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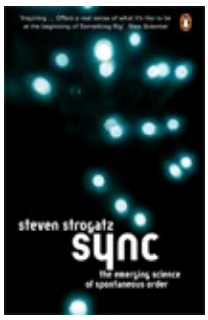
Reviews

'Sync: the emerging science of spontaneous order'

reviewed by Rachel Thomas



Sync: the emerging science of spontaneous order

by Steven Strogatz

It's not very often that something I read makes me want to jack in my lovely job at *Plus* and return to study and research. But that is just what happened when reading *Sync* by Steven Strogatz.

The book tells the story of how questions from diverse areas Why do we sleep when we do? How do fireflies flash in unison? Why does our heart beat? How do you link generators in a power grid? have developed into a new field of study. This new field, which Strogatz calls *synchrony*, examines how order can spontaneously break out in complex systems. The role of sync in such diverse areas of science is fascinating, but equally fascinating is his evocative description of the process of doing this research. Strogatz describes theoretical concepts and research problems almost as if they were physical entities that you could touch or smell.

The first section, "Living Sync", takes us on a tour of the phenomenon in the living world. Fireflies flashing in sync, the beating of heart cells, and the dramatic effects of tinkering with the internal biological clocks that govern our sleep cycles. One of the most striking features of this section is the exotic nature and sheer geographic scope of the research a French researcher living alone in underground caves to experiment with his sleep cycles, fireflies flashing in Thailand and in Tennessee, theoretical experiments on group synchronisation in the US, and mathematical proofs in Japan. Gradually people began to link these disparate areas together, and Strogatz explains how maths was the language used to analyse and describe these phenomenon.

And here we get the first taste of Strogatz's excellent skill in guiding the reader through a mathematical proof, explaining the first tractable model of group synchronisation developed by a Japanese physicist, Yoshiki Kuramoto. Reading this section feels like touring a beautiful architectural structure, appreciating its ingenuity and creativity, its beauty and its strength, giving a real feel for the proof without any of the mathematical details that might put some people off. That isn't to say Strogatz shies away from mathematical concepts, there is much discussion on linear and nonlinear dynamics, differential equations, differences between particular mathematical models, but these are always explained in a physical, tangible way.

The second section, "Discovering Sync", gives a history of the area, and focuses on sync in inanimate settings, such as engineering, power grids, physics and astronomy. This section also begins to reveal Strogatz's own personal journey, and the personal journey of others in research. This is one of the strengths of the book. It presents research, and in particular mathematical research, as a very human pursuit, guided by human curiosity as well as by seeking solutions to real world problems. Strogatz presents both of these motivations side by side with equal importance. The light it sheds for us on curiosity driven research helps us to understand why some researchers seek to understand abstract, theoretical objects, and the wonderful insights that can result from researchers following hunches even if they don't seem to have immediate applications.

One of my favourite passages describes Strogatz and his colleagues' curiosity−driven research into superconductor devices used in physics, engineering and medicine. He describes the moment they recognised Kuramoto's Model, which up until this point had been entirely theoretical, in their equations: "an enigma like the monolith in *2001: A Space Odyssey*, buried under the soil, waiting for us apes to find it, beckoning, the key to sync".

The final section, "Exploring sync", takes us to the very beginning of Strogatz's career and gives a personal account of his beginnings crossing the bridge between mathematics and biology. He goes on to explore some of the new frontiers of sync and complexity research. Using this mathematics to describe the most human phenomena cognition, memory, and group behaviour such as mob psychology and fads with such success was surprising, and helped emphasise the huge scope of this area of research. However throughout the book, there were times when I did feel the success of sync was being overplayed: I was curious to have a glimpse of one or two of the dead ends when attempts to apply this approach had not played out.

With his beautifully and enthusiastically written book, Strogatz takes us all over the world, and through nearly every area of science, on a tour of one of the newest fields of research. Equally importantly, the book also welcomes us into the world of research, introduces us to Strogatz's friends, and gives a compelling personal account of a life in research. Strogatz's book is likely to tempt many of us to follow him on this adventure.

Book details:

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Rachel Thomas is Co−Editor of *Plus*.

Plus is part of the family of activities in the Millennium Mathematics Project, which also includes the NRICH and MOTIVATE sites.