

Jarník's note of the lecture course Punktmengen und reelle Funktionen by P. S. Aleksandrov (Göttingen 1928)

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In: Martina Bečvářová (author); Ivan Netuka (author): Jarník's note of the lecture course Punktmengen und reelle Funktionen by P. S. Aleksandrov (Göttingen 1928). (English). Praha: Matfyzpress, 2010. pp. 47–49.

Persistent URL: <http://dml.cz/dmlcz/401005>

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JARNÍK'S NOTEBOOKS FROM GÖTTINGEN

From the 1870's onwards, the most talented and outstanding mathematicians and physicists from the Czech lands went abroad, enabled by government scholarships and funding, in order to extend and deepen their mathematical knowledge and skills. Among these were Ludvík Kraus, František Machovec, Jan Vilém Pexider, Antonín Sucharda, Josef Sylvester Vaněček, Eduard Weyr, Emil Weyr, August Leo Otto Biermann, Karl Bobek, Seligman Kantor, František Nachtikal, August Seydler, Vincenc Strouhal. Others went to complete their doctoral degrees or to publish their books or papers. They travelled mainly to Germany, France or Italy and studied in the most prestigious mathematical centers of the period, at Berlin, Göttingen, Hamburg, Leipzig, Munich, Paris, Strasbourg, Milano, and Rome. Here, they hoped to be more closely involved in the latest mathematical trends and methods and to become acquainted with the newest ideas in the field; they also hoped to be able to have their first papers accepted by respected journals and their first monographs issued by internationally known publishing houses; and finally, they sought out the most advanced education methods which they could bring back with them on their return to universities and polytechnics in the Czech lands.

These trends continued through the first three decades of the 20th century, when Czech and German mathematicians from the Czech lands obtained scholarships to study in Göttingen (Josef Grünwald, Vojtěch Jarník, Jan Vilém Pexider, Ladislav Seifert, Emil Schoenbaum, Václav Simandl, František Vyčichlo), in Hamburg (Otakar Borůvka, Vladimír Kořínek), in Munich (Ludwig Berwald) and in France or Italy (Otakar Borůvka, Eduard Čech, Václav Hlavatý, Václav Pleskot, Václav Posejpal, František Rádl, Ladislav Seifert, František Vyčichlo).

Basic characterization

Among of the most special archival materials from this period deposited in the Archive of the Academy of Sciences of the Czech Republic are fourteen "notebooks" which contain the lectures of Emmy Amalie Noether, Karl Grandjot, Pavel Sergeevich Aleksandrov and Bartel Leendert van der Waerden. These notebooks were kept by Vojtěch Jarník, the future prominent mathematician, during his studies at Göttingen in the academic years 1923/1924, 1924/1925 and 1927/1928.

The notebooks were discovered by Jindřich Bečvář in 2004 when he was preparing an extensive monograph on the life and work of Vladimír Kořínek (1899–1981), an outstanding Czech algebraist of the 20th century.¹ Kořínek's unusually vast archival collection containing his personal, pedagogical and

¹ Z. Kohoutová, J. Bečvář: *Vladimír Kořínek (1899–1981)* (in Czech), Edition History of Mathematics, volume 27, Research Center for the History of Sciences and Humanities, Prague, 2005.

professional materials as well as some materials of his friends and colleagues from Charles University and the Czech Academy of Sciences is of special interest as it allows us to trace the development of mathematics in our country.²

Although Jarník and Kořínek were good friends and colleagues, we are not able to explain how Jarník's notebooks came to be deposited in Kořínek's archival collection. As we described in the chapter devoted to Jarník's life, we know that he studied modern structural algebra under Noether in the academic year 1923/1924 and 1924/1925: the notebooks contain her lectures titled *Invariantentheorie* (summer semester 1923/1924), *Körpertheorie* (summer semester 1923/1924), *Gruppentheorie II.* (winter semester 1924/1925), *Hyperkomplexe Zahlen und Gruppencharaktere* (winter semester 1927/1928); the theory of numbers and modern structural algebra under van der Waerden in the academic year 1927/1928: the notebooks contain his lectures titled *Allgemeine Idealtheorie* (winter semester 1927/1928) and *Algebraische Zahlen* (summer semester 1927/1928); modern algebra under Grandjot in the winter semester in 1927/1928: the notebooks contain two of his lectures titled *Algebra II* and *Galoissche Theorie*; and analysis under Aleksandrov in the summer semester 1927/1928: the notebook contains his lecture titled *Punktmengen und reelle Funktionen*. It is not without interest that Jarník attended lectures predominantly on modern algebra and very rarely those on number theory and analysis, although these two topics represent his main mathematical subjects.

Jarník's notes were kept in small rectangular exercise books ($16,4 \times 20,6$ cm) each with a hard black cover; they have been preserved in an amazingly good condition. His German notes are carefully written in blue ink; almost everything is legible. They have few grammatical and syntactic mistakes, almost no corrections and contain very few inaccuracies.³ Each notebook has 120 pages, usually completely filled with notes. On the interior page of the cover, Jarník's Göttingen address is written (in the academic year 1927/1928 – Dr. V. Jarník, Göttingen, Bühlstrasse 28).

Jarník's notebooks give us a record of Göttingen's mathematical lectures and seminars, which were very popular in the Czech lands before the Second World War. They also provide information on mathematics and teaching in Göttingen, information not generally known even in Germany. Most importantly, they were written by an excellent Czech mathematician who possessed an acute understanding of the material being presented. Since we do not have many similar documents from that time, they are a unique contribution to our understanding of this period, and should be interesting not only for mathematicians, but also for historians, linguists and everyone who wants to learn something about mathematics in the first half of the 20th century.

² In the Archive of the Academy of Sciences of the Czech Republic, there are 46 archival boxes of V. Kořínek's documents.

³ Only the records of Noether's lectures are not quite so clear, but as we know from the recollections of her students, she was not a good lecturer.

Aleksandrov and his Punktmengen und reelle Funktionen

After some discussion we decided to start with a study of Jarník's fifth notebook.⁴ The following section therefore contains the lecture course of Aleksandrov titled *Punktmengen und reelle Funktionen*⁵ taken from his notebook plus our commentary.

In this notebook Jarník did not write down the dates of the lectures as he usually did in other notebooks. From his inscription we know that he attended Aleksandrov's lectures in Göttingen in the summer semester 1927/1928. We do not know precisely the period in which the course was delivered and how many lectures it consisted of. However, Aleksandrov stayed in Göttingen between June 4 and August 4, 1928. In fact, in the letter from Princeton, dated April 20, 1928, Aleksandrov wrote to Hausdorff:

Ich bleibe hier bis zum 25. Mai – an welchen Tage ich mit dem Dampfer "Carmania" wieder nach Europe zurückkehre. Am 4. Juni hoffe ich bereits in Göttingen zu sein (wo ich wieder den ganzen Sommer) (d.h. den Rest des Sommersemesters) zu verbleiben beabsichtige.

In the letter from Batz (Loire-Inférieure), dated August 9, 1928, Aleksandrov informs Hausdorff about his dental problems during his stay in Göttingen, which made the visit to Hausdorff impossible:

*... ich könnte zu Ihnen also frühestens Sonnabend abends kommen, also am 5. VIII. abends, und das war natürlich schon zu spät.*⁶

Jarník's notes can be naturally divided into three parts: *Punktmengen* (47 pages), *Bairesche Funktionen und Borelsche Mengen* (24 pages) and *Suslinschen Mengen* or *A-Mengen* (36 pages).

The contents of the notebook carefully follows that recorded by Jarník. No corrections according with contemporary German orthography have been made. Only some missing full stops at the end of the sentences and some evidently missing letters (for example "e" in the word Bairesche) were added. Some paragraph breaks were introduced to allow a clearer understanding as Jarník usually wrote from margin to margin and the division of his text is not easy to follow. Jarník's symbol for the proposition – the simple twiddle on the left margin – was replaced in the computer transcription by two vertical segments on the left margin.

⁴ It is intended that this work will continue in the near future.

⁵ The first 107 pages of the notebook contain Aleksandrov's lectures, the last nine pages of the notebook contain a short part of van der Waerden's lecture titled *Algebraische Zahlen* which continues in Jarník's ninth notebook, and the remaining four pages are blank.

⁶ The letters are available in *Nachlass Hausdorff*, Kapsel 61, Universitäts- und Landesbibliothek Bonn, Handschriftenabteilung; we thank to Professor Walter Purkert for this information and the permission to reproduce the text.