How We Live and Why We Die: The Secret Lives of Cells

Author: Dehaan, Robert L.

Source: BioScience, 60(1) : 75-76

Published By: American Institute of Biological Sciences

URL: https://doi.org/10.1525/bio.2010.60.1.12

A Society of Cells

How We Live and Why We Die: The Secret Lives of Cells. Lewis Wolpert. W. W. Norton, 2009. 256 pp., illus. $24.95 (ISBN 9780393072211 cloth).

Lewis Wolpert begins his story of *How We Live and Why We Die: The Secret Lives of Cells* with two 19th-century discoveries that are at the core of what biologists refer to as the cell theory. First, the recognition in the 1830s by German physiologist Theodor Schwann and botanist Matthias Schleiden that all living things are made of cells. And second, the concept that cells can only originate from other existing cells, made famous in the epigram popularized by Rudolf Virchow (1858): "Omnis cellula e cellula" (every cell from a preexisting cell). But living organisms, humans among them, are not only made of cells that reproduce; these cells have a certain degree of independence. Each of us, Wolpert reminds the reader, is a society of billions of cells, each with a life of its own—"yet there is no overall controller of this cellular society; it is a true cooperative" (p. 2).

Lewis Wolpert is emeritus professor of Biology as Applied to Medicine at University College London (he recently turned 80). He wrote *How We Live and Why We Die* because "it struck me that many of my non-scientific friends haven't got a clue what cells are about…. With all the stuff going on with stem cells and cloning, I thought people really should have some understanding of the nature of life, and the nature of their lives." (Ahuja 2009). Wolpert, who is a Fellow of the Royal Society and a Fellow of the Royal Society of Literature, was awarded the Commander of the British Empire in 1990. He has devoted most of his distinguished career to experimental embryology, and once famously declared, "It is not birth, marriage, or death, but gastrulation which is truly the most important time of your life."

doi:10.1525/bio.2010.60.1.12

Born in South Africa, but for many years a member of the British intelligentsia, Wolpert's effort to provide a light and entertaining intellectual history of the cell, to unravel "the mystery, power, and above all the sheer cleverness of our society of cells" (p. 7) is, for the most part, successful. After an introductory chapter to set the stage, he offers a brief—if Eurocentric—history of the rise of evidentiary science and the discovery of cells and cellular functions. Hippocrates's explanation of disease based on excesses or deficits of the four humors is noted as an example of early science. The five-phase theory of Huang Di, an ancient Chinese physician whose explanations of the causes of disease preceded those of Hippocrates by some 2200 years, is never mentioned.

Wolpert likes the "society" metaphor. Inside each cell is a society of molecules that can carry out all the required activities, and the machines that do almost all the work are proteins, the most complex and varied of all molecules.

The next few chapters deal with the traditional topics of cell biology: cell membranes, protein structure, enzymes, cell replication, genes and genetic coding, protein synthesis. Wolpert is reasonably successful in finding the right balance between needed facts and unnecessary detail. But along the way, I found myself too often having to rely on my own knowledge rather than what I found on the page. Wolpert likes the "society" metaphor. Inside each cell is a society of molecules that can carry out all the required activities, and the machines that do almost all the work are proteins, the most complex and varied of all molecules. The functioning of these proteins is determined largely by selectively binding to other molecules. The specificity of this binding depends on their amino acid sequence, which determines how the long protein molecules are folded, which, in turn, defines what they bind to.

Throughout these first descriptive chapters, many questions arise, and in most cases are answered with some degree of clarity. The author provides an especially clear account of how genetic information is coded and is translated into protein structure, with interesting side trips into the perils of how we talk about the genetic control of behavior. It is in the middle chapters (covering fertilization, meiosis, embryonic development, and morphogenesis) that the author's long experience as a developmental biologist is evident. Forty years ago, Wolpert introduced a clever heuristic to explain how various cell types could develop in different locations in the embryo. He did this in a now-famous paper (Wolpert 1968) illustrating how a French flag pattern could appear—three parallel stripes of blue, red, and white—if the flag's units (cells) could gain positional information through intercellular signaling. These ideas were largely vindicated with the later discovery of the Homeobox genes, which do indeed specify positional information in cells of early metazoan embryos. In these chapters, the writing is lucid, well organized, and informative. The detail in the description of how spatial patterning occurs in the embryo and how the various cell types differentiate may make these sections difficult for nonscientists, but the persistent reader has much to learn here.

This is not to say that the accounts are totally free of problems. It may be disconcerting to find mention of "germ layers" (p. 88) with no definition of the term. Moreover, essentially all of the processes of cell and developmental biology that Wolpert wants to describe in these chapters require the reader to grasp the physical organization of molecules or structures. To rely solely on a verbal description of how amino acids

are coupled together by ribosomes, for example, or the process of chromosome reduction in meiosis, greatly complicates the reader's task. To understand mitotic division and comprehend how objects like spindles, poles, and asters perform their functions requires the reader to visualize their architecture and positional relationships. I suspect that the process of gastrulation, whereby the three germ layers are formed and take up their required locations (as outlined in chapter 7), will be virtually impossible for the lay person to visualize from just the verbal account. In a future edition, illustrations, even simple sketches, would enhance understanding.

In the final third of the book, Wolpert moves progressively further from his field of expertise. He tackles neurobiology, including learning, neural nets, and even genetic control of behavior. He discusses differential growth and aging, the latter explained not by genetic regulation but by wear and tear: "an accumulation of unrepaired cellular and molecular damage and the limitations in cell maintenance and repair functions" (p. 147). Subsequent chapters deal with cancer and cellular defenses against disease; "cancer cells break all the rules of cooperation in this happy [cellular] community" (p. 177). Other diseases like cystic fibrosis, sickle cell disease, or muscular dystrophy result from gene mutations or other "mistakes in the society of cells." The last chapter attempts to deal with evolution and the origin of life but ends realistically and with a tangible sense of disappointment: "Even though our cells' origins remain uncertain…."

In a sense, these final chapters are the most interesting, in that they stray beyond the orthodoxies of experimental science. The author is fearless in offering opinions. For the Catholic church's decision that the soul enters the fetus at conception, Wolpert questions with Anne McLaren how many of those who believe the fertilized egg to be a human would ignore the cries of a baby in a burning building and choose instead to save a hundred frozen eggs. In discussing the ethics of human cloning: "I have offered a prize bottle of champagne to anyone who could show me that cloning a human being raises any new ethical issues" (p. 116). Regarding creationist views of the beginnings of life: "There is no evidence whatsoever for such a creator or designer, but those who believe that there is one have no need to think hard about the origin of life" (p. 215).

When I was in my early teens a favorite uncle gave me a copy of Hendrik Willem Van Loon's *The Story of Mankind.* This now-famous book begins with an image of an enormous rock, a hundred miles high and a hundred miles wide. Once every thousand years a little bird comes to this rock to sharpen its beak. When the rock has thus been worn away, then a single day of eternity will have gone by. That image—whimsical, powerful, accessible—was one of my early "aha" moments, giving me a new way to think about time and about the world. Lewis Wolpert's *How We Live and Why We Die* is described in the publishers blurb as "an accessible guide to understanding the human body and, essentially, life itself." I read the book, hoping to find a story filled with powerful images that I might give to my teenage grandaughters, to lead them to some new ways to think about living things. Professor Wolpert's "society of cells" is only partially successful in achieving that admittedly demanding goal.

ROBERT L. DeHAAN
Robert L. DeHaan (rdehaan@emory.edu) is C. H. Candler Professor of Cell Biology Emeritus and Senior Science Advisor, Division of Educational Studies at Emory University in Atlanta, Georgia.

References cited

Ahuja A. 2009. Lewis Wolpert gives the miracle of life the hard cell. Times Online. (19 November 2009; *http://entertainment.timesonline.co.uk/tol/arts_and_entertainment/books/article5986558.ece*)

Virchow R. 1858. Die Cellularpathologie in ihrer Begründung auf physiologische und pathologische Gewebelehre. August Hirschwald.

Wolpert L. 1968. The French flag problem: A contribution to the discussion on pattern development and regulation. In Waddington C H, ed. Towards a Theoretical Biology. Edinburgh University Press.

DID YOU COMPETE OR COOPERATE TO FIND YOUR MATE?

The Genial Gene: Deconstructing Darwinian Selfishness. Joan Roughgarden. University of California Press, 2009. 272 pp., illus. $24.95 (ISBN 9780520258266 cloth).

Unless you're Brad Pitt or Megan Fox, attracting mates can be a complicated process, and most will agree that some degree of competition is involved. Limited resources of value, whether they be other people, places to live, or food, will lead to competition among individuals or societies that attempt to secure them. Whether it is good or bad, natural or unnatural, competition underlies much of the current human condition.

To see what this has to do with Joan Roughgarden's book, *The Genial Gene: Deconstructing Darwinian Selfishness,* some history is useful. Charles Darwin proposed the theory of sexual selection as a corollary to natural selection because he recognized that animals possess many traits that appear detrimental to survival, such as encumbering decoration and gaudy coloration. He proposed that such traits are beneficial, even if they reduce survival, if they confer a long-term advantage in terms of relative mating success. Darwin recognized that such an advantage could accrue either because elaborate traits determined the outcome of male-male competition or because females preferred them.

The theory of sexual selection was largely discounted for 75 years or so, because although biologists (most of whom were males) agreed that male-male competition was obvious, they mostly disagreed that females actively influenced the distribution of mating. Yet over the last 50 years, biologists have documented time and again that female choice is often the most important process determining who mates with whom. Since this realization, evolutionary biologists and behavioral ecol-

doi:10.1525/bio.2010.60.1.13