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Foundations of Chemistry Book Review – Dr. Robert T. Hanlon

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Paul Sen
"Einstein's Fridge. How the difference between hot and cold explains the universe."
ISBN: 978-1-5011-8130-6

Guided by his belief "that the history of science is the history that matters," Paul Sen wrote *Einstein's Fridge* to "celebrate the heroes and heroines of science," and specifically the science of thermodynamics, which he cites as the "most useful and universal scientific theory ever conceived." His narrative thread, which successfully intertwines history and science, follows the chronological timeline of thermodynamics' marquee players, namely Sadi Carnot, James Joule, Hermann von Helmholtz, William Thomson, Rudolf Clausius, James Clerk Maxwell, Ludwig Boltzmann, and J. Willard Gibbs, along with welcome focus on some of the lesser-known contributors, such as Jean-Baptiste Say, Napoleon's spy who traveled to Britain and discovered that a key reason for Britain's economic surge was the rise of the steam engine; Katherine Maxwell, who partnered with her husband James's experimental program to quantify the impact of temperature and pressure on gas viscosity; and Henriette von Aigentler, who supported her husband Ludwig Boltzmann in his emotional struggles brought on by critics of his work. Sen also included a very nice chapter on Emmy Noether. While perhaps not as well known as others, Noether made significant contributions to thermodynamics in the form of what became known as "Noether's Theorem" regarding symmetry and energy conservation.

Sen's book is rich with stories covering a wide range of thermodynamic science. He adds bits and pieces of history and science that make his book a fun and engaging read, ranging from Alan Turing's quest to show how the dissipation of free energy drives the creation of pattern and structure in life to Jacob Bekenstein's and Stephen Hawking's development of the relationship between black holes and thermodynamics. He shined the light on the human side of Claude Shannon and also the stories of Rolf Landauer and Charles Bennett, two IBM researchers who sought connections between information theory and the 2nd Law of Thermodynamics. Throughout the entire book, Sen sprinkled strategically placed, thought-provoking questions to lead the reader along the path of discovery.

While Sen wrote to a depth appropriate to his objective, I was left with two wishes: 1) I wish that he had included more illustrations to better clarify some of his more challenging, and at times confusing, technical sections, such as those on Gibbs' free energy and those on Turning's mathematics of life, and 2) I wish that he had spent more time on certain important topics such as Clausius's fifteen year, nine memoir journey to entropy and Gibbs's extensive contributions that arguably set the foundation for classical thermodynamics and less time on other topics that, while interesting, were somewhat irrelevant to the objective of this book, such as the entrepreneurial development of an improved refrigerator by Einstein and Leo Szilard.

Sen's book is built on the power of the story absent the equations. Plenty of books offer the equations, and Sen thankfully didn't repeat what has already been said. Few books offer the rich stories he presents in such effective detail. This book belongs on the shelf next to the textbooks.

I read Sen's book from cover to cover and enjoyed the journey. I'd truly look forward to spending an afternoon with him, discussing these and other stories about the history of thermodynamics.

END