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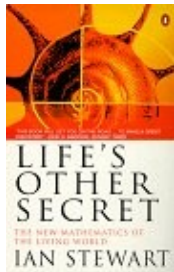
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Mar 2002

Reviews

'Life's other secret'

reviewed by Helen Joyce



Life's other secret: The new mathematics of the living world

Ever since Watson and Crick worked out the double helix structure of DNA in 1953, the role of genetics in biology has grown and grown. Genetic determinism – the belief that we are controlled by our genes and that no other factor is significant – is now all-pervasive.

Here Ian Stewart challenges this orthodoxy, telling us that "life is a partnership between genes and mathematics". The mathematical control of the growing organism is the "other secret" of life referred to in the title, the first being the molecular structure of DNA.

This book is unusual and welcome, as an illustration from biology rather than physics of the "unreasonable effectiveness of mathematics". Mathematical physicists are a well-known hybrid; mathematical biologists are not. The examples given are fascinating and easily accessible; Stewart discusses, among other things, the role of Fibonacci numbers in plant forms, the mathematics of animal locomotion, and the gradualist/punctuationalist controversy in evolution.

This last is particularly interesting, because mathematics can provide a paradigm shift, not just a new model. Evolutionary theorists are divided (bitterly in some cases) over whether evolution always proceeds by imperceptible steps (gradualism) or whether periods of no change and great change alternate (punctuationalism). The fossil record shows various mass extinctions, which is evidence claimed by the punctuationalists in their favour. But what causes these periods of massive change? A comet hitting the earth is thought to have caused the most recent mass extinction, when the dinosaurs died out. Enormous volcanic eruptions are also thought by some to have played a role in some mass die-offs. But mathematicians'

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understanding of chaotic dynamical systems seems to imply that no particular dramatic event is needed to cause a mass extinction. They will sometimes happen for no proximate reason. Such deterministic but unpredictably complex outcomes of relatively simple systems are called "emergent" and much of the book is concerned with them.

Stewart tells us that "a lot of properties of life are turning out to be physics, not biology". He explains that genes don't do anything they don't have to. For example, if an elephant falls off a cliff it doesn't need its genes to tell it how to hurtle to earth – that will happen automatically. Stewart describes many less trivial phenomena that look sufficiently complicated to require close genetic supervision, but which can be modelled satisfactorily by a few basic instructions, with everything else left to mathematics. For example, the flocking behaviour of birds can be modelled satisfactorily by just assuming that genes controls how close to be to nearby birds and how to behave when those birds come closer to you. The flock will then form naturally.

A minor point about the book was the *somewhat intrusive* constant use of italics. Stewart seems not to trust his reader to understand his prose without signposting the more important words – which is doing the reader and himself an injustice. He writes clearly enough to be able to abandon this stylistic tic.

Life's other secret is an description of a field in its infancy, stronger on tantalizing glimpses of things to come than on solid theory. But that's not a fault of the book – it's inevitable given that the application of mathematics to the science of life has only just begun. Even more excitingly, Stewart raises the prospect that "there may be a new *kind* of mathematical theory out there in the intellectual darkness, [and that] biology is the key to finding it."

Book details:

Life's Other Secret: The new mathematics of the living world

Ian Stewart

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