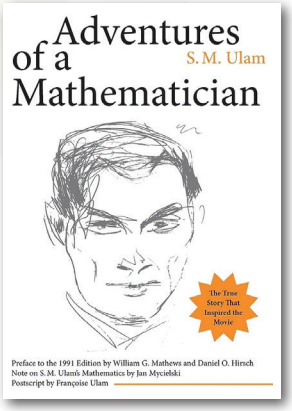
Adventures of a Mathematician By Stanislaw Ulam

Reviewed by Divakaran D



Stanislaw Ulam is probably best known among pure mathematicians for one of his early works with Karol Borsuk: the Borsuk-Ulam theorem. The special case of this theorem in dimension 2 is usually dubbed as "there are always two antipodal points on earth's surface that have the exact same temperatures and exact same pressures." Hidden behind is a reasonable assumption that temperature and pressure vary continuously on the surface of the earth. Among well-read non-mathematicians, he is probably well-known for his central role in the Manhattan Project. Few people would know that he invented the Monte-Carlo method, that he came up with the concept of cellular automata, and that he even made important contributions to the moon landing project and mathematical biology.

His intellectual life was truly an adventure making "Adventures of a Mathematician" an apt title for his autobiography.

Ulam lived through two World Wars and was directly impacted by them. During the first World War, he was still a child. But, Lwow, the city he lived in, was besieged by the Ukrainians in 1918. He recollects,

> *For the adults, it might have been a strenuous time, to say the least, but not for us. Strangely enough, my memories of these days are of the fun I had playing, hiding and learning card games with children for the two weeks before the siege was lifted with the arrival of another Polish army from France. This broke the ring of besiegers. For children, wartime memories are not always traumatic.*

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In addition to the World Wars, his home was also affected during the Polish-Russian War in 1920. He lived through a time of great turmoil, especially for a Jew like himself. And the second World War affected him deeply. Although he was in USA by the time of the second World War, he knew Poland would no longer be the way he knew it to be and was deeply anxious for his family and friends back in Poland. A career in academics also seemed difficult during the beginning of the war as the celebrated mathematician Jacques Hadamard was offered a lectureship and Tarski was working as an instructor. Given these circumstances, he took up an instructorship in the University of Wisconsin Madison where he was later promoted to an Assistant Professor in his second year. Although he had a good time teaching and doing mathematics in Wisconsin, the war slowly directed his interests into mathematical physics and other applied areas. He also had a strong urge to help in the war effort. He even tried unsuccessfully to volunteer in the air force. It is this urge to contribute to the war effort that took him to Los Alamos and the work on the fission and fusion bombs.

In the book, Ulam does not talk a lot about his personal life, his emotions, or his feelings. In fact, we hardly get to know his wife Françoise. How he impressed his wife by sending her the letter d'Alembert sent to Mademoiselle de Lespinasse is among the few but very interesting aspects of his personal life that we get to know. This story was also interesting because the description of d'Alembert matched perfectly with Françoise Ulam's impressions of Ulam. A bit more of his personal life and self-reflections, I feel could have made the book even more interesting. The most personal/emotional he gets is when he describes his relationship with Von Neumann. We do get a sneak peek into the life of Von Neumann and his emotions behind certain things through the eyes of Ulam. Ulam also spends a chapter discussing the impact of the death of Von Neumann and Fermi, some discussions about death, the possibility of not being able to do mathematics in old age, etc. This is one of the most beautiful chapters in the book.

A lot of what is there in the previous paragraph stems from my preference for getting to know a person's thoughts, opinions, feelings, and emotions. Let me share some of the opinions or thoughts shared by Ulam that I found interesting. Ulam says that mathematicians tend to be vain and try to propose a linear order of "class" among well-known mathematicians. He also freely shares his ordering and judgement on various famous mathematicians and physicists. These subjective judgments often, but not always, match their fame and are very interesting. Being an educator, I was also interested in his thoughts about mathematics education. He says,

> *One may wonder whether teaching mathematics really makes much sense. If one has to explain things repeatedly to somebody and assist him constantly, chances are he is not cut out to do much in mathematics. On the other hand, if a student is good, he does not really need a teacher except as a model and perhaps to influence his tastes.*

Interestingly, this matches a lot with what Feynman says about teaching, quoting Gibbon:

> *the power of instruction is seldom of much efficacy except in those happy dispositions where it is almost superfluous.*

These thoughts are somewhat disturbing for an educator. I try to come to terms with it by thinking that this probably might be the case for the few who will rise to the absolute top. But the vast majority of people need not do "much" (at least in Ulam's eyes) in mathematics. I believe that good teaching can make a significant impact on students who are trying to acquire a basic understanding of mathematics which they may use in other spheres of life. Moreover, I also believe that many mediocre researchers would not have become what they have if not for the help of a dedicated teacher.

He also ponders what leads to some being a lot more successful than others. He believes an ability to imitate in childhood and some inborn curiosity in the field is certainly important. But,

> *Another determining factor may be the initial accidents of success or failure in a new pursuit. I believe that the quality of memory develops similarly as a result of initial accidents, random external influences, or a lucky combinations of the two. Nothing succeeds like success, it is well-known, especially in early youth.*

As Ulam had practised mathematics in multiple languages, he shares his impressions of the impact of language on the way mathematics is done. He also compares the difference in cultures of mathematics in various countries—often emphasising the strengths and weaknesses of each country. To give an example, he says,

> *I had my meals at Adams House, and the lunches were particularly agreeable. We sat at a long table — young men and sometimes great professors; the conversations were very pleasant. But often, towards the end of a meal, one after the other would gulp his coffee and suddenly announce "Excuse me, I've got to go to work!" Young as I was I could not understand why people wanted to show themselves to be such hard workers.*
>
> *In Poland, people would also pretend and fabricate stories, but in the opposite sense. They might have been working frantically all night, but they pretend they never worked at all. This respect for work appeared to me as a part of the Puritan emphasis on action versus thought, so different from the aristocratic traditions of Cambridge, England, for example.*

Ulam was most famous for asking excellent questions and also guessing the answers to some of them. True to his nature, the book also contains many scientific and mathematical questions waiting to be answered. One such question, called the Ulam game or Renyi-Ulam game has gained widespread popularity. There are several other questions like that and one of my favourites is the following:

> *As is well known, the theory of special relativity postulates and is built entirely on the fact that light always has the same velocity regardless of the motion of the source or the observer. From this postulate alone everything follows, including the famous formula $E = mc^2$. Mathematically speaking, the invariance of the cones of light lead to the Lorentz group of transformations. Now a mathematician could, just for mathematical fun, postulate that the frequency, for example, remains the same, or that some other class of simple physical relation is invariant. By following logically, one could see what the consequences would be in such a picture of a not "real" universe.*

Finally, let me get to an aspect of his life that may be a bit controversial—his role in the development of the fission and fusion bombs and his thoughts about the same. During the development of the fission bomb during the second world war, he was actively looking to help the war effort. About returning to Los Alamos to work on the fusion bomb, he says,

> *I felt no qualms about returning to the laboratory to contribute further studies of the development of atomic bombs. I would describe myself as having taken a middle course between naive idealism and extreme jingoism. I followed my instincts (or perhaps the lack of instincts) and was mainly interested in the scientific aspects of the work. The problems of nuclear physics were very interesting and led into new regions of physics and astrophysics. Perhaps I also felt that the technological sequels to scientific discoveries were inevitable.*

I am however not convinced that he was mainly interested in the scientific aspects. I believe he trusted his new home and thought that if anyone should hold such power, it should be the USA. I feel so, because a few lines before, he says,

I was in favour of continuing strong armament policies if only not to run the risk of being overtaken by other nations.

In general, I believe that, even for the most rational people, many of their decisions are guided by emotions—they are just better at rationalising the decision post facto. He was a victim of many wars and lost most of his family to the second World War. The following words of Françoise Ulam suggest that he probably believed these bombs will be a deterrent for future wars.

When I voiced my reservations about still living at the heart of the thermonuclear work, Stan would reassure me that barring accidents, the H-bomb rendered war impossible. He also agreed, however, that there are too many bombs already, and he did not believe that Russia would invade Western Europe, one of the supposed reasons for super-rearmament.

But, sadly we may never know his true thoughts, as his reflections in the book may not be completely reliable. In 1945-1946 he had to undergo brain surgery. He says,

By the way, many of the recollections of what preceded my operations are hazy. Thanks to what Françoise told me later I was able to put it together.

Although we have an unreliable narrator, it cannot be far away from reality, else readers would have pointed out inconsistencies between his version and reality. So, the unreliability of the narrator only puts into doubt the motives or emotions behind real incidents. Perhaps this is why there is so little about emotions. Of course, I am letting my imagination run loose and this is certainly just my reading. Please read through it and let me know what you feel.

To summarise, the life of Stanislaw Ulam is a window into the troubling political scenario and the exciting scientific and technological developments of the time. The book would be of great interest to those who are interested in the history of science or/and are interested in understanding what transpires in the minds of scientists and mathematicians as they change the course of human affairs “through a few scribbles on a blackboard or on a sheet of paper". The life of Ulam transcends the separation of mathematics into “pure" and “applied" and gives a lot of insights into the culture of doing mathematics. Thus, it would be of great interest to mathematicians and mathematics educators. However, I feel, it might not be suitable to those who are starting their journey in the world of mathematics. Ulam fits well into the stereotype of a genius with innate potential. His life and some of his opinions may discourage some of the young learners who already doubt if they are “worthy" of being a mathematician. I believe everyone is worthy and we can all make contributions to the best of our abilities— like the squirrel that helped Rama build his bridge!

DIVAKARAN D works at Azim Premji University, where his main focus is undergraduate education. He has a deep interest in pedagogy. His research interests are in the fields of Geometry and Topology. He obtained his PhD from the Indian Institute of Science, Bangalore, and followed this with post-doctoral fellowships at the Institute of Mathematical Sciences, Chennai, at the University of Edinburgh, and at IISER Bhopal. Most recently he has been working on the Lean Theorem Prover. He may be contacted at divakaran.d@azimpremjifoundation.org.