Salvador Luria and Max Delbrück on Random Mutation and Fluctuation Tests

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Mutations of Bacteria from Virus Sensitivity to Virus Resistance
Salvador Edward Luria and Max Delbrück
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Do mutations arise randomly over time? Or are they induced by unfavorable environments? By addressing these crucial evolutionary questions, Salvador Luria and Max Delbrück won a Nobel Prize and helped to start the field of bacterial genetics.

In 1943, it had long been known that bacterial cultures rapidly develop resistance to viral infection. Some biologists argued that viruses directly induced resistance mutations, while others believed the mutations arose spontaneously before exposure to the virus. But when Luria and Delbrück first attempted to distinguish between these two hypotheses, they were frustrated by what appeared to be irritatingly inconsistent mutation rates. Then, after watching a colleague win a jackpot ($3 in dimes!) at a slot machine, Luria realized this inconsistency was telling him something: the number of mutant bacterial colonies present at the end of the experiment depended on when the mutations arose. Mutations arising in earlier generations would be present in many descendent cells (a "jackpot"), whereas mutations occurring in later generations would be present in only a few cells.

Luria passed his insight to Delbrück, who worked out the expected statistical distribution of the number of mutant cells per culture. Their data decisively rejected the hypothesis that bacteria became resistant only after being exposed to the virus and strongly supported the prediction that the phage-resistant mutations had a constant probability of occurring in each cell division.

The Luria–Delbrück article had three important impacts beyond its direct conclusion: it showed that elegant statistical analysis could illuminate biological processes that could not be directly observed, it contributed to Luria and Delbrück winning the 1969 Nobel Prize in Medicine or Physiology (shared with Alfred Hershey), and it led, indirectly, to a continuing debate about whether organisms exert physiological control over their mutation rates.

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Image of Max Delbruck and Sal Luria at Cold Spring Harbor Laboratory, 1953. Courtesy of Cold Spring Harbor Laboratory Archives.
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