



Freaks of nature

What anomalies tell us about development and evolution

Mark S. Blumberg

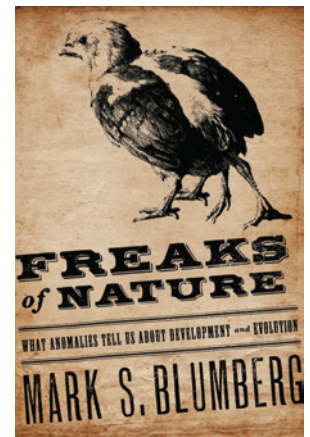
Oxford University Press. New York, New York, USA. 2008.

344 pp. \$22.95. ISBN: 978-019-532282-8 (hardcover).

Reviewed by Scott F. Gilbert

Swarthmore College, Swarthmore, Pennsylvania, USA.

E-mail: sgilber1@swarthmore.edu



Written in a conversational tone appropriate for a general audience, *Freaks of nature* is a set of examples and anecdotes demonstrating the plasticity of and interactions between development and behavior. Although subtitled *What anomalies tell us about development and evolution*, the book doesn't contain information on gene enhancers or fitness landscapes, nor does it use any of the specialist vocabulary needed to understand development, evolution, or the interaction of these two areas. Instead, Blumberg, editor-in-chief of *Behavioral Neuroscience* and a faculty member in the Department of Psychology at the University of Iowa, is trying to counter the culturally pervasive concept of the exclusively genetic basis for physical form and behavior in humans and other animals. Since such genetically deterministic stories are propagated more by the popular media than in science classes, this book confronts such reductionist accounts in an enjoyable, jargon-free manner appropriate for the shelves of Borders or Barnes & Noble.

Freaks of nature brings together evidence for the amazingly plastic coordination of behavior, brain, and skeleton that allows men and women born without legs to walk on their hands, that permits goats and dogs born with malformed forelimbs to walk bipedally, and that allows conjoined twins to function in society. The book celebrates the reciprocal plasticity of behaviors and morphology such that changes in behavior can cause changes in neural anatomy and changes in skeletons can cause alterations of behavior. This book also focuses on the interchangeability of genetic and environmental causations, showing that syndromes

such as holoprosencephaly (the failure of the embryonic forebrain to separate into two hemispheres) can be occasioned by both genetic and environmental agents.

The first chapter introduces us to a variety of physical disfigurements, how such examples provide insight into human and animal development, and how these aberrations can be considered alternative developmental outcomes. The author's aim is to show the malleability and reciprocal interactions of both the mind and body. The second chapter uses examples such as cyclopia to show that development has to be considered in discussing how variations occur. Evolutionary developmental biologists might not wish to use such extreme examples as evidence for the interaction of evolution and development, but we must remember that this is not a book written for researchers in the field. The chapter moves between a detailed historical analysis of early twentieth century teratology and varied examples of developmental anomalies to demonstrate that "timing is everything" when it comes to gene expression. Timing is indeed everything, but so are location and amount. (The ability to think in terms of systems allows such nonadditivity.)

The third and fourth chapters, on locomotion, are probably the most interesting and the most central to the book. Here, Blumberg gives a fascinating and well-reasoned analysis for the plasticity and integration of mind and body. He uses both evolutionary examples and teratological examples, showing how development is critical for understanding both. Thus, he analyzes the locomotory behavior of gerbils (bouncing), dormice (galloping), and jerbo-

as (bipedal walking) to show the reciprocal changes in their anatomies and behaviors. This is one of the few places where experimental data are introduced to bolster the conclusion that behavioral plasticity predominates over instinct and that form and behavior inform each other as development proceeds. This is also where one of the central points of the book is made: that changes in anatomy are recognized during development such that a new brain organization and a new set of behaviors can be generated. The brain is not genetically pre-programmed for a particular type of behavior as much as it is programmed to adapt to its peripheral inputs.

The last chapter concerns sex, that most malleable of phenotypes. Here Blumberg walks the middle ground, properly criticizing both the strictly genetic determinant views of sexual behavior and the tabula rasa views that sexual behaviors are strictly environmental. In this chapter, Blumberg praises ambiguity and learning. Genetic and environmental components must be integrated even to allow birds to recognize their conspecific mating partners.

Freaks of nature attempts to bring to the general public some of the insights of Pere Alberch and Gilbert Gottlieb, two of the most important thinkers on plasticity and development (physical in the case of Alberch and mental in the case of Gottlieb.) As a scientific book, *Freaks of nature* might not be deep, but as a book for the general public to learn about developmental plasticity, this is a good place to start. Certainly, any attempt to bring the insights of Gottlieb and Alberch to the general public has to be applauded.