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Richard Dawkins in 1976, around the time he published his first best-selling book.

IN RETROSPECT

The Selfish Gene

Matt Ridley reassesses Richard Dawkins's pivotal reframing of evolution, 40 years on.

Books about science tend to fall into two categories: those that explain it to lay people in the hope of cultivating a wide readership, and those that try to persuade fellow scientists to support a new theory, usually with equations. Books that achieve both — changing science and reaching the public — are rare. Charles Darwin's *On the Origin of Species* (1859) was one. *The Selfish Gene* by Richard Dawkins is another. From the moment of its publication 40 years ago, it has been a sparkling best-seller and a scientific game-changer.

The gene-centred view of evolution that Dawkins championed and crystallized is now central both to evolutionary theorizing and to lay commentaries on natural history such as wildlife documentaries. A bird or a bee risks its life and health to bring its offspring into the world not to help itself, and certainly not to help its species — the prevailing, lazy thinking of the 1960s, even among luminaries of evolution such as Julian Huxley and Konrad Lorenz — but (unconsciously) so that its genes go on. Genes that cause birds and bees to breed survive at the expense of other genes. No other explanation makes sense, although some insist that there are other ways to tell the story (see K. Laland *et al*. *Nature* **514,** 161–164; 2014).

What stood out was Dawkins's radical insistence that the digital information in a gene is effectively immortal and must be the primary unit of selection. No other unit shows such persistence — not chromosomes, not individuals, not groups and not species. These are ephemeral vehicles for genes, just as rowing boats are vehicles for the talents of rowers (his analogy).

As an example of how the book changed science as well as explained it, a throwaway remark by Dawkins led to an entirely new theory in genomics. In the third chapter, he raised the then-new conundrum of excess DNA. It was dawning on molecular biologists that humans possessed 30–50 times more DNA than they needed for protein-coding genes; some species, such as lungfish, had even more. About the usefulness of this "apparently surplus DNA", Dawkins wrote that "from the point of view of the selfish genes themselves there is no paradox. The true 'purpose' of DNA is to survive, no more and no less. The simplest way to explain the surplus DNA is to suppose that it is a parasite."

Four years later, two pairs of scientists published papers in *Nature* formally setting out this theory of "selfish DNA", and acknowledged Dawkins as their inspiration (L. E. Orgel and F. H. C. Crick *Nature* **284,** 604–607 (1980); W. F. Doolittle and C. Sapienza *Nature* **284,** 601–603; 1980). Since then, Dawkins's

The Selfish Gene
RICHARD DAWKINS
Oxford University Press: 1976.

speculation has been borne out by the discovery that much surplus DNA consists of reverse transcriptase — a viral enzyme whose job is to spread copies of itself — or simplified versions of transposons dependent on it. Thus, Dawkins's ideas helped to explain what was going on inside genomes, as well as between individuals, even though the book was written long before DNA sequencing became routine. The complexity of the structure of the gene itself has since grown enormously, with the discovery of introns, control sequences, RNA genes, alternative splicing and more. But the essential idea of a gene as a unit of heritable information remains, and Dawkins's synthesis stands to this day.

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For a review of Richard Dawkins's latest memoirs, see: go.nature.com/cqukcg

On *The Selfish Gene*'s 30th anniversary, many of Dawkins's admirers, including writer Philip Pullman and cognitive scientist Steven Pinker, contributed essays to the book *Richard Dawkins* (Oxford University Press, 2006) edited by his former students Alan Grafen and Mark Ridley (no relation of mine). In this Festschrift, the philosopher Daniel Dennett argued that the book was not just science, but "philosophy at its best". In my contribution, I pointed out that the success of the book had spawned a gold rush for popular-science writers, as publishers began offering large advances in the hope of finding the next *Selfish Gene*. James Gleick's *Chaos* (Abacus, 1988), Stephen Hawking's *A Brief History of Time* (Bantam, 1988) and Pinker's *The Language Instinct* (William Morrow, 1994) were among the nuggets mined before the boom petered out.

Although his book brimmed with original thoughts, Dawkins was quick to acknowledge that he was building on the discoveries and insights of others, notably the evolutionary theorists William Hamilton, George Williams, John Maynard Smith and Robert Trivers. They were equally quick to appreciate that he had done something more than explain their ideas. Trivers wrote the foreword, and Maynard Smith narrated a television documentary about the book soon after it was published. Williams said in an interview that Dawkins's book had "advanced things a lot further than mine did" (see go.nature.com/21j1mt); Hamilton wrote that *The Selfish Gene* "succeeds in the seemingly impossible task of using simple, untechnical English to present some rather recondite and quasi-mathematical themes of recent evolutionary thought" in a way that would "surprise and refresh even many research biologists" (W. D. Hamilton *Science* **196,** 757–759; 1977).

As a first-year undergraduate in the zoology department at the University of Oxford, UK, where Dawkins was about to teach me

Dawkins speaking at an atheist event in 2012.

computing and animal behaviour, I found the book exhilarating and bewildering. Until then, my teachers had helpfully divided the world into right ideas and wrong ones. But here was a writer turning some settled science upside down and inviting me to join him on a journey to discover a truth that seemed to him "stranger than fiction". Was he right or wrong? I was being shown the arguments, not the answers.

The origin of *The Selfish Gene* is intriguing. Dawkins revealed in the first volume of his memoirs, *An Appetite for Wonder* (Bantam, 2013; see E. Scott *Nature* **501,** 163; 2013), that the idea of selfish genes was born ten years before the book was published. In 1966, the Dutch biologist Niko Tinbergen asked Dawkins, then a research assistant with a new doctorate in animal behaviour, to give some lectures in his stead. Inspired by Hamilton, Dawkins wrote in his notes (reproduced in *An Appetite for Wonder*): "Genes are in a sense immortal. They pass through the generations, reshuffling themselves each time they pass from parent to offspring … Natural selection will favour those genes which build themselves a body which is most likely to succeed in handing down safely to the next generation a large number of replicas of those genes … our basic expectation on the basis of the orthodox, neo-Darwinian theory of evolution is that Genes will be 'selfish'."

"Dawkins's ideas helped to explain what was going on inside genomes long before DNA sequencing became routine."

Dawkins began writing the book in 1973, and resumed it in 1975 while on sabbatical. At the suggestion of Desmond Morris, the zoologist and author of *The Naked Ape* (Jonathan Cape, 1967), Dawkins showed some draft chapters to Tom Maschler of Jonathan Cape, who strongly urged that the title be changed to 'The Immortal Gene'. Today, Dawkins regrets not taking the advice. It might have short-circuited the endless arguments, so beloved of his critics and so redolent of the intentional stance (in which we tend to impute mental abilities to unconscious things, from thunderstorms to plants), about whether selfishness need be conscious. It might even have avoided the common misconception that Dawkins was advocating individual selfishness.

In the end, it was Michael Rodgers of Oxford University Press who enthusiastically published *The Selfish Gene*, after demanding "I must have that book!" when he saw early draft chapters. It was an immediate success, garnering more than 100 reviews, mostly positive. Dawkins went on to write books that were better in certain ways. *The Extended Phenotype* was more groundbreaking, *The Blind Watchmaker* more persuasive, *Climbing Mount Improbable* more logical, *River out of Eden* and *Unweaving the Rainbow* more lyrical, *The Ancestor's Tale* more encyclopaedic, *The God Delusion* more controversial. But they were all variations on the themes he so eloquently and adventurously set out in *The Selfish Gene*. ■

Matt Ridley's *latest book is* The Evolution of Everything. *He is a columnist for* The Times.
Twitter: @mattwridley