Stefan Banach

(March 30, 1892 – August 31, 1945)

Stefan Banach was a Polish mathematician whose contributions gave birth to the fundamental branch of mathematics called 'functional analysis'. It is hard to believe that one person's influence on a topic was so fertile as to produce most of the fundamental theorems of the subject.

Interestingly, his surname on the birth certificate is that of his mother Katarzyna Banach while the first name is that of his father, Stefan Greczek; the name Banach is supposed to be a nickname that is a variant of Benedict. His parents were not married. He was brought up not by his parents but by the foster family of one Franciszka Plowa and her niece with whom the child was left by his mother. In Grammar School IV, Stefan found mathematics to be his favourite subject although he was critical of the level of the syllabus. The syllabus was roughly – review and further study of highest common divisor and least common multiple; systematic study of common fractions; conversion of common fractions into decimals and *vice versa*; ratios and proportions; the rule of three and use of simple proportions; inference; calculation of percentage; axial and central symmetry; congruent triangles and their applications; the most important properties of circles, quadrilaterals and polygons.

Stefan Banach was judged to have poor eyesight and hence unfit to serve in the military; therefore, he taught in schools during World War I. In 1916, the senior mathematician Hugo Steinhaus accidentally spotted Banach who was mostly self-taught until then and took him under his wings. In fact, a number of questions that had proved difficult for Steinhaus to make progress on were solved within a week of their collaboration! Stefan met Łucja Braus, who was working as a secretary to a cousin of Steinhaus. They married in September 1920. Their son Stefan Jr. was born in 1922, and went on to become a neurosurgeon.

Along with a few other contemporaries, Banach and Steinhaus founded the Polish Mathematical Society. Interestingly, Banach was awarded a doctorate in 1920 but his research work was published two years later. It is said that before he could find time to write up some research work for publication, the fertility of ideas produced more and stronger results. This contained a wealth of astounding work which created the (then) new branch of mathematics known (now) as functional analysis. News of Banach's path-breaking ideas brought prominent mathematicians like Émile Borel, Fréchet, Lebesgue, Montel, Zermelo, von Neumann, Alexandrov, Luzin, and Sobolev from all over the world to to Lwów (also written sometimes as Lvóv or as Lviv – it is in present day Ukraine).

Steinhaus commented about Banach's ability to work under any condition, without regard to ease or comfort. Steinhaus mentioned that Banach's professor's salary was sufficient but his "fondness for frequenting coffee-houses, utter disregard of any bourgeois concern for material interests, and an absence of regularity in daily affairs, finally plunged him into debt and very trying times." During one of Steinhaus's humorous speeches alluding to Banach's smoking habit, he mentions the so-called Banach's 'matchbox problem' – an elementary exercise in probability actually. Although often attributed to Banach, this problem is not due to him. The problem is essentially the following question. Suppose a mathematician carries two matchboxes at all times – one in her left pocket and one in her right. Each time she needs a match, she is equally likely to take it from either pocket. Suppose she reaches into a pocket and discovers for the first time that the box picked is empty. If it is assumed that each of the matchboxes originally contained a certain number N of matches, what is the probability that there are exactly k matches in the other box? This can be answered by the negative binomial distribution.

In the company of Banach, local mathematicians in Lwów used to gather around at the Scottish Café to have vigorous mathematical discussions. Only two undergraduate students S Ulam and J Schreier had the honour of getting invited to these mathematical meetings. It is said that being invited to the Scottish Café's mathematical discussions was equivalent to being knighted! Banach, Ulam, and Mazur were the most active participants of these intense mathematical discussions. The café had marble table tops on which one could write and erase easily. That would strike a chord with the erstwhile Indian milieu – using shale sticks on writing slates and erasing easily! This continued for years until Banach's wife bought a thick notebook for them to use during discussions at the café. Thus was born the Scottish Book wherein the mathematicians frequenting the café posed challenging problems. Special mention should be made of Ulam who was Banach's student and became world renowned later for a number of reasons. Ulam discovered the Monte-Carlo method for statistical sampling. He became a part of the Manhattan project and, along with Teller, resolved the problem of initiating fusion in the hydrogen bomb. Ulam's brilliance is almost legendary; Gian-Carlo Rota said of him: "His mind is a repository of thousands of stories, tales, jokes, epigrams, remarks, puzzles, tongue-twisters, footnotes, conclusions, slogans, formulas, diagrams, quotations, limericks, summaries, quips, epitaphs, and headlines. In the course of a normal conversation he simply pulls out of his mind the fifty-odd relevant items, and presents them in linear succession. A second-order memory prevents him from repeating himself too often before the same public!"

The group of mathematicians at Lwów also established in 1929, the journal *Studia Mathematica* which is still active. Considering his influence on contemporary mathematics, it was inevitable that Banach would be elected to be the President of the Polish Mathematical Society, and this happened in 1930. However, the second World War drastically changed the course of

his life. During the second World War, Soviet Union occupied Lwów, but Banach who was in the good books of the Soviet mathematicians initially continued to hold the chair at Lwów. In 1941 when Lwów was occupied by the Germans, universities closed down and he worked (along with his son) at the Typhus Research Institute as a lice feeder! This was one way university professors avoided random arrests during the Nazi invasion. After the war, Banach returned to Lwów in 1944 and assisted in the attempts to rebuild the university. However, he decided to move to Kraców where he had been offered a chair. Unfortunately, he was diagnosed with lung cancer in January 1945 and passed away in Lwów itself in August of the same year.

Some of Banach's fundamental contributions to mathematics have been described in two or three articles in this issue. As mentioned earlier, his ideas created an entirely new subject which is part and parcel of mathematics college education today. The theory created by Banach and its manifold applications inspired almost all of the work on functional analysis in the next three decades. To end on a lighter vein:

The Scottish Café was replete
With functional analysts – all elíte.
A discovery a day was routine
For Banach – was it in the caffeine?
No, it was the norm and it was complete!

An open set in a Banach space
Under continuous functional stays.
Open – this is not even half
Continuity is closedness of graph.
Such facts are now common place!

B Sury
Indian Statistical Institute
Bangalore
Email: surybang@gmail.com