ARCHIVUM MATHEMATICUM (BRNO)
Tomus 33 (1997), 9 – 12

FROM THE RECOLLECTIONS OF OTAKAR BORŮVKA - THE FOUNDER OF THE BRNO SCHOOL OF DIFFERENTIAL EQUATIONS

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Dedicated to the memory of Professor Otakar Borůvka

The aim of this contribution is to get the reader acquainted by means of the recollections of Otakar Borůvka and archives material with the events accompanying the birth of the Brno school of differential equations. The recollections are drawn from the records of the Ethnographical Institute of the National Museum in Brno, where they were made on the occasion of the 90th birthday anniversary of O. Borůvka. The source of the other information was his personal archives. They contain a great amount of material speaking not only about his pedagogical and scientific activity, but also about his private life. It includes e.g. the manuscripts of his scientific papers and lectures, a detailed documentation of his travels abroad, lecture stays and international conferences, extensive working and private correspondence and many others.

The first deep contact of O. Borůvka with the theory of differential equations was evidently his paper *Über die partiellen Differentialgleichungen, denen hermitesche Formen genügen* dating back to the year 1934. That originated in the period of his scientific work in differential geometry. At the end of the 1930s and in the early 1940s Prof. Borůvka dealt exclusively with the theory of groupoids, groups and decompositions. Towards the end of World War II, when it was necessary to think of the renewal of pedagogical and scientific work, O. Borůvka, on the basis of the discussion with the outstanding Prague mathematician František Vyčichlo, decided to change the orientation of his scientific work and pass from algebra to differential equations.

Immediately after the war he started organizing special lectures and seminars for students devoted to differential equations. Thus, in the winter term 1945-46 he lectured differential equations to the extent of 5 lessons a week. From the point of view of the further development of differential equations the most important can be considered the mathematical seminar in which, under his heading, students spoke on the topics from differential equations proposed by him.

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In 1947 O. Borůvka founded the scientific Seminar on Differential Equations in which mathematicians from the whole republic participated. From about 1952 its members with O. Borůvka at the head oriented above all on linear equations of the 2nd order and then on equations of higher orders with the final aim of building up their theory. The first results of such a theory were published by O. Borůvka in 1953 in the Czech. Math. Journal in the paper *О колеблющихся интегралах дифференциальных линейных уравнений 2-ого порядка.* In the same year he also presents his results abroad for the first time at the VIIth Congress of Polish Mathematicians in Warsaw by the lecture entitled: *Propriétés nouvelles des intégrales des équations differetielles ordinaires linéaires du second ordre.*

The archives also include interesting documentation witnessing the fact that O. Borůvka, under the influence of discussions with Prof. Vyčichlo, decided to write a textbook on differential equations. In the end it was not published, although Prof. Borůvka had been working at it for many years.

In the letter of 23 January, 1943 Borůvka informs Vyčichlo that he would enter into writing such a textbook and already in December of the same year he writes: "*Now I study hard and I write about differential equations, but the book is still in a very far future.*" From the letters that Borůvka and Vyčichlo exchanged in further years it is clearly evident that O. Borůvka was working intensely at that textbook. At the end of 1949 the manuscript was evidently almost finished. On 21 October, 1949 Vyčichlo writes to Borůvka that he must state the date to the printing office, when the manuscript will be submitted to the composition and that it is planned for the second half of 1950. In his answer of 31 October, 1949 Borůvka asks not to state differential equations in the binding way in the publication plan for 1950 and he continues: "*My book about differential equations in the real domain will contain much material and will hand an overview of the greatest part of the theory of differential equations, I think in some respects better than e.g. Kamke or Sansone. This can be achieved in a relatively small volume, because in elements I can refer to Czech textbooks (Petr, Jarník, Čech).*"

This is the last mention of the prepared textbook in the archives. The book, however, did not see its edition. The fact remains that the first and the only textbook by Borůvka on differential equations is the mimeographed textbook for students which appeared in Bratislava in 1961.

And how does Prof. Borůvka himself remember that period?

"*Already in 1944, when it was clear that the war would be over soon and that the victory of the Allies was certain, it was necessary for me to think about my future activity realistically, i.e. on the one hand my pedagogical activity, but also my scientific one as well.*"

As for the pedagogical activity, it was necessary to see to it that those students who started studying before the war might accomplish their studies and the newcomers might begin studying ... How to organize lectures to satisfy all those students?

"In this respect I did not worry ... I was rather thinking of what trend to start, as far as scientific work was concerned. At that time scientific work was not controlled in any way and the professors bore the responsibility personally and individually and I had not a good overview of what it looked like in this country on the whole and in what direction scientific work in mathematics should continue.

I went to Prague, it was at the end of 1944, to consult the matter with my colleagues. I spoke above all to František Vyčichlo whom I estimated very much. We discussed the matter thoroughly and arrived at the conclusion that it was essential to start pursuing the theory of differential equations which is immensely important as far as applications are concerned and which was much neglected before the war and in essence it was not at all developed."

"And since we did not see anyone that would take up that task, I declared that I would take the matter myself, although it was not an easy decision, because it meant to change the field of my scientific work."

Thus Professor Borůvka changed the topic of his scientific work for the fourth time. First he passed from mathematical analysis to differential geometry, in later years he oriented himself on algebra and now he was to addict himself to differential equations.

"Well, I set to work with zest and soon I found a problem, and I think that was the greatest success I somehow achieved in this field, because I found a very broad and a very, very hopeful and useful problem."

This problem was "The Study of Global Properties of Linear Differential Equations of the n-th Order".

"Very soon I recognized that it was an immensely difficult problem of long lasting which I could not master with my own forces in the near future. The problem, the main problem and difficulty was the fact that here there occurred absolutely new questions which had no models, no basic concepts were known, not to mention any methods that would permit some systematic study, etc. And that is why I came with the idea that the solution of that problem was possible only in that way that in the first period one would acquire some experience in the simplest cases and only in the second period, on the basis of the found concepts and obtained experience one would go to the extension of those results to the most general case. And I did so in that way."

Hence O. Borůvka began with the study of differential equation of the 2nd order, as the simplest and from the point of view of further generalization the most important case of differential equations of the n-th order. At that time it was not at all sure whether the equations of higher order would not behave differently from what would be expected from what he would learn about equations of the second order. Also there was a certain risk, it might have happened that, when the theory of differential equations of the n-th order were finished, equations of the second order would disappear in it as an unimportant case. Professor Borůvka was aware of all those dangers, but, despite all that, he set to work with great zest.

"I fought my way at the beginning with difficulties, but at the end I succeeded in getting a number of excellent fellow workers, I distributed them the topics occurring to me in the course of my work, students working at their doctor's dissertation theses joined us and thus it happened that within fifteen years my monograph appeared, first of all in German..."

By his lecture on this new theory of transformation of linear differential equations O. Borůvka opened the first international conference Equadiff I which took place in Prague in 1962. The overview of the present state of the transformation theory is described in the paper by F. Neuman *Transformation Theory of Linear Ordinary Differential Equations - From Local to Global Investigations*, published in this volume.

Ending our recollections of Otakar Borůvka let us remind his wisdom with several fragments from discussions with him at the close of his life. *"I would like to remember facts in my life that were essential not only for me personally, but chiefly for mathematics and for the future mathematical generation:*

Before every serious task I try to find carefully and dutifully how to fulfil it in the best way, and when I find a solution, I carry it as best as I can according to my best sense and conscience and with all my might. I consider success a natural consequence of my activity and I do not ascribe it a particular importance. I consider failures to be signs of the complexity of life and I draw information from them. But I am never sorry for my decisions, because at every moment I acted as best as I could.

...

And maybe just because none of us knows which day will be his or her last, I tried knowingly and according to my powers to live in each of them fully and to work. In the same way as my teachers lived - Matyáš Lerch, Ladislav Seifert and Eduard Čech - they gave me a lot - I also feel the duty to pass most of it to the young talented generation. They always sided with the talented and diligent ones, that was their and in the end also my creed: I will set you on the horse, but you must ride the horse yourselves."

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