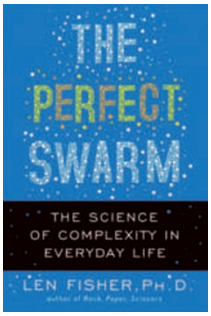
Herd on the street



The Perfect Swarm: The Science of Complexity in Everyday Life

By Len Fisher

BASIC BOOKS: 2010. 260 PP. £13.99

Physicists are unable to solve the three-body problem — at least, not analytically. So how do we tackle problems involving more than two objects, such as traffic flow, the spread of epidemics or hiring the best secretary? And if the system as a whole can do what the individuals alone cannot? The science of complexity encompasses these problems and more. Len Fisher weighs in to show that there are simple underlying rules, some intuitive and others not, that provide a handle on complex behaviour.

The introduction to *The Perfect Swarm* is one of the best I've read in a long while: "Shortly after *Star Wars* hit box-office records, a group of ninety-seven locusts sat down to watch the film". Of course I had to read on to find out what happened! Did the locusts feel the Force? Later, Fisher revealed the results of the study. Two scientists — who won an Ig Nobel prize for their efforts — had fixed the locusts in place and clamped electrodes to their heads (the locusts'), and recorded neuronal activity as the spaceships moved across the screen. Approaching objects caused a greater electrical response than receding objects. They indeed felt the Force! When allowed to fly (though tethered), locusts would tuck in their delicate wings and go into a diving glide when an object approached from the side. So that's how they avoid collisions. The swarm has no leader and generally follows the wind, but if each member simply moves with their immediate neighbours, the group stays coherent and responsive to predators. Swarm intelligence made simple.

Can humans learn from the collective behaviour of insects and animals? Yes we can! On busy sidewalks, pedestrians generally self-organize into streams flowing in opposite directions. It's best to go with the flow, as both simulations and observations show that it does not pay to weave in and out. But Fisher explains that we can manipulate crowds as well. Armed with about twenty friends, he showed that by increasing the local density on a moderately crowded street, his group managed to create a moving column of people by boxing in other pedestrians. However, increase that density and the moving lanes come to a standstill.

In confined spaces, panic can spread within a jammed crowd, sometimes with tragic consequences. In 2006, 346 pilgrims were crushed to death in Mecca. Studies of the video footage have revealed that above a critical density of one and a half square feet per person, individuals cannot help going with the crowd. Those trying to push against the crowd create force chains that separate the crowd into blocks that move at different relative speeds and in different directions. Because stress release is unpredictable, a whole block of people can fall down quite suddenly, and for no apparent reason.

The trick is to prevent such crowds from building up in the first place. But if you find yourself in an escaping crowd, what do complexity experts say we should do? Fisher explains that we should "go with the crowd 60 percent of the time and use our own ideas and initiative 40 percent of the time." This is because if you just go with the crowd, everyone is likely to use one exit. And if you do your own thing, you will probably find an exit at random. Well if a building is on fire, and I'm not familiar with the exits, I'm not sure I would remember to follow the crowd only 60% of the time! More useful is his advice to act immediately if there is any danger; in the 9/11 World Trade Center attack, only 55% of the survivors evacuated immediately without first retrieving belongings or securing their files.

So when does group intelligence overtake that of the individual members? When guessing the number of something — such as jellybeans in a jar — the group always does better, if independent estimates are averaged. If the group discusses the problem and then everyone gives their estimate, the accuracy is much worse, because people can be affected by persuasive individuals. But when it comes to making a choice, when there is one correct answer, the majority usually does best. This brings us to the jury system. That the jury discusses the case before coming to a verdict means that jurors are not independent, and that some can be bullied into a decision. Not ideal. In fact, there is no ideal voting system, according to Fisher. We should choose the most 'practicable' method.

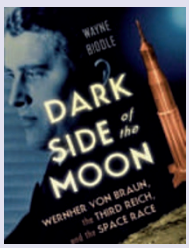
Then our author races through the science of networks. It's a huge topic in itself but Fisher limits himself to showing how networks work and how to take advantage of them, such as identifying the hubs. He does a decent job, but I prefer Albert-László Barabási's more objective approach in *Linked*. This is an unfair comparison, as *Linked* is a book about networks, not just a chapter, and *The Perfect Swarm* covers so much ground that it isn't possible to go into depth. The chapter on making decisions is also interesting, but over all too quickly.

That said, I don't think the book needs to be longer. This book is a taster, without mathematical gymnastics and with many personal anecdotes, written for somebody who is not familiar with the science of complexity. It's easy to dip into, but once I set it down I forgot about it. Only the looming deadline (the next day, ahem) prompted me to finish reading it. There are plenty of interesting factoids in the book to impress your lunch table crowd, but don't all rush at once to buy the book. ❐

REVIEWED BY MAY CHIAO

May Chiao is a senior editor for Nature Physics

ON OUR BOOKSHELF



Dark Side of the Moon: Wernher von Braun, the Third Reich, and the Space Race

By Wayne Biddle

NORTON & CO: 2009. 220 PP. £18.99

Wernher von Braun went from designing V2 rockets for Hitler to putting men on the Moon. Turncoat of dedicated scientist? Or apolitical? "'Once the rockets are up, who cares where they come down. That's not my department,' says Wernher von Braun." (from Tom Lehrer's song 'Wernher von Braun').