A Slot Machine, A Broken Test Tube. Salvador Edward Luria. Harper Collins Publishers Inc., USA. 1984. 1st edn. 228 pp. (Original from The University of Michigan). Price: Rs 60.

Salvador Edward Luria (13 August 1912–6 February 1991) was an Italian microbiologist and a medical doctor, who won the Nobel Prize for Physiology or Medicine in 1969 jointly with Max Delbrück and Alfred Hershey, for their discoveries on the replication mechanism and genetic structure of viruses. However, less commonly known is how exactly he did so. In his autobiography, *A Slot Machine, A Broken Test Tube*, Luria has related his experiences in an intimate and enjoyable fashion.

He candidly makes quirky and often controversial statements, and unabashedly bares his innermost thoughts and opinions. Although it is the story of how Luria made such breakthrough discoveries in science, he also touches upon all aspects of life, from love to religion to politics. Luria's unconventional sentiments leap off every page. In the Introduction itself, he says 'If an autobiography is to be more than a superficial record of events, it must be something of a confession. It must be a study of the author's personality, a dissection of action and motives, a revelation of the self'. Luria has successfully done exactly this.

When someone speaks of a Nobel Prize, the immediate feeling we get is awe and admiration. A Nobel Prize-winner is considered as someone who lives in a different realm altogether. Reading Luria's autobiography serves to dispel this half-baked notion, and put in its place the picture of someone wholly dedicated to research and progress.

Luria was similar to any Jewish–Italian student of the middle class. So, what set this Nobel Prize-winner apart from the rest? Was it an exemplary education? Maybe not. Luria says blatantly that he was always on the verge of failing his natural science courses as it was impossible for him to learn and recall names and hierarchies.

Was it a preordained conclusion? When we speak of the minds so celebrated today, they all seem to have one thing in common. They were all immersed in their subject from a young age itself, pointing towards greatness from birth. However, Luria was just like any of us. After secondary education he was left with 'a good store of knowledge but without any real passion for learning'. He found making a professional choice very hard and finally went into medical school due persuasion by his parents. In medical school, Luria found that although patient examination and diagnosis excited him, he never fully identified with medicine as an activity. This sentiment was reinforced when he was called upon to serve in the army. He only found his calling later, when he became interested in physics due to the influence of his friend, Ugo Fano. Luria soon found that his interest in physics would only ever remain amateurish, but it was at that point that he was given Delbruck's articles on genes and was hooked to the subject.

Could it have been an unparalleled intellect? After reading this book in which Luria has tried to avoid both false modesty as well as extravagant praise, we conclude that he was an extremely sharp individual. However, we do not believe that this is what won him the Nobel Prize. Half the world is intelligent and observative, yet only a meagre percentage of such people ever make breakthrough discoveries.

Maybe after spending his whole life with thoughts only for research, it was statistically bound to happen. However, Luria recounts many other aspects of his life and makes it clear that he was not the clichéd stuffy scientist. One part which made us laugh out loud was when he speaks of his suspicion of misleading Enrico Fermi into thinking too highly of him because of his brief excursion into physics. He says, 'I wondered whether or not I had let him down, whether he would be pleased with me or think me a shallow man […]. As I was so musing and looking down along the Hudson River […], suddenly before my eyes the lights of the city failed: the great blackout of 1965. It seemed a rather exaggerated response to my questioning.'

Some would believe that it was pure happenstance that Luria stumbled upon the discovery, a mere question of favourable circumstances. In a way, this is not wrong. Luria himself says, 'Science's path is essentially opportunistic'. 'If I had not discovered restriction and modification of bacteriophage they would have been discovered elsewhere within a few months'. Yet, we do not fully agree with this opinion either. Maybe because we can always ask the question, how did every circumstance magically favour him? Even a broken test tube proved to be a blessing in disguise. Our conclusion is that Luria himself had the ability to cope with any situation that came his way and turn it into a positive one. He made his fate; it was not like he was some passive audience to his own destiny. How favourable can circumstances be for a Jewish–Italian during the Second World War? And yet, he managed to win a Nobel Prize.

It was his passion, dedication, and his unwavering search for knowledge that gave him prevalence. Once he found his passion, Luria was ever committed. Any observation he made was immediately connected with his work. Also, his life was not just work. He talks of his deep interest in literature as well as art. He describes dances and parties and a sculpting class he attended over the years. He did not think of research as work, but 'the outcome of an ethical choice: a commitment to rationality'.

It is due to this curiosity and bond with the subject that Luria was able to observe a slot machine and convert that theory into a Nobel Prize. He had found that when spreading about a billion phage-sensitive bacteria with phage, all except a few were killed. The few remaining bacteria grew into specifically and permanently resistant colonies. However, Luria was unable to ascertain whether the phage-resistant bacteria were produced by the direct action of phage or were spontaneous mutations.

He struggled with the problem for several months to no avail. Inconceivably, he found the solution at a faculty dance. Watching a colleague put dimes in a slot machine made him start thinking about the actual numerology of slot machines. By applying the analogy of the slot machine yields to resistant bacteria Luria, with the help of Delbrück, came up with a fluctuation test based on Poisson's distribution of rare independent events. Basically, if the bacteria mutated on contact with phage, all cultures should have had similar number of resistant colonies. On the other hand, if it was spontaneous and could have happened at any time, the distribution of resistant colonies in different cultures would vary widely. Luria was thus able to show that mutations are spontaneous random occurrences.

An interesting experience he relates in the book is about the first time on his

own in a laboratory in Paris. There he found that cells could multiply till about a 100 in sulfanilamide before they were inhibited. He says, 'Not being a good biochemist, I failed to see the implications of this finding […]. This could have led me to explain the mode of action of sulfonamides, a discovery made a year later by the British biochemist D. D. Woods. It was the first – not last – lost opportunity in my scientific career. It is a risk that faces the naïve scientist venturing into a new field without the required knowledge of the background.' Reading this, we were filled with enthusiasm as well as trepidation. It showed us how easy it is to make a discovery as well as to miss one. It taught us that one must forever be asking questions and never take anything for granted. According to Luria, 'One defines a problem that seems significant in its implications and worth exploring; then one looks for a system […] that offers a promising point of attack'.

Another unforgettable piece of advice is his description of 'Beadle and Tatum's work' on gene control of organism traits. Beadle had earlier tried to tackle this question by working on the pigmentation in the eyes of fruit flies. The problem proved too difficult, so he used common bread mould, *Neurospora*. 'Beadle's shift to bread mold – which incidentally illustrates the opportunism of scientific research, shifting from one material to another in pursuit of the solution of a general problem – was an astute and brilliant move.' In this simple example, he has competently explained the essence of the unity of living organisms.

Apart from research, we learn about politics, literature, art, science, ethics, religion and so much more from this book. Luria maintains a clever balance between modesty and self-esteem. His clear ardour for science can be seen in every other thing. One interesting statement was 'The world of science may be the only participatory democracy'.

An admirable fact about Luria – from the beginning, he foresaw the integration of disciplines. He speaks often of the usefulness of the analytical view of a physicist in biology and the vital need for chemistry in biochemistry. In fact, he was the one who made James Watson (co-discoverer of the DNA structure with Francis Crick) study biochemistry.

Luria, in his life, met and befriended a large number of great minds which are held in such esteem today. His descriptions of them are quite refreshing and unexpected. It was pleasant to read these personal tidbits about such revered men and women. He spoke his mind in every page, whether his thoughts were controversial, biased or irreverent. For example Luria says, 'I have a nasty suspicion that a good deal of traditional subject matter is kept in textbooks because it provides […] quiz questions'. He himself maintained a singular dislike towards mugging throughout his life.

His book is an honest and unbiased exploration of himself. It gives many insights to various aspects of life, and is definitely a must read. The reverence with which he speaks of science and his colleagues is inspiring. Reading this book, it feels like we actually get to know Luria. He ceases to be a 'Nobel Prize-winner' and rather becomes an admirable man who has much to teach us about life.

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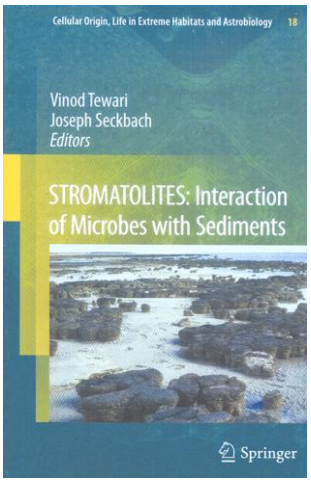

Stromatolites: Interaction of Microbes with Sediments. Vinod Tewari and Joseph Seckbach (eds). Springer, Dordrecht. 2011. xxix + 751 pp. Price not mentioned.

Stromatolites are the first biogenic structures produced on the Earth around 3.5 billion years ago. They are in the true sense trace fossils whose presence simply confirms the interaction of microbial life with sediments. They are abundantly recorded in the Precambrian deposits with varied morphologies ranging in size from microscopic dimensions to the size measurable in metres. Stromatolites acquired varied shapes from bedded to columnar, attached or unattached, domal or flat. In the Precambrian eon some of the stromatolite forms acquired unique morphologies which are restricted in a specific time-frame and thus appear as time-controlled. This lead to their use, quite successfully in many cases, for intrabasinal and interbasinal correlations. In spite of enormous work done on the stromatolites since more than a 100 years, particularly in the last few decades, there are many aspects which are still not understood, especially the variation of morphologies in the Precambrian stromatolites, as these morphologies are not reported in the Phanerozoic as well as in the modern environmental setting. The early evolution in the microbial community must have influenced the stromatolite morphologies, which needs to be identified. There is a good possibility for the search of microbial community in the black-bedded cherts associated with the stromatolites which produced them. In the light of this, the book under review is a welcome addition to our understanding about stromatolites of both modern environmental setting and fossil records. The book is a collection of papers covering different aspects of stromatolite formation, with contributions from 84 experts from 27 countries. The editors have been successful in soliciting 34 research papers on various topics. The last chapter is written by the editors themselves giving a summary and conclusions. They have also given their views in the context of the emerging branch of astrobiology.

The book has been subdivided into seven parts. The first part covers Archean–Proterozoic stromatolites and microbiota. This includes seven research papers, out of which two are from India. Only one paper by Sugitani *et al*. deals with Archean microfossils from the Pilbara craton, western Australia which suggests early evolution of a diverse and complex ecosystem in a shallow-water environment in the Archean. The paper is an important contribution in the light of the fact that Archean fossils are rare and invariably poorly preserved with skepti-