was proclaimed) was partly caused also by the fact that the Czechoslovak authorities did not automatically recognize diplomas and academic degrees awarded by foreign schools and made the procedure of international recognition more strict, eventually required additional Czechoslovak state examinations. The candidates of the German nationality who formerly went to Vienna, Budapest, Berlin, Göttingen or Munich, now remained in Prague. The Faculty Science of the German University in Prague was a relatively small, but signifi-

¹⁸In the Austrian Empire, resp. Austro-Hungarian Empire, it was possible to undergo the PhD examination with international recognition at universities in Vienna, Graz, Innsbruck, Budapest, Černovce (Černovice, Czernowitz) and Kolozsvár (Klausenberg, Cluj, Kluž). Especially Vienna was a favourite destination of the Germans from the Czech lands. With very insignificant trouble of purely formal character, it was possible to obtain doctorates in Germany and France throughout the 19th century. The destination of our (German as well as Czech) mathematicians was usually Göttingen, Berlin, Munich or Hamburg, the destination of Czech mathematicians was also Paris or Strasburg.

cant European institute of natural sciences and pedagogy. The University was attractive for foreign students of Jewish religion and democratic opinions from Lithuania, Latvia, Ukraine, Hungary and Poland and, starting from mid-1930s, also from Germany. This was partly due to the renown and professional achievements of some professors (e.g. L. Berwald, R. Carnap, C.I. Cori, Ph. Frank, A. Kirpal, A. Lampa, K. Löwner, A. Naegle, G.A. Pick, E.G. Pringsheim, F. Spina), relatively low school fees and cost of living, good accessibility of Prague, varied multicultural environment as well as political and religious liberty.

1.2. Doctorate degrees awarded in mathematics at Czech University in Prague in the years 1882 till 1945.¹⁹ From 1882 to 1939, the doctoral candidates at C.k. Czech Charles-Ferdinand University, resp. Charles University, submitted 159 doctorate theses in mathematics (including twelve females, resp. eight foreigners),²⁰ 150 doctorates were awarded. All the theses, except for two, were written in the Czech language.

In the years 1882/1883–1920/1921, the candidates at the Faculty of Philosophy of the Czech University, resp. Charles University in Prague²¹ defended 1118 doctorates in philosophy, including 62 in mathematics, i.e. 5.5%. 62 doctoral theses written in the Czech language were submitted, all of which were accepted and evaluated positively. Three of the candidates were absent from some part of the PhD examination, and as a consequence did not obtain the doctoral degree. The candidates usually took the main PhD examination in mathematics and a subsidiary PhD examination in philosophy. All the 59 successful candidates underwent the complete doctoral procedure. One doctorate was obtained by a woman. To complete the information, one doctorate degree was revoked after sixteen years based on a decision of Czechoslovak court of justice because its holder committed a deplorable crime.

In the years 1920/1921–1939/1940, the Faculty of Science of Charles

¹⁹The analysis is based on the studies of various “fonds” of the Archive of the Charles University in Prague.

²⁰The foreigners included six Russians, one Latvian and one Ukrainian (according to the present-day structure of Europe). In the students catalogues or PhD protocols, Russia (the Soviet Union in [30]) is given as the state of birth (or origin). They were all citizens of Russian nationality, who left Russia convulsed by a civil war and political problems and settled down in the Czechoslovak Republic.

²¹From 1882 to 1920, the university used its official name *C.k. česká Karlo-Ferdinandova univerzita v Praze*, starting from the year 1920, Charles University in Prague. Further on we will use the present-day standard name Charles University in Prague.

University started the defence of 1088 doctorates in Natural Sciences, including 97 doctorates in mathematics, i.e. 8.9%.²² One doctorate procedure was stopped at the very beginning since the submitted doctoral thesis was not accepted. A year later, the candidate submitted a new thesis and was successful in a new procedure. The candidates submitted 95 theses in Czech and two theses in French. Five candidates did not undergo the prescribed PhD examinations and did not obtain the degree (including one woman). The candidates usually took the main PhD examination in mathematics (mathematical analysis and algebra, geometry and algebra, geometry and mathematical analysis) and a subsidiary PhD examination in philosophy of exact sciences²³ (experimental physics and analytical mechanics, in a few cases).

The number of successfully accomplished doctoral procedures was 91, including eight women. Five of the candidates had to undergo some of the PhD examinations repeatedly (including two women). One candidate submitted his doctoral thesis in the spring of 1939 and in autumn of the same year he passed both PhD examinations – however, he graduated only in summer of 1945. Six candidates submitted their theses by the year 1939, which were accepted and evaluated positively. The doctoral procedures started before the closure of the Czech universities and high schools, however, the candidates did not have enough time to pass all the required examinations. Their doctoral procedures were carried out as late as between 1945 and 1952.

From November of 1939 to the summer of 1945, Charles University did not award any doctorate in mathematics because the university was closed on the 17th of November 1939 by the Nazi occupiers. The university activities were resumed only after the liberation, starting with the extraordinary summer semester of 1945.

The number of doctoral procedures in mathematics at the Faculty of Philosophy was five per cent, at the Faculty of Science almost eight per cent. What was mentioned above with regard to the German University in Prague also applies to the Czech universities. One should however

²²In the school-year 1920/1921, the newly established Faculty of Science of Charles University in Prague started its educational activities. The first 25 doctoral candidates were still registered at the Faculty of Philosophy of Charles University. In the winter semester of the school-year 1939/1940, the Faculty of Science of Charles University started 9 doctorate procedures, however majority of them were completed only after the war. One of the doctoral procedures was in mathematics.

²³At the Faculty of Science of Charles University in Prague, one-hour subsidiary PhD examination in philosophy of exact sciences replaced the former examination in classical philosophy. This change enabled a deeper interconnection of philosophy, history, logic, mathematics and natural sciences.

note that for the Czech doctoral candidates in mathematics, Prague was, till 1920, the only place where they could submit their doctoral theses in the Czech language and take the PhD examination in their mother tongue. After the year 1920, this possibility was extended to Brno. However, this did not result in a decrease of interest in doctoral procedures held in Prague because, after the formation of the Czechoslovak Republic, the chances of the holders of doctorate degrees to find an employment increased a little. This was caused by the fact that the number of positions for professors, associate professors and assistants at the Czech universities increased (because new schools were founded, the number of the faculties of the Czech Technical University in Prague and the Czech Technical University in Brno increased), the number of positions for mathematical experts in state administration increased (new ministries, insurance institutions, banks, financial administration etc.) and the network of the Czech secondary and professional schools was expanded.

1.3. Doctorate degrees awarded in mathematics at Prague universities – brief comparison. The proportion of all the doctorates awarded at the Czech Faculty of Philosophy and the German Faculty of Philosophy is 1118 : 625, i.e. 1.8; the proportion of the doctorates awarded in mathematics is 59 : 10, i.e. 5.9; the proportion of the doctorates awarded in mathematics to females is 1 : 1.

The proportion of all the doctorates awarded at the Czech Faculty of Science and the German Faculty of Science is 1088 : 773, i.e. 1.4; the proportion of the doctorates awarded in mathematics is 91 : 25, i.e. 3.6; the proportion of the doctorates awarded in mathematics to females is 8 : 3, i.e. 2.7. The data are compared in the tables below.

In the years 1882/1883 until 1944/1945, 2206 doctorates were defended at the Czech University in Prague, resp. at Charles University in Prague, and 1486 doctorates were defended at the German University in Prague, which means that Charles University in Prague awarded approximately 1.5 time more doctorates than the German University in Prague. Comparing the numbers of doctorates awarded in mathematics in the same period we can see that Charles University awarded 150 doctorates in mathematics (including those started before 1939 but completed only after the war) whereas the German University in Prague awarded 39 doctorates (excluding international recognition). This means that Charles University awarded 4 times more doctorates in mathematics than the German University in Prague. Charles University in Prague had only one regular professor of mathematics until the beginning of

the 20th century, whereas the German University in Prague had, from the start of its educational activities, two professors of mathematics, one regular and one extraordinary professor. It was only from the year 1903 that both universities had two professors of mathematics. Charles University in Prague had three professors of mathematics (Karel Petr (1868–1950), Jan Sobotka (1862–1931) and Václav Láska (1862–1943)) from the year 1911, whereas the German University in Prague had usually two mathematicians (Georg Alexander Pick (1859–1942) and Gerhard Hermann Waldemar Kowalewski (1876–1950), resp. G.A. Pick and Ludwig Berwald (1883–1942)) in the pre-war and inter-war period. In the 1930s, the German University in Prague had three professors of mathematics (L. Berwald, Karl Löwner (1893–1968) and Arthur Winternitz (1893–1961)). Charles University in Prague had more pedagogues with the right to supervise and evaluate the doctoral theses (Bohumil Bydžovský (1880–1969), Václav Hlavatý (1894–1969), Vojtěch Jarník (1897–1970), Vladimír Kořínek (1899–1981), Miloš Kössler (1884–1961), V. Láska, K. Petr, Emil Schoenbaum (1882–1967)).

The subjects of the doctoral theses in mathematics at the German University in Prague usually reflected more promptly and closely the new trends in mathematics (especially modern analysis, differential and an affine geometry) and they represented a higher level of expertise.²⁴ Their authors obtained positions at prestigious foreign universities and reached considerable renown.²⁵ It was naturally due to the fact that approximately the same number of pedagogues educated a smaller number of students and doctoral candidates.²⁶

After Czechoslovakia was formed, the German University in Prague was not abolished but, on the contrary, it became a recognized and respected state university with equal rights, which was not suppressed or oppressed or financially harmed by the new republic.²⁷ In the post-war Europe divided into states conceived on, more or less, nationality principle, it was in fact the only official, complete and recognized state

²⁴For more information see [4] and [7]. For more information of the mathematics at the Czech University in Prague see [5] and [6].

²⁵We can mention e.g. F.A. Behrend, L. Bers, A. Erdélyi, P. Kuhn, E. Lammel, H. Löwig, K. Löwner, M. Pinl and O. Varga. Their careers and works are mentioned in [4] and [7].

²⁶For more information see [4] and [7].

²⁷Let us mention that after the First World War the Imperial Russian University in Warsaw was polonized, the German university in Černovce in Bukovina was abolished, the German university in Kolozsvár was Hungarianized, the German university in Dorpat (Jurjev, Tartu) was changed into an Estonian university and the German schools in Lvov were abolished.

university for the so-called national minority. The University retained this position and renown until the beginning of the World War II.

Let us note that the citizens of the German nationality were not discriminated in Czechoslovakia with regard to university studies. On the contrary, according the population census in February of 1921, 8.761 million people declared to be of Czechoslovak nationality, 3.123 million people of German nationality, 0.745 million people of Hungarian nationality, 0.461 million people of Russian nationality, 0.181 million people of Jewish nationality and 0.075 million people declared to be of Polish nationality. This means that the German population was 23.3%. In Czechoslovakia of 1921, there existed three Czech (Czechoslovak) universities (Prague, Brno, Bratislava) and two Czech Technical Universities (Prague, Brno), one German university (Prague) and two German technical universities (Prague, Brno). This situation remained unchanged in Bohemia and Moravia until November of 1939.

1.4. Brief information on doctorates awarded at Charles University in Prague in the years 1945–1953.²⁸ The history of the German University in Prague came to its definitive end on the 18th of October 1945, when President Edvard Beneš (1884–1948) issued a decree on abolition of all German universities and high schools in Czechoslovakia, retroactive from the 17th of November 1939. This day is symbolic because on the 17th of November 1939, all the Czech universities on the territory of the Protectorate of Bohemia and Moravia were closed for the period of three years by a decree issued by the Reich Protector Konstantin Hermann Karl, Freiherr von Neurath (1873–1956), however the top representatives of the German Reich did not intend to re-open the Czech universities). Nine students, representatives of students' movement were executed in Ruzyně, almost 1100 students were deported to a concentration camp in Sachsenhausen. The pedagogues were forced to take a leave, to retire or to work in the arms industry.

Almost immediately after the liberation, Charles University re-started its activities and regular education by opening an extraordinary summer semester of 1945 so that more than seven grades of secondary-school graduates could study. In the years 1945 till 1952, the Faculty of Science of Charles University in Prague started 1047 doctoral procedures, including 55 in mathematics (i.e. 5.2%). 54 theses were submitted in Czech, one thesis was written in the Polish language. 53 Czech citizens, one Pole and one Bulgarian underwent doctoral procedure. The doctor-

²⁸The analysis is based on the studies of various “fonds” of the Archive of the Charles University in Prague.

ate was awarded to 54 candidates, including five females (i.e. 9.3%).

The above facts indicate that even after 1945, the number of doctorates awarded in mathematics to females did not significantly increase. More intense interest in studying mathematics, obtaining doctoral degree and academic career emerged only at the beginning of the 1960s.²⁹

1.5. Brief information on women's doctorates awarded in Prague in the years 1900–1945. In this paragraph, we try to give a short analysis of the successful doctoral procedures of three women, all PhD female graduates in mathematics at the German University in Prague, and the successful doctoral procedures of eight women, all PhD female graduates in mathematics at Charles University in Prague, and one unsuccessful doctoral procedure are presented. The documents deposited in the Archive of Charles University in Prague, the Archive of the Czech Technical University in Prague and the National Archive of the Czech Republic indicate from what social environment these women came and give information on their cultural, intellectual and material background. They show us how their families and social events influenced them, how the women were motivated by these circumstances, how the women lived, what they dedicated themselves to, what they did, what problems they solved and what complicated their lives (formation and downfall of states, domicile and citizenship issues, availability of common citizenship documents, anti-Semitism, emigration, war, forced deportation to ghettos and concentration camps) etc. The documents could also show changes which took place in our society in the first half of the 20th century. They could open a new view of the significance of nationality, state and domicile, entrepreneurial boom, changes of attitude towards the Jewish religion and changed attitude towards education, advent of economic crisis, view of household modernization, development of tourism and medical care etc.

The following section gives a brief summary of doctoral procedures in mathematics, undergone in the years 1900 till 1945 (resp. 1952) by twelve women.³⁰

2. Doctorates awarded at the German University in Prague.

Saly Ramler (1894–1993) defended her PhD thesis in 1919 under the guidance of Georg Alexander Pick and obtained her PhD degree at

²⁹The analysis is based on the studies of various “fonds” of the Archive of the Charles University in Prague.

³⁰The analysis is based on the studies of various funds of the Archive of the Charles University in Prague, the Archive of the Czech Technical University in Prague and the National Archive of the Czech Republic (Prague).

the Faculty of Philosophy of German University in Prague.³¹ Later, she married the famous Dutch-American mathematician Dirk Jan Struik (1894–2000).

In 1974, D.J. Struik remembered his first meeting with his future wife Saly and described her doctoral thesis. He wrote:

...in July 1923, I married at Prague, in the ancient Town Hall with the medieval clock, Saly Ruth Ramler. She was a PhD in mathematics of the University of Prague, where she had studied under G. Pick and G. Kowalewski. Her thesis was a demonstration of the use of affine reflections in building the structure of affine geometry, a new subject at the time. We had met the previous year at a German mathematical congress. After marriage we settled in Delft.³²

Let us note that Saly Ramler travelled with her husband to the Netherlands, then to Italy, Germany and France. In 1926, they immigrated to the USA, where D.J. Struik obtained a position as a professor at the Massachusetts Institute of Technology (MIT). The motivation for their travel had a political background as it is shown in the following quotation:

... From 1924 to 1926, with Struik's Rockefeller Fellowship, he and his wife travelled to several other European countries and studied, met and collaborated with many of the great mathematicians and scientists of the twentieth century, including Tullio Levi-Civita, Richard Courant and David Hilbert. Nevertheless, by 1926, Struik found himself unemployed in Holland and with limited opportunities in Europe. As a long-time mathematical and political friend of Struik, Lee Lorch of York University in Toronto, Canada, understood from him and wrote in an electronic correspondence to us, that Struik's "political commitments and activities closed European opportunities." Eventually, however, Struik

³¹Saly Ramler defended the PhD thesis titled *Geometrische Darstellung und Einteilung der Affinitäten in der Ebene und in Raume Dreiecks- und Tetraederinhalt* (reviewers G.A. Pick and G.H.W. Kowalewski). Her PhD thesis does not exist now. She passed the first (main) oral examination in mathematics in November 1919. She underwent the second (subsidiary) oral examination in philosophy in December 1919. She obtained her Doctorate Degree of Philosophy at the graduation ceremony on 11th December 1919.

³²D.J. Struik: *A letter from Dirk Struik*, in [10], pp. XIII–XVII, the quotation is from the page XIV.

received two offers, one from Otto Schmidt to go to Moscow and the other from Norbert Wiener to visit MIT. It was a hard choice for him: in the end, he decided to accept the teaching post from Samuel Stratton, the president of MIT.³³

In the first decade after marriage, Saly Ramler Struik travelled with her husband all over Europe. She fascinated his colleagues with her elegance, education and knowledge. She was interested in mathematics and history of mathematics as we can see in the recollections of D.J. Struik and Ch. Davis:

Ruth, working with F. Enriques, published an Italian edition of the tenth book of Euclid's Elements.³⁴

Dirk's love for the history of mathematics was reawakened when Ruth and he wrote a joint article probing (but not solving) the question of whether A.L. Cauchy, when he was in Prague (1833–1836), might have met the Prague mathematician Bernard Bolzano ...³⁵

S. Ramler Struik left mathematics as a young woman, gave up her professional career and devoted herself to her husband and their daughters (Ruth Rebekka, Anne and Gwendolyn) although it was a very difficult decision for her as the following words show:

While she was an accomplished mathematician, she was kept out of mathematics by illness for much of her adult life. She struggled with the tension between raising three daughters and wanting to do mathematics. She found it unfair that women cannot have a career and a family, and she resented and suffered from the discrimination bred out of the traditional expectation that a married woman do nothing but attend to the family. However, in later years she became

³³See [24], p. 43.

³⁴See D.J. Struik: *A letter from Dirk Struik*, in [10], pp. XIII–XVII, the quotation is from the page XIV. F. Enriques published a modern Italian translation of Euclid's Elements named *Gli Elementi d'Euclide e la critica antica e moderna. Libri I–IV*, Alberto Stock – Editore, Roma, 1925, *Gli Elementi d'Euclide e la critica antica e moderna. Libri V–IX, Libro X, Libri XI–XIII*, Nicola Zanichelli Editore, Bologna, 1930, 1932, 1936.

³⁵See [11, p. 585]. Ch. Davis discusses the article D.J. Struik, R. Struik: *Cauchy and Bolzano in Prague*, *Isis* 11(1928), pp. 364–366. The article was also published in *Publications of M.I.T.* (2) 152(1929).

mathematically active again, attending meetings and publishing. The Kovalevskaya Fund at the Gauss School in Peru was endowed in her memory.³⁶

In 1977, S. Ramler Struik published her new article titled *Flächengleichheit und Cavalierische Gleichheit von Dreiecken* [27], whose content is clearly characterized in the journal *Zentralblatt für Mathematik und ihre Grenzgebiete*.³⁷ Reviewer H. Schaal appreciated the article in the following words:

Zwei Dreiecke in der euklidischen Ebene, die von Geraden einer Parallelschar in jeweils längengleichen Strecken geschnitten werden, sind nach dem Cavalierischen Prinzip bekanntlich flächengleich. Hier wird gezeigt, daß auch folgende Umkehrung gilt: Je zwei flächengleiche Dreiecke sind "Cavalierisch gleich", d. h. sie lassen sich in eine solche gegenseitige Lage bewegen, daß sie von Geraden einer Parallelschar in jeweils gleich langen Strecken geschnitten werden. Zu der daran anschließenden Betrachtung, daß zwei Dreiecke in dieser Lage durch eine Affinspiegelung in Richtung der Parallelschar auseinander hervorgehen, sollte ergänzt werden, daß dies für gegenläufig aufeinander bezogene Dreiecke gilt; werden die Dreiecke mit gleichem Umlaufsinn aufeinander bezogen, was ebenfalls möglich ist, so gehen sie, nachdem sie in die genannte Lage gebracht worden, durch Scherung oder Translation in Richtung der Parallelschar auseinander hervor.

O. Bottema in *Mathematical Reviews* described Saly Ramler Struik's proof of Desargues' Theorem:

Two polygons P_1 , P_2 are defined to be Cavalieri-equal if there exists a set of parallel lines l with the following property: the two line segments which any line l has in common with P_1 and P_2 have equal lengths. It then follows from Cavalieri's principle that P_1 and P_2 have the same area. The author proves in an elementary but ingenious way that two triangles $A_1A_2A_3$ and $B_1B_2B_3$ with the same area can be displaced so that the three lines A_iB_i are parallel and the triangles are Cavalieri-equal. Moreover, it follows by means

³⁶See <http://www.tufts.edu/as/math/struik.html>.

³⁷See <https://www.zbmath.org/?q=ai:struik.s-r>, Zbl 0367.50004.

of Desargues' theorem that there is an equiaffine reflection which interchanges the two triangles.³⁸

It is interesting that in 1978, Oene Bottema³⁹ published the article titled *Equi-affinities in three-dimensional space* in the journal of the University in Belgrade ([8]; the quotation is from pp. 9–10), in which he quoted as its very inspiring source Saly Ruth Ramler's forgotten PhD thesis. In his introduction he wrote these words which realistically characterized Ramler's mathematical results:

In the plane and in three-dimensional space the following theorem is well-known: any Euclidean displacement may be written as the product of two line reflections. It can be applied for instance to develop an elegant method to study three positions theory in Euclidean kinematics. The reflection has an analog in affine geometry. For the affine space such a transformation $R(m; U)$ is defined as follows. Let a line m , the mirror, and a plane V , the direction plane, be given; m and V are not parallel. If P is an arbitrary point, V' the plane through P parallel to V , S its intersection with m , then the point P' corresponding to P is on the ray PS , such that $PS + SP' = O$. Obviously $R^2 = I$, the unit transformation; furthermore R is volume-preserving. The product $T = R_2R_1$ of two reflections is an affine, volume-preserving transformation, an equi-affinity. The question arises whether any equi-affinity can be factorized as the product of two reflections. RUTH STRUIK [1] studied this problem long ago by the methods of synthetic geometry. Her interesting and somewhat surprising results are: the property is valid for the analogous problem in the plane, but it does not hold in space. She added the positive theorem: an equi-affinity in space is always the product of three reflections. In the following note we consider, by analytical means, all possible products $T = R_2R_1$, with $R_i = (m_i; U_i)$, $i = 1, 2$ and study the properties of T . It will be seen that the set T does not

³⁸See review MR0513833, available at the address <http://www.ams.org/mathscinet>.

³⁹Oene Bottema (1901–1992) was a Dutch mathematician who defended his PhD thesis named *Figuur van vier kruisende rechte lijnen* at the University in Leiden in 1927 under the guidance of a geometer Willem van der Woude (1876–1974) and taught at the Technical University in Delft.

cover all equi-affinities, which confirms RUTH STRUIK'S statement.

Hilda Falk (1897–1942) defended her PhD thesis in 1921 under the guidance of G.A. Pick and obtained her PhD degree at the Faculty of Science of German University in Prague. She never married and became a professor of mathematics and physics, later a director of the famous secondary girl school in Prague II. In 1942, she was murdered by fascists in the Jewish ghetto in Riga.⁴⁰

Josefine Mayer born **Keller** (1904–?) defended her PhD thesis in 1934 under the guidance of Arthur Winternitz and obtained her PhD degree at the Faculty of Science of German University in Prague. She wrote her PhD thesis as a mother of two small children. Firstly she married Jan Jindřich Frankl, secondly Ernst John and thirdly Alfred Maria Mayer, a famous Prague newspaper owner and publisher. During the WWII, they had to emigrate from Czechoslovakia to save their lives. She never had to work regularly because she came from a very rich Prague family. She took care of her two children, daughter Sofie (born 1925) and son Petr (1930–1938). We have no information on her personal fate in the USA.⁴¹

3. Doctorates awarded at Charles University in Prague.

Marie Fabiánová (1872–1943) defended her PhD thesis in 1901 under the guidance of František Josef Studnička (1836–1903). She was the second woman who 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, later a director of a famous secondary girl school in Prague.⁴²

⁴⁰Hilda Falk defended the PhD thesis titled *Beiträge zur äquiformen Flächentheorie* (reviewers G.A. Pick and Adalbert Prey (1876–1950), Prague German professor of physics). She passed the first (main) oral examination in mathematics and theoretical physics in April 1921. She underwent the second (subsidiary) oral examination in philosophy in May 1921. She obtained her Doctorate Degree of Nature Sciences at the graduation ceremony on 6th of May 1921. Her PhD thesis is not kept in the Archive of Charles University in Prague.

⁴¹Josefine Mayer defended the PhD thesis named *Zur Axiomatik der ebenen Affinen der Geometrie* (reviewers A. Winternitz and L. Berwald). She passed the first (main) oral examination in mathematics in June 1933. She underwent the second (subsidiary) oral examination in natural philosophy in June 1933. She obtained her Doctorate Degree of Nature Sciences at the graduation ceremony on 30th of June 1933. Her PhD thesis is not kept in the Archive of Charles University in Prague.

⁴²Marie Fabiánová defended the PhD thesis named *O rozvoji dyperiodických funkcí v řady a produkty* (On the expansion of doubly periodic functions into series and

Miluše Jašková (1905–1975) defended her PhD thesis in 1928 under the guidance of Karel Petr and obtained her PhD degree at the Faculty of Science of Charles University in Prague. In 1929, she married a 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.⁴³

Helena Navrátilová (1907–?) defended her PhD in 1932 under the guidance of Professor Emil Schoenbaum and obtained her PhD degree at the Faculty of Science of Charles University in Prague. Probably she became a professor of mathematics and gymnastics at the secondary school. We have no information about her personal fate.⁴⁴

Jarmila Šimerková (1910–1975) defended her PhD thesis in 1933 under the guidance of Professor Miloš Kössler and obtained her PhD degree at the Faculty of Science of Charles University in Prague. In

products, reviewers F.J. Studnička and F. Koláček). She passed the first (main) oral examination in mathematics and physics in December 1900. She underwent the second (subsidiary) oral examination in philosophy in November 1901. She obtained her Doctorate Degree of Philosophy at the great graduation ceremony on 13th of November 1901. Only her PhD thesis is kept in the Archive of Charles University in Prague.

⁴³Miluše Jašková was a daughter of Martin Jašek (1879–1945), a famous Czech teacher of mathematics, physics, philosophy and propedeutics at the secondary girl school in Plisen. He was interested in the mathematical heritage of Bernard Bolzano (1781–1848). He partly catalogized his manuscripts deposited in Vienna and Prague. He discovered Bolzano's example of a continuous and non-differentiable function, the so-called Bolzano's function. For relevant mathematical and historical commentaries see [15]. Martin Jašek for a long time collaborated with Saly Ramler, who helped him with reading and making a list of Bolzano's manuscripts deposited in Vienna and Prague.

Miluše Jašková defended the PhD thesis titled *Rozvoj Euler-Maclaurinův* (Euler-Maclaurin series, reviewers K. Petr and B. Bydžovský). She tried to pass the first (main) oral examination in mathematical analysis and algebra in June 1928 but she did not achieve success. At the second attempt, she passed the main oral examination in December 1928. She underwent the second (subsidiary) oral examination in philosophy of exact sciences in May 1928. She obtained her Doctorate Degree of Nature Sciences at the graduation ceremony on 14th of December 1928. Her PhD thesis is not kept in the Archive of Charles University in Prague.

⁴⁴Helena Navrátilová defended the PhD thesis titled *Zákon řídkých zjevů a jeho aplikace na kolektivy pojistných událostí* (The law of rare events and its application to collections of insurance events, reviewers E. Schoenbaum and M. Kössler). She passed the first (main) oral examination in mathematical analysis and algebra in November 1932. She underwent the second (subsidiary) oral examination in philosophy of exact sciences in December 1932. She obtained her Doctorate Degree of Nature Sciences at the graduation ceremony on 19th of December 1932. Her PhD thesis is not kept in the Archive of Charles University in Prague.

1931, as a student, she married Bořivoj Iglauer (1901–?), a clerk at an insurance company in Prague. Later, she only took care of her family, her daughters Pavla (born 1932) and Jana (born 1936).⁴⁵

Věra Čechová (1910–1990) defended her PhD thesis in 1933 under the guidance of the leadership of E. Schoenbaum and obtained her PhD degree at the Faculty of Science of Charles University in Prague. Later, she worked as a specialist in an insurance company in Prague. In 1946, she married her schoolmate Dr. Otta Fischer (1909–1975), a Czechoslovak mathematician – specialist in statistics. Věra Čechová Fischerová worked all her life as an insurance specialist and took care of her family, her son Jan (born 1951) who became a specialist in statistics, an economist and important Czech politician.⁴⁶

Ludmila Illingerová (1908–1974) defended her PhD thesis in 1934 under the guidance of Václav Hlavatý and obtained her PhD degree at the Faculty of Science of Charles University in Prague. She became a professor of mathematics, drawing and descriptive geometry at a 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 (born 1936).⁴⁷

⁴⁵Jarmila Šimerková defended the PhD thesis titled *Zavedení libovolných funkcí v počtu pravděpodobnosti* (Introduction of random functions in probability, reviewers E. Schoenbaum and M. Kössler). She passed the first (main) oral examination in mathematical analysis and algebra in June 1933. She underwent the second (subsidiary) oral examination in philosophy of exact sciences in November 1933. She obtained her Doctorate Degree of Nature Sciences at the graduation ceremony on 24th of November 1933. Her PhD thesis is not kept in the Archive of Charles University in Prague.

⁴⁶Věra Čechová defended the PhD thesis named *Teorie rizika* (Theorie of risk, reviewers E. Schoenbaum and M. Kössler). She passed the first (main) oral examination in mathematical analysis and algebra in June 1933. She underwent the second (subsidiary) oral examination in philosophy of exact sciences in November 1933. She obtained her Doctorate Degree of Nature Sciences at the graduation ceremony on 15th of November 1933. Her PhD thesis is not kept in the Archive of Charles University in Prague.

⁴⁷Ludmila Illingerová defended the PhD thesis named *Loxodromická geometrie* (Loxodromical geometry, reviewers B. Bydžovský and V. Hlavatý). She passed the first (main) oral examination in geometry and mathematical analysis in October 1934. She underwent the second (subsidiary) oral examination in philosophy of exact sciences in October 1934. She obtained her Doctorate Degree of Nature Sciences at the graduation ceremony on 16th of November 1934. Her PhD thesis is not kept in the Archive of Charles University in Prague.

Ludmila Illingerová published five articles. First of them, titled *Příspěvek k neeuclidovské geometrii* [Contribution to the non-Euclidean geometry] [16], is her seminar thesis, which originated in the academic year 1931/1932 in V. Hlavatý's special seminar for philosophy of mathematics. L. Illingerová explained the “apparent” difference between Poincaré's and Klein's models of non-Euclidean geometry of the plane. V. Hlavatý in the journal *Jahrbuch über die Fortschritte der Mathematik* discussed her work in these words:

In der Kleinschen Abbildung der hyperbolischen Ebene gehen drei Punkte vier hyperbolische Kreise. In der Poincaréschen Abbildung bildet sich jeder hyperbolische Kreis auf einen Kreis ab, so daß anscheinend drei Punkte in dieser Abbildung nur einen hyperbolischen Kreis bestimmen. Es wird gezeigt, daß auch in dieser Abbildung drei Punkte vier hyperbolische Kreise bestimmen.⁴⁸

L. Illingerová participated in the Second Congress of Mathematicians of Slavic Countries, which took place in Prague in 1934. She gave a short lecture titled *Loxodromická geometrie* [Loxodromic geometry], whose German written abstract was published under the name *Die loxodromische Geometrie*.⁴⁹

One year later, she sent a short abstract of her PhD thesis *Loxodromická geometrie* to the Czech mathematical journal *Časopis pro pěstování matematiky a fyziky*. It was published under the same title [17] and contained only some basic information on the content of Illingerová's thesis. Publishing of such an abstract was necessary for the successful doctoral procedure.

In 1935, L. Illingerová published a very short mathematical note titled *Poznámka k článku p. Jos. Kopečného: Über die Bestimmung der Summe der Winkel im ebenen Dreieck* [Remark on the article of Jos. Kopečný ...], [18], in which she proved that it was impossible to use hyperbolic and elliptic plane in the regular constructive proof of the theorem on the sum of angles in the plane triangle.⁵⁰

⁴⁸See JFM 59.0553.02 or French abstract in the journal *Zentralblatt für Mathematik und ihre Grenzgebiete*, Zbl 0006.17806.

⁴⁹Zprávy o druhém sjezdu matematiků zemí slovanských, Praha 23. až 28. září 1934, *Časopis pro pěstování matematiky a fyziky* [Report of the Second Congress of Mathematicians of Slavic Countries, Prague, September 23–28, 1934, Journal for Cultivation of Mathematics and Physics] 64(1935), pp. 193–194. It was also published as an independent offprint.

⁵⁰See review in *Jahrbuch über die Fortschritte der Mathematik*, JMF 61.0967.03.

Under the name Ludmila Městková-Illingerová, she published only one article, titled *Některé znaky dělitelnosti* [Some criteria of divisibility], [23], in which she explained the criteria for divisibility by numbers 7 (resp. 49), 13, 17, 19, 37, 99 and 101 for students and secondary school teachers from the point of view of object teaching. She tried to explain and simplify the notes contained in the famous Czech textbook titled *Aritmetika pro IV. třídu středních škol* [Textbook on Arithmetics for fourth class of secondary schools] written by B. Bydžovský, S. Teplý and F. Vyčichlo, [9].⁵¹

Jiřina Frantíková (1914–2000) defended her PhD thesis in 1937 under the guidance of E. Schoenbaum and obtained her PhD degree at the Faculty of Science of Charles University in Prague. She had the special graduation ceremony attended by the President of the Czechoslovak Republic. She worked as a financial specialist in the Ministry of Finance (on the issues of the formation of the state budget, pensions and insurance) and collaborated with Professor E. Schoenbaum as the scientific secretary of the journal *Aktuárské vědy. Pojistná matematika. Matematická statistika*. In 1948, she married František Chytil (1908–?), a doctor of laws. She worked all her active life at the ministry and she also took care of her only son Ivo.⁵²

In 1937, a short abstract of her PhD thesis was published in a journal titled *Spisy vydávané přírodovědeckou fakultou Karlovy university*⁵³, which specialised in publishing of articles of such kind.⁵⁴

Jiřina Frantíková published an article in English titled *Some approximate formulas*, [12]. It was reviewed by K. Löer from Göttingen in the journal *Jahrbuch über die Fortschritte der Mathematik*⁵⁵ and by W. Simonsen from Kodaň (Copenhagen) in the journal *Zentralblatt für*

⁵¹The problem is on the page 7. The textbook was used in Czechoslovakia from the beginning of the 1930s until the end of the 1950s.

⁵²Jiřina Frantíková defended the PhD thesis named *Úrokový problém pro důchody životní s malou poznámkou pro prémiové rezervy smíšeného pojištění* (Interest income problem for life pensions with a little note about premium reserves of mixed insurance, reviewers E. Schoenbaum and M. Kössler). She passed the first (main) oral examination in mathematical analysis and algebra in November 1936. She underwent the second (subsidiary) oral examination in philosophy of exact sciences in December 1936. She obtained her Doctorate Degree of Nature Sciences at the special presidential graduation ceremony on 7th of June 1937. Her PhD thesis is not kept in the Archive of Charles University in Prague.

⁵³Praha, 1937, no. 154, pp. 11–14.

⁵⁴For more information see the review in the journal *Zentralblatt für Mathematik und ihre Grenzgebiete*, [Zbl 0018.15903](#).

⁵⁵See JFM 63.1122.04.

*Mathematik und ihre Grenzgebiete.*⁵⁶

K. Löer discussed Frantíková's results in these words:

Verf. verendet den Mittelwertsatz der Integralrechnung, um den Barwert der Leibrente, der Todesfallversicherung und der Anwartschaft eines Aktiven auf Invalidenrente, alle von der Ordnung k , (z. B. $\bar{a}_x^{(k)} = \frac{1}{k!} \int_0^\infty t^k \cdot {}_t p_x \cdot v^t dt$) näherungsweise zu berechnen. Den dabei auftretenden Zwischenwert bestimmt er dadurch, dass er den gleichen Versicherungsbarwert in zwei verschiedenen Formen darstellt.

W. Simson wrote:

Unter Benutzung des ersten Mittelwertsatzes der Integralrechnung: $\int_a^b \varphi(x)\psi(x)dx = \psi(\zeta) \int_a^b \varphi(x)dx$ ($\varphi(x) \geq 0$, $\psi(x)$ stetig und $\varphi(x)\psi(x)$ integrel im Intervall $a \leq x \leq b$) wird zunächst die Annäherungsformel: $\bar{a}_x^{(k)} = \frac{1}{k!} n_k \dots n_1 \cdot \bar{a}_x$ unter der Voraussetzung bewiesen, daß \bar{a}_{x+t} für $0 \leq t \leq \infty$ annähernd linear ist; n_ν ($\nu = 1, \dots, k$) ist mittels $n_\nu = \nu \bar{a}_{x+n_\nu}$ zu bestimmen. – Die Methode wird demnächst in analoger Weise auf die Barwerte $\bar{A}_x^{(k)}$ und $\bar{a}_x^{i(k)}$ angewandt.

Libuše Kučerová (1902–1987) started her PhD procedure in 1937 under the guidance of V. Hlavatý. Despite many problems during the WWII and post-war changes in the Czechoslovak society, she successfully finished her procedure in 1952 and obtained her PhD degree at the Faculty of Science of Charles University in Prague. 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 school-mate from the Czech Technical University in Prague, who became an officer of the Czechoslovak army. They had no children.⁵⁷

⁵⁶See [Zbl 0016.31601](#).

⁵⁷Libuše Kučerová defended the PhD thesis titled *Geometrie čtyřrozměrného Minkowskiho prostoru M_4 v souvislosti s trojrozměrnou cyklografií* (Geometry of the four-dimensional Minkowski's space M_4 in the connection with the three-dimensional cyclography, reviewers V. Hlavatý and B. Bydžovský). She tried to pass the first (main) oral examination in geometry and mathematical analysis in January 1951 (i.e., 14 years after finishing her PhD thesis, resp. 25 years after finishing her studies at the university). She did not achieve success. Secondly, she passed the main oral examination in June 1952. She underwent the second (subsidiary) oral examination

L. Kučerová wrote three articles (two short notes and one short abstract from her PhD thesis). In 1933, she published her note titled *Poznámka ke Cliffordovým rovnoběžkám* [Remark on Clifford's parallels], [20]. To characterize it, we can use the words of V. Hlavatý,⁵⁸ who was Kučerová's teacher, scientific father and supervisor of her PhD thesis:

In dem uneigentlichen dreidimensionalen elliptischen Raume des vierdimensionalen euklidischen Raumes \mathbb{R}_4 denkt man sich die Clifford'sche orthogonale Fläche. Je zwei Geraden desselben Systems auf dieser Fläche führen auf Ebenenpaare (des \mathbb{R}_4) mit gleichen Extremalwinkeln.

We note that L. Kučerová got interested in the problems of the four-dimensional geometry under the beneficial and strong influence of V. Hlavatý.

She studied a similar problem in her article titled *Poznámka k stejnoúhlým rovinám čtyřrozměrného prostoru* [A remark on isocline planes in four-dimensional spaces], [21]. She took her inspiration from many foreign as well as Czech monographs and articles.⁵⁹ Her knowledge of the classical as well as modern mathematical literature was excellent. We also note that all books were available in the Prague library of the Jednota československých matematiků a fyziků (Union of Czechoslovak mathematicians and physicists), which still exists as a part of the Library of the Mathematical Institute of the Czech Academy of Sciences.

in philosophy of exact sciences in March 1952. Let us note that she had to pass her subsidiary oral examination according to the "new" philosophy of the communist ideology. She obtained her Doctorate Degree of Nature Sciences at the graduation ceremony on 28th of March 1952. Her PhD thesis is not kept in the Archive of Charles University in Prague.

⁵⁸See *Jahrbuch über die Fortschritte der Mathematik*, JFM 59.0554.01.

⁵⁹For example she quoted the following works: H. de Vries: *Die Lehre von der Zentralprojektion im vierdimensionalen Raume* (1905), W. Vogt: *Synthetische Theorie der Cliffordschen Parallelen und der linearen Linienörter des elliptischen Raumes* (1909), R. Bonola: *Die nichteuklidische Geometrie – historisch-kritische Darstellung ihrer Entwicklung* (1919), H. Liebmann: *Nichteuklidische Geometrie* (1923), L. Bianchi: *Lezioni di Geometria differenziale*, volume II (1924), F. Klein: *Vorlesungen über nichteuklidische Geometrie* (bearbeitet von W. Rosemann, 1928), V. Jarolímek: *Základové geometrie polohy v rovině a v prostoru* (volume I and III, 1908 and 1914), Ed. Weyr: *Projektivná geometrie základných útvarů prvního řádu* (1898), V. Hlavatý: *Úvod do neeukleidovské geometrie* (1926) and F. Kadeřávek, J. Klíma, J. Kounovský: *Deskriptivní geometrie* (volume II, 1932), J. Klíma: *K určení úhlu dvou rovin v prostoru čtyřrozměrném a některé úlohy s tím související*, *Časopis pro pěstování matematiky a fyziky* 62(1933), pp. 132–139.

For more information see the review published in the journal *Jahrbuch über die Fortschritte der Mathematik*, JFM 61.1383.13.

The last known mathematical work of Kučerová is titled *La géométrie de l'espace à quatre dimensions de Minkowski en connexion avec la cyclographie à trois dimensions. Laboratoire pour la philosophie des mathématiques*, [22]. It is a French-language abstract of her PhD thesis. See *Jahrbuch über die Fortschritte der Mathematik*, JFM 64.0661.05.

Věra Kofránková (1909–1996) started her PhD thesis in 1937 under the guidance of V. Hlavatý, but she never finished her major examination in mathematics. She married a Czech mathematician Zdeněk Pírko (1909–1983), her school-mate. Later they divorced. V. Kofránková worked as a professor at secondary schools in Prague. She taught mathematics, drawing and descriptive geometry. During all her life she took care of her only daughter Ivana (born 1945), who became a gynecologist.⁶⁰

* * * * *

All the female doctoral candidates were, at that time, Czechoslovak citizens⁶¹ of Czech or German nationality. The candidates of Czech nationality studied exclusively at a Czech university, namely Charles University in Prague, whereas the candidates of German nationality studied exclusively at a German university, namely German University in Prague.

All the female candidates, at the time of their studies, professed a religion, as was more or less usual in the Czech lands. All the German candidates were of Jewish religion, one of them however changed her religion during her studies, even twice. The Czech female candidates were of Roman-Catholic religion, one of them converted to the Czech Brethren Church during her studies, and one of them left the Roman-Catholic Church in the 1950s.

The majority of the female candidates (except for one) descended

⁶⁰Věra Kofránková wrote the PhD thesis titled *Křivky, jejichž poloměr křivosti je lineární kombinací poloměrů křivosti konečného počtu daných křivek, aplikace* (Curves whose radius of curvature is a linear combination of the radii of curvature of finite numbers of curves, applications, reviewers V. Hlavatý and B. Bydžovský). A very short abstract of her thesis was published in the journal titled *Spisy vydávané přírodovědeckou fakultou Karlovy university* (Praha, 1936, no. 150, pp. 33–37). She passed only the second (subsidiary) oral examination in philosophy of exact sciences in May 1937. Her PhD thesis is not kept in the Archive of Charles University in Prague.

⁶¹Because of the origin of her parents, one female candidate had to apply for Czechoslovak citizenship in the administrative procedure.

from socially well-situated, the so-called “middle-class” families, which valued education and supported educational, cultural, athletic and other general activities pursued by their daughters. Their fathers descended mainly from socially lower but financially solid levels (farm or manor administrators, farmers, craftsmen, lower school teachers). This provided the female candidates with financial means, but did not give them sufficient intellectual background.

Father's profession	German female doctors	Czech female doctors
secondary school teacher	0	3
engineer	0	2
clerk	0	2
physician	0	1
lawyer	1	0
municipal school teacher	0	1
entrepreneur	1	0
retailer	1	0

Table 1: Social background of the candidates.

The German doctoral candidates studied, at various times, at the same German gymnasium for girls in Prague II. The Czech candidates studied at Czech secondary schools (real gymnasiums, real reformed gymnasiums and real schools). Only the first Czech doctoral candidate studied at the time when the schools for girls did not have the same rights as the schools for boys and that is why she had to undergo an additional graduation examination at the classical gymnasium for boys in Štěpánská Street in Prague. None of the candidates studied at a classical gymnasium, which emphasized Latin, Greek, history and geography and which was usually preferred by students of humanistic subjects.

High school	German female doctors	Czech female doctors
German gymnasium for girls	3	0
Czech real school	0	3
Czech real gymnasium for girls	0	2
Czech reformed real gymnasium for girls	0	2
Minerva school for girls (“Krásnohorská”)	0	2

Table 2: High-school education of candidates.

Another matter of interest is the duration of the studies of individual female doctoral candidates in mathematics. The average duration of the studies was nine semesters, which was in accordance with the requirement of that time, since the minimum duration of doctoral studies was prescribed to be eight semesters of university studies. The shortest duration of university studies of a candidate was five semesters, the longest duration was fourteen semesters. If we include also the duration of the studies of the Czech candidates in a technical school, resp. the duration of the studies of the German candidates abroad, the shortest duration of their studies was nine semesters, whereas the longest duration was twenty-two semesters. It is also a point of interest that in particular the Czech candidates studied not only mathematics, but also modern foreign languages (French, English, and Italian), history, philosophy and arts. Even physical training was not omitted. The scope of their interests was very wide.

All the German female doctoral candidates properly submitted their doctoral theses, which were accepted and were successful right at the first defence of both PhD examinations. Two of the Czech candidates failed at the first attempt at the main PhD examination in mathematics, however, they were successful at the remedial examination. One of the Czech candidates missed the main PhD examination in mathematics and did not obtain the doctorate. All the German and Czech candidates underwent an examination in philosophy, later changed to philosophy of exact sciences, within the framework of the subsidiary PhD examination.

The majority of the female doctoral candidates in mathematics (except for one) submitted their doctoral thesis, passed both PhD examinations and obtained doctorate within, at the latest, two years after the completion of their studies, most often already in the last year of their studies. This means that they did not prolong their studies, did not postpone submission of their theses and their examinations as is usual nowadays. Let us complete the information with the fact that many of them, apart from doctoral procedure, simultaneously underwent also the demanding examinations of teaching proficiency (two of the three German female doctors,⁶² six of the nine Czech female doctors⁶³).

The first doctorate was awarded to a Czech candidate already in the year 1900. Afterwards, however, there was a pause of almost thirty

⁶²Both German doctoral candidates in mathematics passed examinations of teaching proficiency for the subject mathematics – physics.

⁶³Four Czech doctoral candidates in mathematics passed the examination of teaching proficiency for the subject mathematics – descriptive geometry, one candidate for mathematics – physics, and one for mathematics – physical training.

Number of semesters of university studies	German female doctors	Czech female doctors
five	0	1 ^a
six	0	2 ^b
seven	0	0
eight	0	2 ^c
nine	1	1 ^d
ten	1	2 ^e
eleven	0	0
twelve	0	0
thirteen	1 ^f	0
fourteen	0	1 ^g

^a At the same time, the candidate also studied four semesters at Czech Technical University in Prague.

^b Mostly at the same time, both the candidates also studied four semesters at Czech Technical University in Prague.

^c One candidate also studied two semesters at University in Vienna.

^d At the same time, the candidate also studied eight semesters at Czech Technical University in Prague.

^e One candidate also studied four semesters at Czech Technical University in Prague, the other also studied six semesters at the same school.

^f The candidate probably also studied two semesters at University in Leipzig.

^g Mostly at the same time, the candidate also studied eight semesters at Czech Technical University in Prague.

Table 3: Duration of the studies of individual female doctoral candidates in mathematics.

Number of years after accomplishment of the studies till the graduation	German female doctors	Czech female doctors
0 year ^a	2	5
1 year	0	2
2 years	1	0
25 years	0	1

^a The zero for the years indicates that the candidate submitted her doctoral thesis in the last year of the studies, passed both the PhD examinations and her doctoral graduation took place in the same calendar year.

Table 4: Duration of studies.

years at Charles University (i.e. Czech University), whose reasons are unknown. Further Czech female doctors in mathematics appeared as

late as in the late 1920s and especially in the first half of the 1930s. The Czech candidates of the 1930s probably knew each other, studied at the same university or technical university,⁶⁴ chose the same lectures and optional seminars. Two candidates knew each other already at the time of their secondary school studies because they studied at the same secondary school for girls in Pilsen. One of the female candidates studied at the school where the first Czech female doctor in mathematics worked as a secondary school professor and headmistress.

The first doctorate in mathematics at the German University in Prague was awarded to a woman as late as in 1919, i.e. almost twenty years after the first doctorate in mathematics was awarded at the Czech University. The second doctorate in mathematics was awarded in 1921 and the third one in 1934.

Year when doctorate was awarded	German female	Czech female
1900	0	1
1919	1	0
1921	1	0
1928	0	1
1932	0	1
1933	0	2
1934	1	1
1936	0	1
1952 ^a	0	1

^a The last candidate did submit her doctoral thesis already in 1937, but she took the PhD examinations as late as the early 1950s.

Table 5: Dates of awarding of doctoral degrees.

Let us finish by giving a summary of occupations that the female doctors and doctoral candidates in mathematics pursued after the accomplishment of their doctoral procedures. It is no surprise that almost half of them worked as secondary school professors (five out of twelve),

⁶⁴Four of the nine Czech candidates studied insurance mathematics at the Czech Technical University in Prague, the other three candidates studied “a course for future teachers of descriptive geometry.” Let us mention that the study of insurance mathematics was, in the 1920s and 1930s, relatively popular among women because it enabled them to get prepared for many professions (e.g. insurance technician, statistician, clerk in a bank, insurance house, pension funds, financial administration, accounting firm). The popularity of the course was enhanced by its duration, which was only two years.

a quarter of them became as housewives (three out of twelve), one of them was a housewife and worked as a mathematician only occasionally, one of them worked, all her life, at the Ministry of Finances, one of them worked, all her life, at the insurance company in Prague. Occupation of one of the female doctors could not be ascertained; most probably, she worked as a secondary school professor.

* * * * *

Various archives and library collections were investigated for three years (e.g. Archive of Charles University in Prague, Archive of the Czech Technical University in Prague, National Archive of the Czech Republic, Archive of the Academy of Sciences of the Czech Republic, Prague City Archive, State Regional Archive in Pilsen, State Regional Archive in Litoměřice, State Regional Archive in Zámorsk, Authority of the Municipal District of Prague I, Municipal Authority in Náměšť nad Oslavou, National Conservation Fund of the Czech Republic, Jewish Museum in Prague, Administration of Prague Cemeteries (Olšany, Vinohrady, Malvazinky, Bubeneč), National Library of the Czech Republic, Basic Library of the Academy of Sciences of the Czech Republic, Library of the Mathematical Institute of the Academy of Sciences of the Czech Republic). I am grateful to colleagues at these institutions for their support and assistance in providing archival materials and literature.

Various other materials were gathered. It is interesting that it was possible to find fewer sources on studies of the German candidates, but considerably more sources of information for a deep analysis of their careers and lives. This is due to the fact that the official materials of German schools and institutions were, in the past, more liable to discarding and destruction owing to the political development than the materials of the Czech ones. On the other hand, the personal materials of the German candidates in the National Archives of the Czech Republic were better preserved and accessible because they were not classified as so-called “living,” respectively “unprocessed” or “inaccessible” sources. The lives of the Czech doctoral candidates in mathematics could be reconstructed only partially, thanks to the willingness of their direct relatives. Searching for them was demanding and resembled rather a detective story.⁶⁵

⁶⁵More information about the complicated lives and sad war fates, about families and professional activities of the first eleven female doctors and one doctoral candidate in mathematics will be available in the book M. Bečvářová: *Female doctors in mathematics at the universities in Prague (a brief probe in the personal fates)*, which is in preparation.

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Kobiety i matematyka na uniwersytetach w Pradze w I połowie XX wieku

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Streszczenie. Niniejsze opracowanie poświęcone jest dwunastu kobietom, które przygotowywały się do doktoratów z matematyki na Wydziale Filozoficznym Czeskiego Uniwersytetu w Pradze w latach

1882–1920 i 1921–1945 (noszącego nazwę Uniwersytetu Karola w tym późniejszym okresie), jak również na Wydziale Nauk Przyrodniczych Niemieckiego Uniwersytetu w Pradze w latach 1882–1945. W pierwszej części artykułu przedstawiono krótkie tło historyczne o studiach kobiet na wyższych uczelniach na ziemiach czeskich i statystykę przewodów doktorskich w obu praskich uniwersytetach dla lepszego zrozumienia sytuacji dotyczącej przewodów doktorskich kobiet. W drugiej części artykułu zaprezentowano zakończone pomyślnie przewody w zakresie matematyki trzech kobiet na Uniwersytecie niemieckim w Pradze oraz osiem przewodów na Uniwersytecie Karola, a także jeden przewód, który nie zakończył się obroną.

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