Conference on functional analysis
September 4-10, 1960, Warsaw

by

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The Conference was sponsored by the Mathematical Institute of the Polish Academy of Sciences. The opening was solemnly dedicated to the memory of great Polish mathematician Stefan Banach, who developed functional analysis into an independent mathematical discipline. The memorial celebration which coincided with 15th anniversary of his death was held in Warsaw under the auspices of the Presidium of the Polish Academy of Sciences. The scientific meetings were in Palace Campus of the Polish Academy of Sciences in Jabłonna by Warsaw, and there the closing session was held.

The main purpose of the Conference was to present and discuss the actual state of investigation over-the-world of structure of topological vector spaces and topological algebras. The lectures on this topic were to give a survey of results obtained up to the moment concerning fundamental properties of topological vector spaces and topological algebras of various kinds which appeared in development of functional analysis. It was not planned, however, to keep strictly within this problematics, in order to make it possible for foreign participants to present their results even if they were not much related to the main topic. To give participants ample time for free discussion, the scientific communications were not as a rule delivered in speech, but they were delivered in mimeographed form. The exception were the communications of foreign participants.

The first news on March 1960 about a conference on functional analysis to be held in Poland and coinciding with solemn celebration of 15th anniversary of death of Stefan Banach raised much interest abroad. More than 60 foreign experts expressed desire to participate, but many of them were not able to come to Poland, and eventually there were 33 participants from abroad. The most numerous group consisting of 17 persons were the American mathematicians. From the Soviet Union there was a four person delegation of the Soviet Academy of Sciences lead by S. L. Sobolev. There were also four mathematicians

from East Germany, two from Czechoslovakia, and from France, Italy, West Germany, Hungary, Bulgaria — one from each. There were many famous names among foreign participants. However, chief representants of functional analysis from France were missing, there was nobody from Japanese experts, the representation of the big centers of investigation of functional analysis in Soviet Union was rather scanty. The fact that many invited leading experts from Soviet Union were not able to participate created an essential gap. On the other hand, there were 63 Polish mathematicians working in functional analysis and its applications, including 24 professors and docents. The foreign participants were more than one third, and even though the conference was not enough representative to be called international, it was decided that scientific discussions would be exclusively in English, French, German, or Russian.

The opening session of the conference, which was dedicated to the memory of Stefan Banach, was in the Mirror Hall of Staszic Palace, Warsaw, September 4, 1960. In addition to the participants, there were present many other Polish mathematicians, and delegates of the Polish Academy of Sciences, the Warsaw University, the Council of State, and the Capital-City-of-Warsaw Municipality Council. The chairman was T. Kotarbiński, the President of the Polish Academy of Sciences.

The main point of the agenda was the address on Stefan Banach, his life and scientific activity delivered by H. Steinhaus. It was preceded by short addresses delivered by representatives of the Organizing Committee, the Council of the State, the Polish Academy of Sciences, and some foreign guests.

The first to speak was S. Mazur, the Chairman of the Organizing Committee. Explaining why the Conference on Functional Analysis is dedicated to the memory of Stefan Banach, he said: "To the genius of Stefan Banach, we owe the existence of functional analysis as an independent mathematical discipline. He shaped its fundamental notions and proved its fundamental theorems. Like an appearance of any new scientific discipline the appearance of functional analysis was the final stage of a long historic process. The list of mathematicians whose investigations added to that process is long. There are as famous names as Vito Volterra, David Hilbert, Jacques Hadamard, Maurice Fréchet, and Frédéric Riesz. But the year 1922 was a turning point for mathematics of our century. In that year Stefan Banach published his doctoral dissertation *Sur les opérations dans les ensembles abstraits et leur application aux équations intégrales* in one of the first volumes of a Polish journal "Fundamenta Mathematicae". That short dissertation finally established the foundations of functional analysis, a new mathematical discipline, which was of paramount importance not only for mathematics, but also for the whole science, and especially for physics". After having explained the importance of functional analysis, concluded Mr. Mazur: "In less than fourty years that passed since Stefan Banach doctoral dissertation was published the functional analysis has grown into a huge part of mathematics which attracs attention of more and more mathematicians all over the world. The ideas of Stefan Banach were much developed and perfected by investigations of Polish mathematicians as well as those in big centers of functional analysis in Soviet Union, the United States of America, and in France. The development of functional analysis up to the present moment has shown that the concepts created by Stefan Banach have a permanent scientific value. The functional analysis is a lasting monument of its founder".

The next speaker was Vice-President S. Kulczyński. Stefan Banach, he said, was the most prominent mathematician in history of Polish mathematics, and one of the most eminent Polish scientists, the discoveries of whose are lasting contribution to human culture. He analyzed the conditions in which the scientists worked in Poland between the Wars and after the Second World War, and concluded that may be the influence of the ideas born in Banach's mind would be greater if he would have worked in better conditions, or like those now existing in Poland.

In the name of Polish Academy of Sciences T. Kotarbiński spoke about Banach as of one of the most prominent Polish scientists, and expressed admiration for his mathematical genius.

Particular interest raised the speeches of foreign mathematicians. They appraised the functional analysis and especially the discoveries of Stefan Banach in this scope and their meaning for the development of mathematics and science. S. L. Sobolev, the Chairman of the delegation of the Soviet Union Academy of Sciences, spoke in the name of Soviet mathematicians. Said Mr. Sobolev: "Exactly fifteen years ago the world science suffered a severe loss — Stefan Banach died. This brilliant and deep mathematician, one of the founders of the most important modern mathematical trend — the functional analysis, left to humanity many important discoveries and excellent achievements of human genius. His works were numerous, and he created his own mathematical school whose pupils and continuators can be found all over the world.

The first half of XX century was the time of unusual discoveries in physics and mathematics. As a result of scientific revolution in physics caused by the discovery of the theory of relativity and the quantum theory the picture of modern science changed thoroughly, and so did the ideas of scientists. The classical ideas of space and time, and physical values vanished. In the language of modern physics the physical values are operators — and that notion was not known in XIX century. The whole set of ideas of modern physics, its fundamental notions grew on the ground already prepared by achievements of new mathematics.

The scientific revolution in mathematics, as important as that in physics, ran parallel to it, or even a little in advance. In mathematics the old concepts were not thrown away, the already existing ideas did not have to be abolished. It would not be in keeping with the character of mathematics. But here too, much like in physics, quite unexpectedly a discovery occurred of an immense new world, a new universe, and as a result the old mathematical truths appeared in new light. At present, there is no mathematical discipline where the influence of functional analysis could not be felt. The functional analysis gives a touch of modernity". Next he explained the fundamental meaning of the works of Stefan Banach for development of mathematics, and especially such classical parts of mathematical analysis as the theory of differential equations, theory of integral equations, and theory of numerical methods, and for development of physics. Speaking about the influence of Stefan Banach and his associates on Soviet mathematics between the Wars, said Mr. Sobolev: "We all then still young beginning Soviet scientists were under the influence of the Lvov mathematical school, Banach himself and his close friends and pupils. Some of them do not live today, like Schauder, others are still working. Results of investigations directly related and based on the results of Stefan Banach were often published in the Soviet Union during the last quarter of the century, and still are. Banach was one of most excellent representants of the Polish mathematical school, whom it owes its world position". Concluding, Mr. Sobolev spoke about his personal impression of Stefan Banach great personality. Said he: "Polish nation gave to humanity such people like Frédéric Chopin, Adam Mickiewicz, Marie Skłodowska, who will stay forever in history of human culture, and has every reason to take pride of its great son — Stefan Banach, whose name will always be bound with development of mathematics in XX century".

M. H. Stone spoke in the name of the group of American mathematicians: "The influence of Stefan Banach on mathematics of our century gives him lasting place in history of science. By his own scientific activity and stimulation of activity of other mathematicians in his country, Poland, as well as other countries, he made a decisive influence on the course of development of functional analysis. Many of us who gathered here to commemorate that great Polish mathematician realize how his ideas stimulated our own minds in twenties and early thirties. The others whose activity started a little later remember him rather as a master in whose original work *Théorie des Opérations Linéaires* they sought learning and inspiration. The homage we now pay to Stefan Banach goes from our hearts as well as minds. We all who happened to be here and participate in this celebration and may express our admiration for him have friends in many countries, who are sorry they cannot be here with us". After having explained why Stefan Banach works made such deep and significant influence on development of modern mathematics, said Mr. Stone: "Poland at the time of the First World War and immediately thereafter was certainly not a lucky place for a young mathematician to begin his career; even for one with better personal position. On the other hand the great enthusiasm which accompanied the emergence of excellent Polish mathematical school in early twenties created proper atmosphere, unusually stimulating for development of Banach's own ideas. He of course made the most of vivid interest paid in Poland to problems of set theoretic topology, not forgetting at the same time his own aims in analysis. As a result his achievements are first of all characterized by masterly application of topological methods that give deep theorems of functional analysis, which his precedents and contemporaries did not perceive. Banach exposed his ideas in mature and condensed form in his famous monograph, emphasizing with unusual clarity the subtle correlation of topological and algebraic considerations in making abstract and general concepts really fruitful..." Further, Mr. Stone said that although Stefan Banach went not that far as modern mathematics needs it in generalizing the concept of finite dimensional space, the generalization he obtained yielded deep results which it was possible to apply directly to the most fascinating in his time problems of classical mathematical analysis. Speaking of difficulties and many unsolved problems in theory of Banach spaces, he concluded: "We who follow him may be grateful to him for the light he threw on so many aspects of functional analysis and for many problems he left us".

B. Sz.-Nagy was the last foreign representative to speak. Said he: "Rendering homage which Hungarian mathematicians respectfully pay to the memory of Stefan Banach, I cannot help mentioning the close ties joining Banach works with the works of our great teacher the late Frédéric Riesz, who passed away four years ago. The classical works of Riesz on function spaces and functionals and linear transformations in that spaces to much extent inspired the broad investigation of Banach and his associates, the results of which were presented in Banach's excellent treaties *Théorie des Opérations Linéaires*. That was no doubt one of the book that influenced most the development of modern mathematics. Even though the theory there presented was preceded by the treaty of E. H. Moore *General Analysis* and prepared by investigation of M. Fréchet and others of abstract spaces, and even though that theory could use methods developed before for more particular aims, the authors of which, by the way, as for instance Frédéric Riesz, forecasted their general power, that theory was almost exclusively created by Banach and his associates". Further, Mr. Nagy spoke about the great efficiency of the methods of functional analysis, in solving various mathematical problems.

Closing the memorial session S. Żelent took the floor, the Vice-President of the Capital-City-of-Warsaw Municipality Council. He honoured in the name of that Council the memory of Stefan Banach, and announced that to make the memory of Stefan Banach last the Council voted to name after Stefan Banach one of the streets in Warsaw. So named was the main street in Pole Mokotowskie, near Aleje Żwirki i Wigury, which is in the part of the city concentrating many scientific and academic institutes. The news was accepted with appreciation by all present.

The scientific sessions of the Conference were held through September 5-10, 1960 in the Palace Campus of the Polish Academy of Sciences in Jabłonna, 10 a. m. — 2 p. m. Many mathematicians joined who were not listed as participants of the Conference. They attended the sessions and participated in the afternoon informal meetings. There were 31 lectures given on sessions, 23 of them were delivered by foreign mathematicians. There were no sections — all lectures were to be given before the full audience. Many topics were touched, but they all centered around the problem of structure of topological vector spaces and topological algebras, as it was intented by organizers.

Closing the Conference on September 10, 1960, Mr. Mazur, the Chairman of the Organizing Committee, said: "It was nice that so many foreign guests accepted our invitation and not only came to us, but were willing to give us a number of interesting lectures. No doubt Polish participants profited much from private talks with our guests from abroad. It was particularly of interest for our younger colleagues, who are very ambitious and want to continue the work started by Stefan Banach. We hope the cooperation iniciated with success between Polish and foreign experts in functional analysis and its applications will keep going further. No matter what our views are on which way to choose to ensure to all the people the happy prosperous future, we are united by passion for developing mathematics and desire that it be used only for the benefit on the people".

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This volume contains all one-hour lectures, without short communications. The papers are published in the form supplied by the authors.

Stefan Banach

by

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Stefan Banach was born on 20 March 1892, in Cracow. His father, an official in the railway administration, Greczek by name, came of a peasant family living in the highlands. The particulars of Banach's early childhood are unknown; however, we know that immediately after his birth he was put under the guardianship of a laundress, living in a garret in Grodzka Street (nr 70 or 71); Banach was the name of her husband. Since that time Banach never saw his mother, so that practically he did not know her. Neither did his father care for him. Since the age of 15, Banach had to support himself by private teaching. He was very keen on giving coaching lessons in mathematics. As far as mathematics goes, he was selftaught. We do not know how or when he acquired the knowledge of French but we do know that as a schoolboy he read Tannery's "Introduction à la théorie des fonctions". Before the First World War, he attended lectures delivered at Jagellon University by S. Zaremba, but he did so irregularly and only for a short time. A little later, he moved to Lwów Institute of Technology, and there he passed what was called the "first examination" certifying that he had studied engineering for two years. When, in 1914, the First World War broke out, Banach returned to Cracow. One summer evening, in 1916, as I was walking along the "Planty"([1]), I heard a conversation, or rather only a few words. I was so struck by the words "the Lebesgue integral" that I came nearer to the bench on which the speakers were sitting and, then and there, I made their acquaintance. The speakers, Stefan Banach and Otto Nikodym, were discussing mathematics. They told me they had another chum — Wilkosz. It was not only mathematics that bound together those three young men, it was the hopeless situation of young people in the "fortress Cracow" (such was the official status of Cracow in those days of war), the insecurity of the future, the difficulty of earning one's living, the lack of contacts not only with foreign scientists, but even with the Polish ones — such was the atmosphere of this city in 1916. But all that

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([1]) A park surrounding the city.