



EVOLUTION'S RAINBOW



**DIVERSITY, GENDER,
AND SEXUALITY IN
NATURE AND PEOPLE**

WITH A NEW PREFACE BY THE AUTHOR

JOAN ROUGHGARDEN

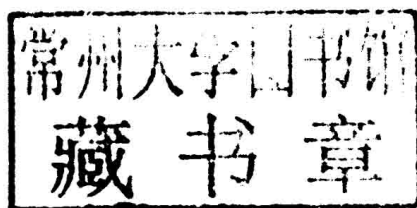
Evolution's Rainbow

Diversity, Gender, and Sexuality
in Nature and People

Tenth Anniversary Edition

With a New Preface by the Author

Joan Roughgarden



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EVOLUTION'S RAINBOW

To my sisters on the street
To my sisters everywhere
To people everywhere

Preface to the 2013 Edition

After ten years, *Evolution's Rainbow* still offers a valuable overview of how diverse the sexuality and gender expression is among animals and people. Part of this book's lasting value is how it brings the scope of this diversity together in one place.

Another value is that this book's approach is biological, whereas most books about sexuality and gender come from the humanities or medicine. My approach is what a Martian biologist would take in an expedition to Earth. A newly arriving Martian would gaze about to discern the diversity here in animals, including humans. As you read this book, imagine you're a young Darwin, not the bearded, aged thinker of most photographs but the young lad trying to discover just what's "out there"—the Darwin who jumps ashore in the Galápagos to marvel at the strange and surprising creatures he finds. As you jump ashore onto the field of sexuality and gender, you too will find many surprising facts. The task is to scope out this diversity, not to explain it but to accept it and put it all on the table for further discussion later on. I wrote this book with the mind-set of an expeditionary biologist, like those in the 1800s or a Martian visiting Earth today. I knew that the stereotypes of male and female behavior weren't accurate in animals and suspected they weren't accurate for people either. So this book is an expedition to find out what is going on out there.

This book also shines a searchlight on the inadequacies of existing science to account for the diversity in gender and sexuality it now knows about. Scientists today are interested, so they say, in research that is “transformative,” and the major science-funding agencies of the U.S. government and some private foundations claim to be seeking proposals for work that satisfies this aim. However, two kinds of scholarship are transformative—extensional and destabilizing. Extensional research is easy to be enthusiastic about—it’s usually risky, but wow, if it works, then it can answer all sorts of questions. Extensional research often involves developing a new technology and applying it to long-standing empirical problems. Destabilizing scholarship can be just as transformative as extensional research. But instead of enthusiasm, defensiveness and hostility invariably greet it. No one wants to see their cherished theories dashed to the ground, becoming a midden of broken ideas. *Evolution’s Rainbow* is transformative and destabilizing. The main tool for destabilizing scholarship is criticism. Of course, transformation is only complete when reconstruction succeeds the destabilization. My efforts at reconstruction appear in my sequel to this book, *The Genial Gene*.¹ *Evolution’s Rainbow* sets the table for the reconstruction that is beginning to take place now.

This book criticizes a venerable account of “universal” male and female gender roles that Darwin wrote about in 1871 under the heading of “sexual selection.”² This account may already be familiar to you from popular media and nature shows that portray males as universally promiscuous and females as always choosy and coy. These male and female traits are purported to explain, for instance, why the peacock has a lovely tail—promiscuous peacocks are supposed to advertise their tails to peahens, who then choose only the most beautiful as their mates. This book illustrates how absurd these stereotypes are when faced with the real facts of life. In response to my critique beginning with this book, many biologists are redefining sexual selection so that it no longer refers to sex roles such as promiscuous male and coy female. Sexual selection has been redefined to be more generic, referring now merely to any traits that evolve because of competition for mates without attributing any general characteristics to males or females.³ This revised definition is much better than the early sex-role version this book criticizes. I regard this revision as a healthy reconstruction of sexual selection provoked by

this book and my subsequent writings. Of course, this reconstructed version of sexual selection may still often be incorrect if traits thought to evolve in response to competition for mates actually evolve in response to some other form of natural selection, such as those involving cooperation between males and females, as *The Genial Gene* describes. The generality of the revised version of sexual selection is presently an open research question in biology.

Evolution's Rainbow has now appeared in translation in Brazilian Portuguese and in Korean, and *The Genial Gene* in French. Also, a talented graphic artist, Gwen Seemel, has written and illustrated a lovely book that features many of the animal species discussed here and is suitable for children, titled *Crime against Nature*.⁴ I hope you join the many readers who have enjoyed and benefited from *Evolution's Rainbow*.

Joan Roughgarden
Kapa'a, Hawai'i
April 17, 2013

NOTES

1. J. Roughgarden, 2009, *The Genial Gene*, University of California Press.
2. C. Darwin, 1871, *The Descent of Man and Selection in Relation to Sex*, John Murray.
3. D. M. Shuker, 2010, Sexual selection: Endless forms or tangled bank?, *Anim. Behav.* 79:E11–E17.
4. G. Seemel, 2012, *Crime against Nature: A More Accurate Telling of What's Natural*, self-published.

Preface to the 2009 Edition

Evolution's Rainbow surveyed the extensive diversity in sex, gender, and sexuality now known to exist among both nonhuman animals and people. When the book appeared in 2004, the extent of same-sex sexuality in animal societies was poorly publicized, even among biologists. Other phenomena such as gender multiplicity, sex-role reversal, and sex changes were even less well known. Biology undergraduates as well as the general public were being misled by textbooks and nature shows into thinking of a heterosexual binary as “nature’s way.” Today the situation has begun to improve; for example, exhibitions for the general public about gender and sexuality diversity opened in 2006 at the Natural History Museum of the University of Oslo, Norway, and in 2008 at the Museum of Sex, in New York City. Also in 2008, the Lesbian and Gay Veterinary Medical Association produced a DVD of my lecture at its 2007 annual conference in Washington, DC, titled *Sexual Diversity in the Animal Kingdom*, distributed through Amazon.com. Although it may be decades before information about the extent of sexual and gender diversity becomes common knowledge, the genie is out of the bottle at last.

The challenge today is to work through the implications of this diversity whose reality destabilizes our understanding of biological nature. The standard evolutionary account of gender and sexuality originates with Charles Darwin’s writing on the topic of “sexual selection” and

these specific writings—not his overall theory of evolution—are challenged by the new information. I concluded in 2004 that the extent of this diversity pointed to sexual selection's being on the wrong track. I proposed that Darwin's theory of sexual selection should be replaced by a new theory that I christened "social selection." Whereas sexual selection emphasizes mating, focusing on who mates with whom, social selection would emphasize participating in a social infrastructure to produce and raise offspring, and would focus more on how to deliver offspring into the next generation than on how to attract mates. In the social selection context, the diversity of gender and sexuality makes evolutionary sense, rather than seeming at odds with evolution, because of the valuable social roles the diversity represents.

In 2004, and probably even today, most biologists believe that Darwin's original sexual selection theory can somehow be widened and extended to account for gender and sexuality diversity. I don't think so. To the contrary, since 2004 the evidence and theoretical arguments against sexual selection have grown so much that those who continue to champion sexual selection theory are, I think, uninformed or in denial. Meanwhile, work on developing social selection into an alternative to sexual selection continues in my laboratory. This reissue of *Evolution's Rainbow* accompanies the publication in 2009 of my new book, *The Genial Gene*, which extends my critique of sexual selection based on studies that appeared after 2004 and provides a summary of the research from my laboratory on social selection.

In addition to discussing diversity in gender and sexuality among animals, *Evolution's Rainbow*, in the third of its three parts, reviewed gender and sexuality across cultures and through history. In particular, I called attention to passages in the Bible, in both the Christian and Hebrew Testaments, that teach the inclusion of gender-variant persons in community and worship. This theme has been taken up by religious scholars at Loyola University, Chicago, resulting in a book, *Christianity, Gender, and Human Sexuality: An Interdisciplinary Dialogue*, by Marie Vigen and Patricia Beattie Jung, to be published in 2009. Also since 2004, many advances have taken place in the public sector to secure rights for diverse people, although much remains to be done. Only in medicine and psychology, the areas treated in the middle part of the book, has the

progress been disappointing since 2004. These professions are still dominated by binarist thinking that retards coming to grips with the facts of diversity.

I hope you enjoy this reissue of *Evolution's Rainbow*. The book was exciting, even exhilarating, to write as I was uncovering fascinating information that I knew would be inherently interesting to many and would also challenge our preconceptions about what is biologically natural.

San Francisco
August 2008

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Diversity Denied

On a hot, sunny day in June of 1997, I attended my first gay pride parade, in San Francisco. The size of the crowd amazed me. As I marched from Civic Center up Market Street to San Francisco Bay, a throng of onlookers six persons deep on both sides shouted encouragement and support. For the first time, I felt the sheer magnitude of the gay community.

I stored this impression in the back of my mind. How, I wondered, does biology account for such a huge population that doesn't match the template science teaches as normal? When scientific theory says something's wrong with so many people, perhaps the theory is wrong, not the people.

It wasn't just the number of gay people that astonished me, but the diversity of personal expression in the parade. A drag queen or two were featured in the newspapers, but many other, less flamboyant presentations with different mixtures of gendered symbols were evident as well. I was intrigued, and resolved to investigate further if I ever got the chance. During the next few months I intended to transition into a transgendered woman.¹ I didn't know what the future held—whether I'd be fired as a biology professor, whether I'd become a nightclub waitress, whether I'd even stay alive. I couldn't make long-term plans.

Still, I found my mind leaping from one question to another: What's

the real story about diversity in gender and sexuality? How much diversity exists in other vertebrate species? How does diversity evolve in the animal kingdom? And how does diversity develop as individuals grow up: what role do genes, hormones, and brain cells play? And what about diversity in other cultures and historical periods, from biblical times to our own? Even more, I wondered where we might locate diversity in gender expression and sexual orientation within the overall framework of human diversity. Are these types of diversity as innocent as differences in height, weight, body proportion, and aptitude? Or does diversity in gender expression and sexuality merit special alarm and require careful treatment?

A few years after the 1997 parade, I was still alive and still employed. I had been forced to resign from my administrative responsibilities, but found myself with more time for research and writing. I was able to revisit the questions that had flooded my mind as I walked in the parade on that lovely day. This book is the result.

I found more diversity than I had ever dreamed existed. I'm an ecologist—diversity is my job—and yet I was still astonished. Much of this book presents the gee-whiz of vertebrate diversity: how animal families live, how animal societies are organized, how animals change sex, how animals have more than two genders, how species incorporate same-sex courtship, including sexual contact, as regular parts of their social systems. This diversity reveals the evolutionary stability and biological importance of expressions of gender and sexuality that go far beyond the traditional male/female or Mars/Venus binary. I also found that as we develop from tiny embryos to adults, our genes make decisions. Our glorious diversity is the result of our “gene committees” passing various biochemical resolutions. No gene is king, no body type reigns supreme, nor is any template universal in a cacophonous cellular democracy.

I studied how some cultures value transgender people, found where in the Bible transgender people occur, and learned that people from various cultures organize categories of identity differently. Although all cultures span the same range of human diversity, they have different ways of distinguishing gay, lesbian, and transgender identities.

All these facts were new to me, and even now seem utterly engaging, leading to page after page of I-didn't-know-that, wow, and really. This book, then, is a memoir of my travels through the academic spaces of

ecology and evolution, molecular biology, and anthropology, sociology, and theology. My general conclusion is that each academic discipline has its own means of discriminating against diversity. At first I felt that the book's main message would be a catalogue of diversity that biologically validates divergent expressions of gender and sexuality. This validating catalogue is indeed important. But as I reflected on my academic sojourn, I increasingly wondered why we didn't already know about nature's wonderful diversity in gender and sexuality. I came to see the book's main message as an indictment of academia for suppressing and denying diversity. I now conclude that all our academic disciplines should go back to school, take refresher courses in their own primary data, and emerge with a reformed, enlarged, and more accurate concept of diversity.

In ecology and evolution, diversity in gender and sexuality is denigrated by sexual selection theory, a perspective that can be traced to Darwin. This theory preaches that males and females obey certain universal templates—the passionate male and the coy female—and that deviations from these templates are anomalies. Yet the facts of nature falsify Darwin's sexual selection theory. In molecular biology and medicine, diversity is pathologized: difference is considered a disease. Yet the absence of a scientific definition of disease implies that the diagnosis of disease is often a value-loaded exercise in prejudice. And in the social sciences, variation in gender and sexuality is considered irrational, and personal agency is denied. Gender- and sexuality-variant people are thought to be motivated by mindless devotion to primitive gods, or compelled by far-fetched psychological urges, or brainwashed by social conventions, and so on: there is always some reason to avoid taking gender- and sexuality-variant people seriously.

The fundamental problem is that our academic disciplines are all rooted in Western culture, which discriminates against diversity. Each discipline finds its own justification for this discrimination. This book blows the whistle on a common pattern of disparaging gender and sexuality variation in academia and predicts foundational difficulties for each discipline.

Although criticism is valuable in its own right, and a critic has no responsibility to suggest solutions, I do suggest improvements when I can. I offer alternatives for interpreting the behavior of animals, interpreta-

tions that can be tested and will lead ultimately to more accurate science. I suggest new perspectives on genetics and development that may yield a more successful biotechnology industry. I show that mathematical criteria for the rarity of a genetic disease point to possibly overlooked advantages for genes presently considered defective. I suggest new readings of narratives recorded from gender-variant people across cultures. I call attention to overlooked aspects of the Bible that endorse gender variation.

I do *not* argue that because gender and sexuality variation occur in animals, this variation is also good for humans. People might anticipate that as a scientist I would say, “Natural equals good.” I do *not* advocate any version of this fallacy that confuses fact with value. I believe the goodness of a natural trait is the province of ethical reasoning, not science. Infanticide is natural in many animals but wrong in humans. Gender variation and homosexuality are also natural in animals, and perfectly fine in humans. What seems immoral to me is transphobia and homophobia. In the extreme, these phobias may be illnesses requiring therapy, similar to excessive fear of heights or snakes.²

I also do not suggest that people are directly comparable to animals. Indeed, even people in different cultures have life experiences that may not be comparable, and comparing people to animals is even riskier. Still, parallels can sometimes be found between cultures. Rugby is a counterpart to American football but located in a different sports culture. Some aspects of American football, like the way play begins by hiking the ball, are comparable to rugby. Similarly, parallels can sometimes be drawn between how people behave and how animals behave, as though animals offered biological cultures resembling ours. I’m quite willing to anthropomorphize about animals. Not that animals are really like people, but animals are not just machines either. We make an error if we attribute too much human quality to animals, but we underestimate them if we think they’re mechanical robots. I’ve tried to strike a balance here.

I’ve borrowed the word “rainbow” for the title of the book and use it throughout. The word “rainbow” signifies diversity, especially of racial and cultural minorities. The Reverend Jesse Jackson ran for president with the Rainbow Coalition. The rainbow also symbolizes gay liberation.

You probably work with or supervise biologically diverse people. You