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RICHARD DAWKINS

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EPILOGUE

THE
SELFISH
GENE

40TH ANNIVERSARY EDITION



OXFORD LANDMARK SCIENCE

THE SELFISH GENE

Richard Dawkins was Charles Simonyi Professor for the Public Understanding of Science at Oxford University from 1995 to 2008. Born in Nairobi of British parents, he was educated at Oxford and did his doctorate under the Nobel Prize-winning ethologist Niko Tinbergen. From 1967 to 1969 he was an Assistant Professor at the University of California at Berkeley, returning as University Lecturer and later Reader in Zoology at New College, Oxford, before becoming the first holder of the Simonyi Chair. He is an Emeritus Fellow of New College.

The Selfish Gene (1976; second edition 1989) catapulted Richard Dawkins to fame, and remains his most famous and widely read work. It was followed by a string of bestselling books: *The Extended Phenotype* (1982), *The Blind Watchmaker* (1986), *River Out of Eden* (1995), *Climbing Mount Improbable* (1996), *Unweaving the Rainbow* (1998), *A Devil's Chaplain* (2003), *The Ancestor's Tale* (2004), *The God Delusion* (2006), and *The Greatest Show on Earth* (2009). He has also published a science book for children, *The Magic of Reality* (2011), and two volumes of memoirs, *An Appetite for Wonder* (2013) and *Brief Candle in the Dark* (2015). Dawkins is a Fellow of both the Royal Society and the Royal Society of Literature. He is the recipient of numerous honours and awards, including the 1987 Royal Society of Literature Award, the *Los Angeles Times* Literary Prize of the same year, the 1990 Michael Faraday Award of the Royal Society, the 1994 Nakayama Prize, the 1997 International Cosmos Prize for Achievement in Human Science, the Kistler Prize in 2001, and the Shakespeare Prize in 2005, the 2006 Lewis Thomas Prize for Writing About Science, and the Nierenberg Prize for Science in the Public Interest in 2009.

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INTRODUCTION TO 30TH ANNIVERSARY EDITION

It is sobering to realize that I have lived nearly half my life with *The Selfish Gene*—for better, for worse. Over the years, as each of my seven subsequent books has appeared, publishers have sent me on tour to promote it. Audiences respond to the new book, whichever one it is, with gratifying enthusiasm, applaud politely and ask intelligent questions. Then they line up to buy, and have me sign ... *The Selfish Gene*. That is a bit of an exaggeration. Some of them do buy the new book and, for the rest, my wife consoles me by arguing that people who newly discover an author will naturally tend to go back to his first book: having read *The Selfish Gene*, surely they'll work their way through to the latest and (to its fond parent) favourite baby?

I would mind more if I could claim that *The Selfish Gene* had become severely outmoded and superseded. Unfortunately (from one point of view) I cannot. Details have changed and factual examples burgeoned mightily. But, with an exception that I shall discuss in a moment, there is little in the book that I would rush to take back now, or apologize for. Arthur Cain, late Professor of Zoology at Liverpool and one of my inspiring tutors at Oxford in the sixties, described *The Selfish Gene* in 1976 as a 'young man's book'. He was deliberately quoting a commentator on A.J. Ayer's *Language Truth and Logic*. I was flattered by the comparison, although I knew that Ayer had recanted much of his first book and I could hardly miss Cain's pointed implication that I should, in the fullness of time, do the same.

Let me begin with some second thoughts about the title. In 1975, through the mediation of my friend Desmond Morris I showed the partially completed book to Tom Maschler, doyen of London publishers, and we discussed it in his room at Jonathan Cape. He liked the book but not the

title. ‘Selfish’, he said, was a ‘down word’. Why not call it *The Immortal Gene*? Immortal was an ‘up’ word, the immortality of genetic information was a central theme of the book, and ‘immortal gene’ had almost the same intriguing ring as ‘selfish gene’ (neither of us, I think, noticed the resonance with Oscar Wilde’s *The Selfish Giant*). I now think Maschler may have been right. Many critics, especially vociferous ones learned in philosophy as I have discovered, prefer to read a book by title only. No doubt this works well enough for *The Tale of Benjamin Bunny* or *The Decline and Fall of the Roman Empire*, but I can readily see that ‘The Selfish Gene’ on its own, without the large footnote of the book itself, might give an inadequate impression of its contents. Nowadays, an American publisher would in any case have insisted on a subtitle.

The best way to explain the title is by locating the emphasis. Emphasize ‘selfish’ and you will think the book is about selfishness, whereas, if anything, it devotes more attention to altruism. The correct word of the title to stress is ‘gene’ and let me explain why. A central debate within Darwinism concerns the unit that is actually selected: what kind of entity is it that survives, or does not survive, as a consequence of natural selection. That unit will become, more or less by definition, ‘selfish’. Altruism might well be favoured at other levels. Does natural selection choose between species? If so, we might expect individual organisms to behave altruistically ‘for the good of the species’. They might limit their birth rates to avoid overpopulation, or restrain their hunting behaviour to conserve the species’ future stocks of prey. It was such widely disseminated misunderstandings of Darwinism that originally provoked me to write the book.

Or does natural selection, as I urge instead here, choose between genes? In this case, we should not be surprised to find individual organisms behaving altruistically ‘for the good of the genes’, for example by feeding and protecting kin who are likely to share copies of the same genes. Such kin altruism is only one way in which gene selfishness can translate itself into individual altruism. This book explains how it works, together with reciprocation, Darwinian theory’s other main generator of altruism. If I were ever to rewrite the book, as a late convert to the Zahavi/Grafen ‘handicap principle’ (see pages 406–12) I should also give some space to Amotz Zahavi’s idea that altruistic donation might be a ‘Potlatch’ style of

dominance signal: see how superior to you I am, I can afford to make a donation to you!

Let me repeat and expand the rationale for the word ‘selfish’ in the title. The critical question is: Which level in the hierarchy of life will turn out to be the inevitably ‘selfish’ level, at which natural selection acts? The Selfish Species? The Selfish Group? The Selfish Organism? The Selfish Ecosystem? Most of these could be argued, and most have been uncritically assumed by one or another author, but all of them are wrong. Given that the Darwinian message is going to be pithily encapsulated as *The Selfish Something*, that something turns out to be the gene, for cogent reasons which this book argues. Whether or not you end up buying the argument itself, that is the explanation for the title.

I hope that takes care of the more serious misunderstandings. Nevertheless, I do with hindsight notice lapses of my own on the very same subject. These are to be found especially in [Chapter 1](#), epitomized by the sentence ‘Let us try to teach generosity and altruism because we are born selfish’. There is nothing wrong with teaching generosity and altruism, but ‘born selfish’ is misleading. In partial explanation, it was not until 1978 that I began to think clearly about the distinction between ‘vehicles’ (usually organisms) and the ‘replicators’ that ride inside them (in practice genes: the whole matter is explained in [Chapter 13](#), which was added in the second edition). Please mentally delete that rogue sentence and others like it, and substitute something along the lines of this paragraph.

Given the dangers of that style of error, I can readily see how the title could be misunderstood, and this is one reason why I should perhaps have gone for *The Immortal Gene. The Altruistic Vehicle* would have been another possibility. Perhaps it would have been too enigmatic but, at all events, the apparent dispute between the gene and the organism as rival units of natural selection (a dispute that exercised the late Ernst Mayr to the end) is resolved. There are two kinds of unit of natural selection, and there is no dispute between them. The gene is the unit in the sense of replicator. The organism is the unit in the sense of vehicle. Both are important. Neither should be denigrated. They represent two completely distinct kinds of unit and we shall be hopelessly confused unless we recognize the distinction.

Another good alternative to *The Selfish Gene* would have been *The Cooperative Gene*. It sounds paradoxically opposite, but a central part of the book argues for a form of cooperation among self-interested genes. This emphatically does not mean that groups of genes prosper at the expense of their members, or at the expense of other groups. Rather, each gene is seen as pursuing its own self-interested agenda against the background of the other genes in the gene pool—the set of candidates for sexual shuffling within a species. Those other genes are part of the environment in which each gene survives, in the same way as the weather, predators and prey, supporting vegetation and soil bacteria are parts of the environment. From each gene’s point of view, the ‘background’ genes are those with which it shares bodies in its journey down the generations. In the short term, that means the other members of the genome. In the long term, it means the other genes in the gene pool of the species. Natural selection therefore sees to it that gangs of mutually compatible—which is almost to say cooperating—genes are favoured in the presence of each other. At no time does this evolution of the ‘cooperative gene’ violate the fundamental principle of the selfish gene. [Chapter 5](#) develops the idea, using the analogy of a rowing crew, and [Chapter 13](#) takes it further.

Now, given that natural selection for selfish genes tends to favour cooperation among genes, it has to be admitted that there are some genes that do no such thing and work against the interests of the rest of the genome. Some authors have called them outlaw genes, others ultra-selfish genes, yet others just ‘selfish genes’—misunderstanding the subtle difference from genes that cooperate in self-interested cartels. Examples of ultra-selfish genes are the meiotic drive genes described on pages 304–6, and the ‘parasitic DNA’ originally proposed on pages 56–7 and developed further by various authors under the catchphrase ‘Selfish DNA’. The uncovering of new and ever more bizarre examples of ultra-selfish genes has become a feature of the years since this book was first published.*

The Selfish Gene has been criticized for anthropomorphic personification and this too needs an explanation, if not an apology. I employ two levels of personification: of genes, and of organisms. Personification of genes really ought not to be a problem, because no sane person thinks DNA molecules have conscious personalities, and no sensible

reader would impute such a delusion to an author. I once had the honour of hearing the great molecular biologist Jacques Monod talking about creativity in science. I have forgotten his exact words, but he said approximately that, when trying to think through a chemical problem, he would ask himself what he would do if he were an electron. Peter Atkins, in his wonderful book *Creation Revisited*, uses a similar personification when considering the refraction of a light beam, passing into a medium of higher refractive index which slows it down. The beam behaves as if trying to minimize the time taken to travel to an end point. Atkins imagines it as a lifeguard on a beach racing to rescue a drowning swimmer. Should he head straight for the swimmer? No, because he can run faster than he can swim and would be wise to increase the dry-land proportion of his travel time. Should he run to a point on the beach directly opposite his target, thereby minimizing his swimming time? Better, but still not the best. Calculation (if he had time to do it) would disclose to the lifeguard an optimum intermediate angle, yielding the ideal combination of fast running followed by inevitably slower swimming. Atkins concludes:

That is exactly the behaviour of light passing into a denser medium. But how does light know, apparently in advance, which is the briefest path? And, anyway, why should it care?

He develops these questions in a fascinating exposition, inspired by quantum theory.

Personification of this kind is not just a quaint didactic device. It can also help a professional scientist to get the right answer, in the face of tricky temptations to error. Such is the case with Darwinian calculations of altruism and selfishness, cooperation and spite. It is very easy to get the wrong answer. Personifying genes, if done with due care and caution, often turns out to be the shortest route to rescuing a Darwinian theorist drowning in muddle. While trying to exercise that caution, I was encouraged by the masterful precedent of W. D. Hamilton, one of the four named heroes of the book. In a paper of 1972 (the year in which I began to write *The Selfish Gene*) Hamilton wrote:

A gene is being favoured in natural selection if the aggregate of its replicas forms an increasing fraction of the total gene pool. We are going to be concerned with genes supposed to affect the social behaviour of their bearers, so let us try to make the argument more vivid

by attributing to the genes, temporarily, intelligence and a certain freedom of choice. Imagine that a gene is considering the problem of increasing the number of its replicas, and imagine that it can choose between ...

That is exactly the right spirit in which to read much of *The Selfish Gene*.

Personifying an organism could be more problematical. This is because organisms, unlike genes, have brains and therefore really might have selfish or altruistic motives in something like the subjective sense we would recognize. A book called *The Selfish Lion* might actually confuse, in a way that *The Selfish Gene* should not. Just as one can put oneself in the position of an imaginary light beam, intelligently choosing the optimal route through a cascade of lenses and prisms, or an imaginary gene choosing an optimal route through the generations, so one can postulate an individual lioness, calculating an optimal behavioural strategy for the long term future survival of her genes. Hamilton's first gift to biology was the precise mathematics that a truly Darwinian individual such as a lion would, in effect, have to employ, when taking decisions calculated to maximize the long term survival of its genes. In this book I used informal verbal equivalents of such calculations—on the two levels.

On page 168 we switch rapidly from one level to the other:

We have considered the conditions under which it would actually pay a mother to let a runt die. We might suppose intuitively that the runt himself should go on struggling to the last, but the theory does not necessarily predict this. As soon as a runt becomes so small and weak that his expectation of life is reduced to the point where benefit to him due to parental investment is less than half the benefit that the same investment could potentially confer on the other babies, the runt should die gracefully and willingly. He can benefit his genes most by doing so.

That is all individual-level introspection. The assumption is not that the runt chooses what gives him pleasure, or what feels good. Rather, individuals in a Darwinian world are assumed to be making an *as-if* calculation of what would be best for their genes. This particular paragraph goes on to make it explicit by a quick change to gene-level personification:

That is to say, a gene that gives the instruction 'Body, if you are very much smaller than your litter-mates, give up the struggle and die' could be successful in the gene pool, because it has a 50 per cent chance of being in the body of each brother and sister saved, and its chances of surviving in the body of the runt are very small anyway.

And then the paragraph immediately switches back to the introspective runt:

There should be a point of no return in the career of a runt. Before he reaches this point he should go on struggling. As soon as he reaches it he should give up and preferably let himself be eaten by his litter-mates or his parents.

I really believe that these two levels of personification are not confusing if read in context and in full. The two levels of ‘as-if calculation’ come to exactly the same conclusion if done correctly: that, indeed, is the criterion for judging their correctness. So, I don’t think personification is something I would undo if I were to write the book again today.

Unwriting a book is one thing. Unreading it is something else. What are we to make of the following verdict, from a reader in Australia?

Fascinating, but at times I wish I could unread it ... On one level, I can share in the sense of wonder Dawkins so evidently sees in the workings-out of such complex processes ... But at the same time, I largely blame *The Selfish Gene* for a series of bouts of depression I suffered from for more than a decade ... Never sure of my spiritual outlook on life, but trying to find something deeper—trying to believe, but not quite being able to—I found that this book just about blew away any vague ideas I had along these lines, and prevented them from coalescing any further. This created quite a strong personal crisis for me some years ago.

I have previously described a pair of similar responses from readers:

A foreign publisher of my first book confessed that he could not sleep for three nights after reading it, so troubled was he by what he saw as its cold, bleak message. Others have asked me how I can bear to get up in the mornings. A teacher from a distant country wrote to me reproachfully that a pupil had come to him in tears after reading the same book, because it had persuaded her that life was empty and purposeless. He advised her not to show the book to any of her friends, for fear of contaminating them with the same nihilistic pessimism (*Unweaving the Rainbow*).

If something is true, no amount of wishful thinking can undo it. That is the first thing to say, but the second is almost as important. As I went on to write,

Presumably there is indeed no purpose in the ultimate fate of the cosmos, but do any of us really tie our life’s hopes to the ultimate fate of the cosmos anyway? Of course we don’t; not if we are sane. Our lives are ruled by all sorts of closer, warmer, human ambitions and perceptions. To accuse science of robbing life of the warmth that makes it worth living is so

preposterously mistaken, so diametrically opposite to my own feelings and those of most working scientists, I am almost driven to the despair of which I am wrongly suspected.

A similar tendency to shoot the messenger is displayed by other critics who have objected to what they see as the disagreeable social, political or economic implications of *The Selfish Gene*. Soon after Mrs Thatcher won her first election victory in 1979, my friend Steven Rose wrote the following in *New Scientist*:

I am not implying that Saatchi and Saatchi engaged a team of sociobiologists to write the Thatcher scripts, nor even that certain Oxford and Sussex dons are beginning to rejoice at this practical expression of the simple truths of selfish genery they have been struggling to convey to us. The coincidence of fashionable theory with political events is messier than that. I do believe though, that when the history of the move to the right of the late 1970s comes to be written, from law and order to monetarism and to the (more contradictory) attack on statism, then the switch in scientific fashion, if only from group to kin selection models in evolutionary theory, will come to be seen as part of the tide which has rolled the Thatcherites and their concept of a fixed, 19th century competitive and xenophobic human nature into power.

The ‘Sussex don’ was the late John Maynard Smith, admired by Steven Rose and me alike, and he replied characteristically in a letter to *New Scientist*: ‘What should we have done, fiddled the equations?’ One of the dominant messages of *The Selfish Gene* (reinforced by the title essay of *A Devil’s Chaplain*) is that we should not derive our values from Darwinism, unless it is with a negative sign. Our brains have evolved to the point where we are capable of rebelling against our selfish genes. The fact that we can do so is made obvious by our use of contraceptives. The same principle can and should work on a wider scale.

Unlike the second edition of 1989, this anniversary edition adds no new material except this Introduction, and some extracts from reviews chosen by my three-times Editor and champion, Latha Menon. Nobody but Latha could have filled the shoes of Michael Rodgers, K-selected Editor Extraordinary, whose indomitable belief in this book was the booster rocket of its first edition’s trajectory.

This edition does, however—and it is a source of particular joy to me—restore the original Foreword by Robert Trivers. I have mentioned Bill Hamilton as one of the four intellectual heroes of the book. Bob Trivers is another. His ideas dominate large parts of [Chapters 9](#), [10](#) and [12](#), and the

whole of [Chapter 8](#). Not only is his Foreword a beautifully crafted introduction to the book: unusually, he chose the medium to announce to the world a brilliant new idea, his theory of the evolution of self-deception. I am most grateful to him for giving permission for the original Foreword to grace this anniversary edition.

RICHARD DAWKINS

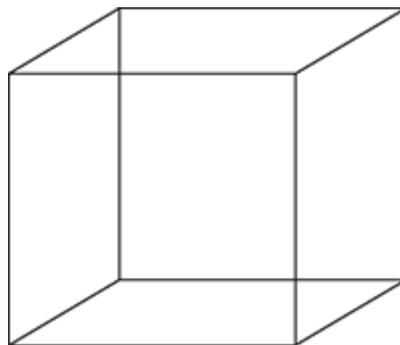
Oxford, October 2005

* Austin Burt and Robert Trivers (2006), *Genes in Conflict: the biology of selfish genetic elements* (Harvard University Press) arrived too late for inclusion in the first printing of this edition. It will undoubtedly become the definitive reference work on this important subject.

PREFACE TO SECOND EDITION

In the dozen years since *The Selfish Gene* was published its central message has become textbook orthodoxy. This is paradoxical, but not in the obvious way. It is not one of those books that was reviled as revolutionary when published, then steadily won converts until it ended up so orthodox that we now wonder what the fuss was about. Quite the contrary. From the outset the reviews were gratifyingly favourable and it was not seen, initially, as a controversial book. Its reputation for contentiousness took years to grow until, by now, it is widely regarded as a work of radical extremism. But over the very same years as the book's *reputation* for extremism has escalated, its actual *content* has seemed less and less extreme, more and more the common currency.

The selfish gene theory is Darwin's theory, expressed in a way that Darwin did not choose but whose aptness, I should like to think, he would instantly have recognized and delighted in. It is in fact a logical outgrowth of orthodox neo-Darwinism, but expressed as a novel image. Rather than focus on the individual organism, it takes a gene's eye view of nature. It is a different way of seeing, not a different theory. In the opening pages of *The Extended Phenotype* I explained this using the metaphor of the Necker cube.



This is a two-dimensional pattern of ink on paper, but it is perceived as a transparent, three-dimensional cube. Stare at it for a few seconds and it will change to face in a different direction. Carry on staring and it will flip back to the original cube. Both cubes are equally compatible with the two-dimensional data on the retina, so the brain happily alternates between them. Neither is more correct than the other. My point was that there are two ways of looking at natural selection, the gene's angle and that of the individual. If properly understood they are equivalent; two views of the same truth. You can flip from one to the other and it will still be the same neo-Darwinism.

I now think that this metaphor was too cautious. Rather than propose a new theory or unearth a new fact, often the most important contribution a scientist can make is to discover a new way of seeing old theories or facts. The Necker cube model is misleading because it suggests that the two ways of seeing are equally good. To be sure, the metaphor gets it partly right: 'angles', unlike theories, cannot be judged by experiment; we cannot resort to our familiar criteria of verification and falsification. But a change of vision can, at its best, achieve something loftier than a theory. It can usher in a whole climate of thinking, in which many exciting and testable theories are born, and unimagined facts laid bare. The Necker cube metaphor misses this completely. It captures the idea of a flip in vision, but fails to do justice to its value. What we are talking about is not a flip to an equivalent view but, in extreme cases, a transfiguration.

I hasten to disclaim any such status for my own modest contributions. Nevertheless, it is for this kind of reason that I prefer not to make a clear separation between science and its 'popularization'. Expounding ideas that have hitherto appeared only in the technical literature is a difficult art. It requires insightful new twists of language and revealing metaphors. If you push novelty of language and metaphor far enough, you can end up with a new way of seeing. And a new way of seeing, as I have just argued, can in its own right make an original contribution to science. Einstein himself was no mean popularizer, and I've often suspected that his vivid metaphors did more than just help the rest of us. Didn't they also fuel his creative genius?

The gene's eye view of Darwinism is implicit in the writings of R. A. Fisher and the other great pioneers of neo-Darwinism in the early thirties,

but was made explicit by W. D. Hamilton and G. C. Williams in the sixties. For me their insight had a visionary quality. But I found their expressions of it too laconic, not full-throated enough. I was convinced that an amplified and developed version could make everything about life fall into place, in the heart as well as in the brain. I would write a book extolling the gene's eye view of evolution. It should concentrate its examples on social behaviour, to help correct the unconscious group selectionism that then pervaded popular Darwinism. I began the book in 1972 when powers-cuts resulting from industrial strife interrupted my laboratory research. The blackouts unfortunately (from one point of view) ended after a mere two chapters, and I shelved the project until I had a sabbatical leave in 1975. Meanwhile the theory had been extended, notably by John Maynard Smith and Robert Trivers. I now see that it was one of those mysterious periods in which new ideas are hovering in the air. I wrote *The Selfish Gene* in something resembling a fever of excitement.

When Oxford University Press approached me for a second edition they insisted that a conventional, comprehensive, page by page revision was inappropriate. There are some books that, from their conception, are obviously destined for a string of editions, and *The Selfish Gene* was not one of them. The first edition borrowed a youthful quality from the times in which it was written. There was a whiff of revolution abroad, a streak of Wordsworth's blissful dawn. A pity to change a child of those times, fatten it with new facts or wrinkle it with complications and cautions. So, the original text should stand, warts, sexist pronouns and all. Notes at the end would cover corrections, responses and developments. And there should be entirely new chapters, on subjects whose novelty in their own time would carry forward the mood of revolutionary dawn. The result was [Chapters 12](#) and [13](#). For these I took my inspiration from the two books in the field that have most excited me during the intervening years: Robert Axelrod's *The Evolution of Cooperation*, because it seems to offer some sort of hope for our future; and my own *The Extended Phenotype* because for me it dominated those years and because—for what that is worth—it is probably the finest thing I shall ever write.

The title 'Nice guys finish first' is borrowed from the BBC *Horizon* television programme that I presented in 1985. This was a fifty-minute

documentary on game-theoretic approaches to the evolution of cooperation, produced by Jeremy Taylor. The making of this film, and another, *The Blind Watchmaker*, by the same producer, gave me a new respect for his profession. At their best, *Horizon* producers (some of their programmes can be seen in America, often repackaged under the name *Nova*) turn themselves into advanced scholarly experts on the subject in hand. [Chapter 12](#) owes more than just its title to my experience of working closely with Jeremy Taylor and the *Horizon* team, and I am grateful.

I recently learned a disagreeable fact: there are influential scientists in the habit of putting their names to publications in whose composition they have played no part. Apparently some senior scientists claim joint authorship of a paper when all that they have contributed is bench space, grant money and an editorial readthrough of the manuscript. For all I know, entire scientific reputations may have been built on the work of students and colleagues! I don't know what can be done to combat this dishonesty. Perhaps journal editors should require signed testimony of what each author contributed. But that is by the way. My reason for raising the matter here is to make a contrast. Helena Cronin has done so much to improve every line—every word—that she should, but for her adamant refusal, be named as joint author of all the new portions of this book. I am deeply grateful to her, and sorry that my acknowledgment must be limited to this. I also thank Mark Ridley, Marian Dawkins and Alan Grafen for advice and for constructive criticism of particular sections. Thomas Webster, Hilary McGlynn and others at Oxford University Press cheerfully tolerated my whims and procrastinations.

RICHARD DAWKINS

1989

FOREWORD TO FIRST EDITION

The chimpanzee and the human share about 99.5 per cent of their evolutionary history, yet most human thinkers regard the chimp as a malformed, irrelevant oddity while seeing themselves as stepping-stones to the Almighty. To an evolutionist this cannot be so. There exists no objective basis on which to elevate one species above another. Chimp and human, lizard and fungus, we have all evolved over some three billion years by a process known as natural selection. Within each species some individuals leave more surviving offspring than others, so that the inheritable traits (genes) of the reproductively successful become more numerous in the next generation. This is natural selection: the non-random differential reproduction of genes. Natural selection has built us, and it is natural selection we must understand if we are to comprehend our own identities.

Although Darwin's theory of evolution through natural selection is central to the study of social behavior (especially when wedded to Mendel's genetics), it has been very widely neglected. Whole industries have grown up in the social sciences dedicated to the construction of a pre-Darwinian and pre-Mendelian view of the social and psychological world. Even within biology the neglect and misuse of Darwinian theory has been astonishing. Whatever the reasons for this strange development, there is evidence that it is coming to an end. The great work of Darwin and Mendel has been extended by a growing number of workers, most notably by R. A. Fisher, W. D. Hamilton, G. C. Williams, and J. Maynard Smith. Now, for the first time, this important body of social theory based on natural selection is presented in a simple and popular form by Richard Dawkins.

One by one Dawkins takes up the major themes of the new work in social theory: the concepts of altruistic and selfish behavior, the genetical definition of self-interest, the evolution of aggressive behavior, kinship theory (including parent-offspring relations and the evolution of the social

insects), sex ratio theory, reciprocal altruism, deceit, and the natural selection of sex differences. With a confidence that comes from mastering the underlying theory, Dawkins unfolds the new work with admirable clarity and style. Broadly educated in biology, he gives the reader a taste of its rich and fascinating literature. Where he differs from published work (as he does in criticizing a fallacy of my own), he is almost invariably exactly on target. Dawkins also takes pains to make clear the logic of his arguments, so that the reader, by applying the logic given, can extend the arguments (and even take on Dawkins himself). The arguments themselves extend in many directions. For example, if (as Dawkins argues) deceit is fundamental in animal communication, then there must be strong selection to spot deception and this ought, in turn, to select for a degree of self-deception, rendering some facts and motives unconscious so as not to betray—by the subtle signs of self-knowledge—the deception being practiced. Thus, the conventional view that natural selection favors nervous systems which produce ever more accurate images of the world must be a very naïve view of mental evolution.

The recent progress in social theory has been substantial enough to have generated a minor flurry of counter-revolutionary activity. It has been alleged, for example, that the recent progress is, in fact, part of a cyclical conspiracy to impede social advancement by making such advancement appear to be genetically impossible. Similar feeble thoughts have been strung together to produce the impression that Darwinian social theory is reactionary in its political implications. This is very far from the truth. The genetic equality of the sexes is, for the first time, clearly established by Fisher and Hamilton. Theory and quantitative data from the social insects demonstrate that there is no inherent tendency for parents to dominate their offspring (or vice versa). And the concepts of parental investment and female choice provide an objective and unbiased basis for viewing sex differences, a considerable advance over popular efforts to root women's powers and rights in the functionless swamp of biological identity. In short, Darwinian social theory gives us a glimpse of an underlying symmetry and logic in social relationships which, when more fully comprehended by ourselves, should revitalize our political understanding and provide the intellectual support for a science and medicine of psychology. In the

process it should also give us a deeper understanding of the many roots of our suffering.

ROBERT L. TRIVERS

Harvard University, July, 1976

PREFACE TO FIRST EDITION

This book should be read almost as though it were science fiction. It is designed to appeal to the imagination. But it is not science fiction: it is science. Cliché or not, ‘stranger than fiction’ expresses exactly how I feel about the truth. We are survival machines—robot vehicles blindly programmed to preserve the selfish molecules known as genes. This is a truth which still fills me with astonishment. Though I have known it for years, I never seem to get fully used to it. One of my hopes is that I may have some success in astonishing others.

Three imaginary readers looked over my shoulder while I was writing, and I now dedicate the book to them. First the general reader, the layman. For him I have avoided technical jargon almost totally, and where I have had to use specialized words I have defined them. I now wonder why we don’t censor most of our jargon from learned journals too. I have assumed that the layman has no special knowledge, but I have not assumed that he is stupid. Anyone can popularize science if he oversimplifies. I have worked hard to try to popularize some subtle and complicated ideas in non-mathematical language, without losing their essence. I do not know how far I have succeeded in this, nor how far I have succeeded in another of my ambitions: to try to make the book as entertaining and gripping as its subject matter deserves. I have long felt that biology ought to seem as exciting as a mystery story, for a mystery story is exactly what biology is. I do not dare to hope that I have conveyed more than a tiny fraction of the excitement which the subject has to offer.

My second imaginary reader was the expert. He has been a harsh critic, sharply drawing in his breath at some of my analogies and figures of speech. His favourite phrases are ‘with the exception of’; ‘but on the other hand’; and ‘ugh’. I listened to him attentively, and even completely rewrote one chapter entirely for his benefit, but in the end I have had to tell the story

my way. The expert will still not be totally happy with the way I put things. Yet my greatest hope is that even he will find something new here; a new way of looking at familiar ideas perhaps; even stimulation of new ideas of his own. If this is too high an aspiration, may I at least hope that the book will entertain him on a train?

The third reader I had in mind was the student, making the transition from layman to expert. If he still has not made up his mind what field he wants to be an expert in, I hope to encourage him to give my own field of zoology a second glance. There is a better reason for studying zoology than its possible ‘usefulness’, and the general likeableness of animals. This reason is that we animals are the most complicated and perfectly-designed pieces of machinery in the known universe. Put it like that, and it is hard to see why anybody studies anything else! For the student who has already committed himself to zoology, I hope my book may have some educational value. He is having to work through the original papers and technical books on which my treatment is based. If he finds the original sources hard to digest, perhaps my non-mathematical interpretation may help, as an introduction and adjunct.

There are obvious dangers in trying to appeal to three different kinds of reader. I can only say that I have been very conscious of these dangers, but that they seemed to be outweighed by the advantages of the attempt.

I am an ethologist, and this is a book about animal behaviour. My debt to the ethological tradition in which I was trained will be obvious. In particular, Niko Tinbergen does not realize the extent of his influence on me during the twelve years I worked under him at Oxford. The phrase ‘survival machine’, though not actually his own, might well be. But ethology has recently been invigorated by an invasion of fresh ideas from sources not conventionally regarded as ethological. This book is largely based on these new ideas. Their originators are acknowledged in the appropriate places in the text; the dominant figures are G. C. Williams, J. Maynard Smith, W. D. Hamilton, and R. L. Trivers.

Various people suggested titles for the book, which I have gratefully used as chapter titles: ‘Immortal Coils’, John Krebs; ‘The Gene Machine’, Desmond Morris; ‘Genesmanship’, Tim Clutton-Brock and Jean Dawkins, independently with apologies to Stephen Potter.

Imaginary readers may serve as targets for pious hopes and aspirations, but they are of less practical use than real readers and critics. I am addicted to revising, and Marian Dawkins has been subjected to countless drafts and redrafts of every page. Her considerable knowledge of the biological literature and her understanding of theoretical issues, together with her ceaseless encouragement and moral support, have been essential to me. John Krebs too read the whole book in draft. He knows more about the subject than I do, and he has been generous and unstinting with his advice and suggestions. Glenys Thomson and Walter Bodmer criticized my handling of genetic topics kindly but firmly. I fear that my revision may still not fully satisfy them, but I hope they will find it somewhat improved. I am most grateful for their time and patience. John Dawkins exercised an unerring eye for misleading phraseology, and made excellent constructive suggestions for re-wording. I could not have wished for a more suitable 'intelligent layman' than Maxwell Stamp. His perceptive spotting of an important general flaw in the style of the first draft did much for the final version. Others who constructively criticized particular chapters, or otherwise gave expert advice, were John Maynard Smith, Desmond Morris, Tom Maschler, Nick Blurton Jones, Sarah Kettlewell, Nick Humphrey, Tim Clutton-Brock, Louise Johnson, Christopher Graham, Geoff Parker, and Robert Trivers. Pat Searle and Stephanie Verhoeven not only typed with skill, but encouraged me by seeming to do so with enjoyment. Finally, I wish to thank Michael Rodgers of Oxford University Press who, in addition to helpfully criticizing the manuscript, worked far beyond the call of duty in attending to all aspects of the production of this book.

RICHARD DAWKINS

1976

1

WHY ARE PEOPLE?

Intelligent life on a planet comes of age when it first works out the reason for its own existence. If superior creatures from space ever visit earth, the first question they will ask, in order to assess the level of our civilization, is: ‘Have they discovered evolution yet?’ Living organisms had existed on earth, without ever knowing why, for over three thousand million years before the truth finally dawned on one of them. His name was Charles Darwin. To be fair, others had had inklings of the truth, but it was Darwin who first put together a coherent and tenable account of why we exist. Darwin made it possible for us to give a sensible answer to the curious child whose question heads this chapter. We no longer have to resort to superstition when faced with the deep problems: Is there a meaning to life? What are we for? What is man? After posing the last of these questions, the eminent zoologist G. G. Simpson put it thus: ‘The point I want to make now is that all attempts to answer that question before 1859 are worthless and that we will be better off if we ignore them completely.’*

Today the theory of evolution is about as much open to doubt as the theory that the earth goes round the sun, but the full implications of Darwin’s revolution have yet to be widely realized. Zoology is still a minority subject in universities, and even those who choose to study it often make their decision without appreciating its profound philosophical significance. Philosophy and the subjects known as ‘humanities’ are still taught almost as if Darwin had never lived. No doubt this will change in time. In any case, this book is not intended as a general advocacy of

Darwinism. Instead, it will explore the consequences of the evolution theory for a particular issue. My purpose is to examine the biology of selfishness and altruism.

Apart from its academic interest, the human importance of this subject is obvious. It touches every aspect of our social lives, our loving and hating, fighting and cooperating, giving and stealing, our greed and our generosity. These are claims that could have been made for Lorenz's *On Aggression*, Ardrey's *The Social Contract*, and Eibl-Eibesfeldt's *Love and Hate*. The trouble with these books is that their authors got it totally and utterly wrong. They got it wrong because they misunderstood how evolution works. They made the erroneous assumption that the important thing in evolution is the good of the *species* (or the group) rather than the good of the individual (or the gene). It is ironic that Ashley Montagu should criticize Lorenz as a 'direct descendant of the "nature red in tooth and claw" thinkers of the nineteenth century ...'. As I understand Lorenz's view of evolution, he would be very much at one with Montagu in rejecting the implications of Tennyson's famous phrase. Unlike both of them, I think 'nature red in tooth and claw' sums up our modern understanding of natural selection admirably.

Before beginning on my argument itself, I want to explain briefly what sort of an argument it is, and what sort of an argument it is not. If we were told that a man had lived a long and prosperous life in the world of Chicago gangsters, we would be entitled to make some guesses as to the sort of man he was. We might expect that he would have qualities such as toughness, a quick trigger finger, and the ability to attract loyal friends. These would not be infallible deductions, but you can make some inferences about a man's character if you know something about the conditions in which he has survived and prospered. The argument of this book is that we, and all other animals, are machines created by our genes. Like successful Chicago gangsters, our genes have survived, in some cases for millions of years, in a highly competitive world. This entitles us to expect certain qualities in our genes. I shall argue that a predominant quality to be expected in a successful gene is ruthless selfishness. This gene selfishness will usually give rise to selfishness in individual behaviour. However, as we shall see, there are special circumstances in which a gene can achieve its own selfish

goals best by fostering a limited form of altruism at the level of individual animals. ‘Special’ and ‘limited’ are important words in the last sentence. Much as we might wish to believe otherwise, universal love and the welfare of the species as a whole are concepts that simply do not make evolutionary sense.

This brings me to the first point I want to make about what this book is *not*. I am not advocating a morality based on evolution.* I am saying how things have evolved. I am not saying how we humans morally ought to behave. I stress this, because I know I am in danger of being misunderstood by those people, all too numerous, who cannot distinguish a statement of belief in what is the case from an advocacy of what ought to be the case. My own feeling is that a human society based simply on the gene’s law of universal ruthless selfishness would be a very nasty society in which to live. But unfortunately, however much we may deplore something, it does not stop it being true. This book is mainly intended to be interesting, but if you would extract a moral from it, read it as a warning. Be warned that if you wish, as I do, to build a society in which individuals cooperate generously and unselfishly towards a common good, you can expect little help from biological nature. Let us try to *teach* generosity and altruism, because we are born selfish. Let us understand what our own selfish genes are up to, because we may then at least have the chance to upset their designs, something that no other species has ever aspired to.

As a corollary to these remarks about teaching, it is a fallacy—incidentally a very common one—to suppose that genetically inherited traits are by definition fixed and unmodifiable. Our genes may instruct us to be selfish, but we are not necessarily compelled to obey them all our lives. It may just be more difficult to learn altruism than it would be if we were genetically programmed to be altruistic. Among animals, man is uniquely dominated by culture, by influences learned and handed down. Some would say that culture is so important that genes, whether selfish or not, are virtually irrelevant to the understanding of human nature. Others would disagree. It all depends where you stand in the debate over ‘nature versus nurture’ as determinants of human attributes. This brings me to the second thing this book is not: it is not an advocacy of one position or another in the nature/nurture controversy. Naturally I have an opinion on this, but I am not