

Separating fact from fiction science

Terry Gaasterland and Kass Schmitt

The Shattered Self: The End of Natural Evolution

By Pierre Baldi

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The nearly possible, sometimes coined “fiction science”, is the short extrapolation from current technology to achievements just around the corner. With the release this year of two reasonable working drafts of the human genome, we are now equipped with biological information as never before. This turn of events makes the nearly possible quite compelling: Now that we have a comprehensive, albeit incomplete and *very* fuzzy, list of human genetic parts, the rate of change is bound to accelerate dramatically in technologies like stem cell engineering, *in vitro* fertilization, monoclonal antibodies as drugs and markers, or therapies designed for highly specific subclasses of multigene diseases.

In his book, Baldi observes that as genomic information synergizes with ongoing developments in computer science, the rate of change in what is nearly possible will increase even more dramatically. He steps through the fundamental issues underlying stem cell research and cloning with specific illustrations of the currently possible and the nearly possible and poses critical questions: How long will it be before all the technical tools are in place to clone human organs, body parts, or entire humans? What remains to be learned before we can nurture an embryo through a full nine months of *in vitro* development? By the mid-21st century, will we be able to create life from scratch, with only a list of instructions at hand? If not in real space, then will it be possible in cyberspace?

This last question highlights the second thread in the book. While asking primary questions about the nearly possible in biotechnology, Baldi, a computer scientist long engaged in research about machine learning and its uses in making sense out of molecular

biology data, is keenly aware of the imagined possible in computer science: a true artificially intelligent creature embodied within the electrons of the computer. Furthermore, he makes us aware that the computer in question is potentially the entire Internet of interconnected computers, each contributing snippets of CPU power, memory, and communicated messages to a distributed whole. Baldi points out that the Internet already contains enough CPUs and memory to hold the brainpower of a handful of humans. Applying Moore’s law of exponential growth, networked computers will soon be capable of representing the complete content of thousands of individuals, and of blurring the boundaries among them.

Baldi addresses the issues using a rational and scientific approach. He avoids degenerating into generalities and insipid warnings by providing example after example for the reader to ponder. He reduces large numbers (e.g., the number of proteins in a cell) to conceivable images (e.g., a football stadium full of tennis balls). And then he presents critical questions in terms that can be grasped with reasonable thought.


Baldi makes explicit the boundary between what we can and cannot do. For example, we do not know how to fold proteins in three dimensions. We barely know how to find bits and pieces of genes in human genomic sequence data. Even knowing all of the parts is far from knowing how all of the parts interact. Soon we will have the complete set of proteins of yeast with structure and functional information about each one. However, this is far from knowing how they interact to solve a biological goal. At the same time, Baldi’s quiet style reminds us gently that we seem to have blind spots when it comes to the most disturbing implications of the genomic/biotech revolution. Many of these disturbing possibilities are not as far in the future as we would like to believe.

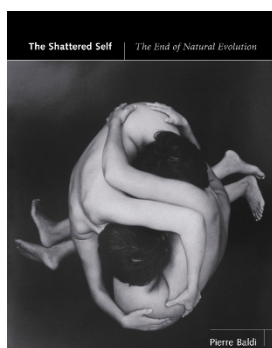
The conditions under which most scientists work are not generally conducive to stepping back to ponder the big picture, let alone telling the nonscientists what they see. The best we tend to get are the memoirs of our esteemed professors emeriti, which, with all due respect, more often than not seem to end with the world just how the hero always said it would

be (the winners write the history). Indeed, as the pace of science and technology increases, scientists are less likely to take time out to reflect on where we have been and where they are taking us, and the more important it becomes that they should do so.

This book looks forward more than back. Baldi provides just enough “history” to provide context, but the book is definitely not about power, personalities, fortunes, or hype (in contrast with Kevin Davies’ *Cracking the Genome: Inside the Race to Unlock Human DNA*, or Gary Zweiger’s *Transducing the Genome: Information, Anarchy, and Revolution in the Biomedical Sciences*). Although Baldi has an appreciation for the overwhelming complexity of the biological systems that we attempt to understand and manipulate, and advocates using caution in perturbing them, he is remarkably calm and unemotional while contemplating the risks. This is in stark contrast with Mae-Wan Ho’s excellent (though at times alarmist) *Genetic Engineering, Dream or Nightmare? The Brave New World of Bad Science and Big Business*, or Jeremy Rifkin’s *The Biotech Century: Harnessing the Gene and Remaking the World*.

This book of questions about the nearly possible extrapolates from our current world with thoughtful, real-life examples. It is perhaps best read with a friend, someone with whom the reader can discuss subtleties and the questions that are opened but not closed. The book is not a guide, nor does it have any answers; rather, its examples and vignettes are designed to provoke the reader to a new level of thought about our world’s fiction science—the nearly possible.

If Baldi and Brunak’s 1998 offering *Bioinformatics: The Machine Learning Approach* demonstrated to young scientists of how genes and genetic data could be amped up, ramped up, and made to rock out (as the elders shook their heads disappointingly: “You call that science? Why, you can’t even dance to it!”), then *The Shattered Self* is Baldi in a rare acoustic set, delivering a handful of slow, thoughtful ballads. Naturally, some early fans will wander away bored, but new devotees will replace them, drawn not only from the “mainstream” public but also from the old guard who are pleasantly surprised to find that underneath all that distortion there is a melody. And it is the rubbing of elbows (and, hopefully, subsequent conversations) between the members of this diverse audience that will be one of the book’s most lasting contributions. 



Terry Gaasterland is an assistant professor and Kass Schmitt is a research programmer at The Rockefeller University in New York (gaasterland@rockefeller.edu).