

## PREFACE

Comparative medicine is functionally “peppered” throughout the scientific enterprise and is value added to biomedical research.

—MACY AND HORVATH (2017), P. 497

How did this book materialize? The answer is personal: I have been fascinated by animal behavior as long as I can remember, and in college I came to view it through an evolutionary lens. In graduate school, I added neurobiology as a research dimension and, consequently, explored both proximate and ultimate causes of behavior. Through all this work I became increasingly intrigued by species differences. At the same time, it appeared to me that many of my fellow neurobiologists became less and less interested in species differences and sought mainly to find the most convenient and popular “models” for their research. At one point, one of those colleagues asked me why I didn’t promote my work on vocal learning in parakeets as a model for the understanding and treatment of human stuttering. I ignored this well-meaning advice and continued to investigate not just how brains control behavior, but also how and why different brains work differently. Of course, I was hardly alone in being fascinated by evolution and keen to study its diverse outcomes. However, it seemed to me that, even among comparative biologists, far more attention was given to commonalities than differences, to features retained from common ancestors rather than, in Darwin’s words, descent *with modification*.

Compounding my unease was that, about a decade ago, I began to hear more and more complaints about how much biological research could not be replicated and how many treatments that worked in mice or other “model organisms” did not translate into effective treatments for humans. Still, most of the biologists I knew felt pressure to make their research translationally relevant (i.e., relevant to human health). Feeling this pressure myself, it occurred to me in early 2019 that I might try to make

my own knowledge of comparative biology translationally relevant. I did not have a proper name for my pursuit at the time, but I was essentially contemplating the kind of comparative medicine that is mentioned in the Preface's opening quote. Specifically, I thought that I might try to analyze the pros and cons of the various model systems that are so prominent in biological research, asking which models are "best" for which specific purposes and how one might account for the translational failures as well as the undoubted successes.

This book is the result. I tried to find simple answers, but they are few and far between. The subject matter is complex, and good people may disagree about which model systems are ideal for which kinds of research. Therefore, I settled for a critical analysis that largely eschews taking sides. As I wrote the book, I often hoped that my efforts might help young scientists decide which model systems they should choose for their research. In addition, I hoped that I might influence more senior scientists who can still shape the future of their field. I knew from the outset that this project was extremely ambitious, and I still fear that it will be dismissed (or worse). However, I did enjoy surveying so many different areas of biology and trying to make sense of what I learned. To use Sydney Brenner's phrase (cited in Friedberg 2008, 9), I delighted in the challenge to "convert the vast amount of information that we are accumulating into knowledge." Hopefully, I have achieved some measure of success, by which I mean that you will find the book useful. It would also make me happy if my work helps to make comparative medicine a more coherent discipline, less peppered across publications and lines of inquiry.

Many people helped improve this book along the way. Jessica Bolker and Todd Preuss provided key initial triggers for my thoughts about model systems, and they provided helpful feedback on my draft. Christopher Platt, who worked for many years at the National Science Foundation as well as the National Institutes of Health, read the entire book and provided incredibly detailed, useful input. Rachel Ankeny, Jorge Busciglio, Hung Fan, Susan Fitzpatrick, Claudia Kawas, Cheryl Logan, Steve Mahler, and Tom Schilling also provided constructive feedback on specific chapters or sections. I am indebted to all of them. Of course, any remaining errors and odd opinions are my own. Finally, I am grateful to Robert Prior and Kate Gibson from MIT Press for handling the book so expertly, and to my wife, Anna, for her perennial support.

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# Model Systems in Biology

## History, Philosophy, and Practical Concerns

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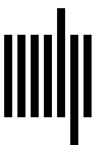
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