

Stem Cells and Leonardo's Cave

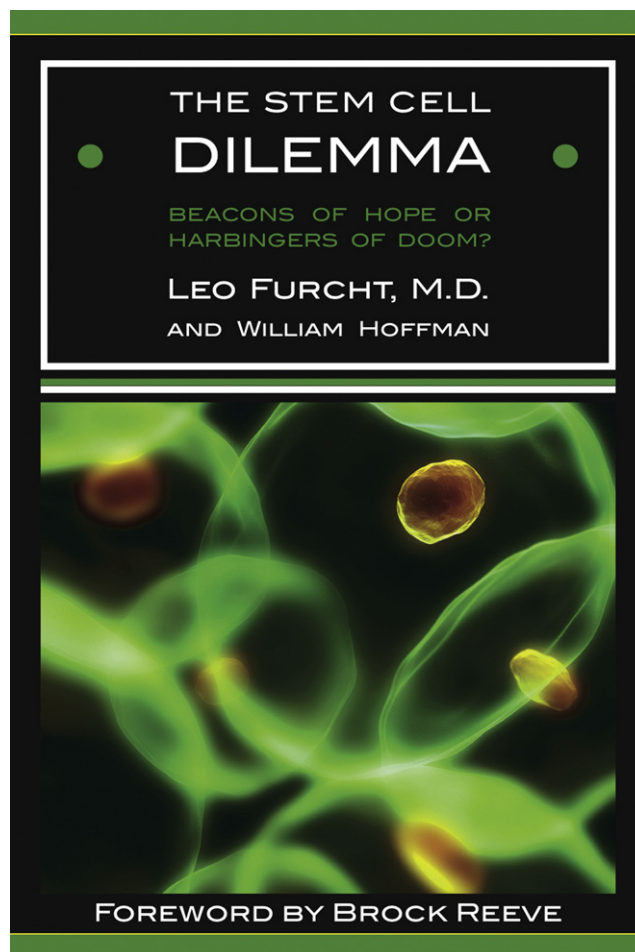
The Stem Cell Dilemma: Beacons of Hope or Harbingers of Doom?

Leo Furcht, M.D., and William Hoffman
New York: Arcade Publishing (2008),
352 pp, ISBN 9781559708722.

Stem cell research is fascinating because it touches so many “hot button” issues in contemporary American society: the exploration of early human development with its connections to abortion and in vitro fertilization (IVF); new therapies for an aging population; the next big entrepreneurial opportunity in a health-dominated economy; the globalization of science; the threat of bioterrorism; and, in this U.S. election year, domestic politics. Not since the recent advances in human genetics and genomics has a biomedical issue so roiled the public imagination. Many see stem cell research as the hope of the future; for others, it represents an incursion of science into a forbidden realm that threatens our moral and biological integrity as humans. In this hypercharged atmosphere, public discussion of human embryonic stem cell research is often distorted by the need to make a point or defend a position. An authoritative book that examines the many facets of stem cell research in a thoughtful, dispassionate, informative manner would make a welcome addition to the ongoing conversation. Unfortunately, *The Stem Cell Dilemma: Beacons of Hope or Harbingers of Doom* only goes partway toward meeting this objective.

Leo Furcht, M.D., a pathologist and prominent scientific administrator, and William Hoffman, a writer and editor, both from the University of Minnesota School of Medicine, have undertaken the ambitious task of addressing a broad range of issues raised by stem cell research. Chapters are devoted to biological fundamentals, possible medical applications, ethical considerations, politics, economic development, and the implications of stem cell technology for bioterrorism. The latter is particularly interesting because it is a new addition to the familiar list of stem cell topics. The book is extensively researched, particularly on policy matters, and the writing is lively and accessible, if at times a bit breezy.

The authors do not shrink from casting the promise and threat of stem cell research in the largest possible terms. Furcht and Hoffman assert that stem cell research brings us to the threshold of a “biorenaissance,” with roots dating back to Leonardo da Vinci, whose drawings of the human body, based on illicit morgue dissections, initiated the modern era of scientific inquiry into biology. The book starts and ends with Leonardo, whose quotations introduce each chapter, along with a relevant anecdote connecting his protean interests to the issue at hand. The defining metaphor is the dilemma that gives the book its title: Leonardo’s quandary as he considers whether or not to enter a Tuscan cave after a violent storm. Should he give in to his “fear of that threatening dark cave” or to his “desire to see if there was some marvelous thing within”? Transferred to modern stem cell research, the authors see entry into the cave as inevitable and desirable, but the “thing within” may be marvelous or



threatening, depending on how it is used. In their view, the major threat is not the violation of ethical norms usually cited, but the possibility that stem cells will be used to bring physical harm to the human race—“to extinguish humankind for all time.” The authors may or may not convince readers that this particular danger is real, but the dilemma is familiar and genuine. Knowledge and technology, whether nuclear physics, human genetics, or brain science, can be used for good or evil. Stem cells thus become a metaphor for science.

Within this framework, the authors give a well-researched, readable, and expert account of many of the currents swirling around stem cells. The chapters I found most informative were those dealing with modern political developments. The unexpected alignments of political personalities in the struggle over federal policy is well covered, as is the extensive and successful effort by the United States to push through a United Nations resolution banning “all forms of human cloning,” an effort that, ironically, was opposed by a group of predominantly Muslim nations, among others. Authoritative accounts of stem cell research activities in a number of key states, including California, New Jersey, Wisconsin, and Massachusetts, are useful. New York, which now has a large state-funded stem cell effort, is not included. A well-informed and succinct discussion of developments in other countries, including China, Singapore, England, and South Korea, is also informative.

The most novel aspect of the book concerns stem cell research and bioterrorism. After 9/11, the United States government substantially augmented its biodefense programs with the establishment of Project BioShield, with a budget of \$5.6 billion over ten years to accelerate the production of vaccines against biological and other weapons. Concerns about bioterrorism also led the Defense Advanced Research Projects Agency (DARPA) of the Department of Defense to initiate a program in 2003 to use hematopoietic stem cells and tissue engineering technology to develop a laboratory-based human immune system for testing new vaccines against biological weapons. The authors are rightly alarmed by the threats posed by the potential use of modern molecular technology to produce biological weapons and see stem cells as a critical link in efforts to both evade and produce such weapons. Systems for screening protective vaccines could also be used for designing and testing biological weapons aimed at circumventing the immune system. "To understand the immune system enough to re-create it is to possess the potential biological power of annihilation."

Surprisingly, the chapters on the science of stem cell research and its potential for medicine are the least satisfying. The authors have read widely in the relevant scientific literature and reference many of the latest findings, but these are presented in a stream of facts, findings, and quoted opinions that are often not well organized to highlight important principles. The origins of stem cell research are extensively (and rapidly) reviewed, starting with Trembly's 1740 study of hydra, through E.B. Wilson, T.H. Morgan, and Lewis Wolpert, to the latest findings by James Thomson and Shinya Yamanaka. Along the way, there are excursions into limb regeneration in amphibians, cellular aging, and the "genetics of stem cells." Although the breadth of coverage is admirable, key concepts such as the role of growth factors and the importance of the

niche in regulating stem cell renewal and differentiation are not well developed. Importantly, the various types of stem cells are often not clearly distinguished or specified, and the discussion of reproductive versus therapeutic cloning is sometimes misleading.

A chapter on the possible health benefits that stem cell research might bring (which unfortunately precedes the biology chapter) describes many promising studies in detail, but often with only a nominal disclaimer that other studies have found different results or that a final judgment has not been made. Such treatment runs the risk of raising expectations that are not realistic. A thoughtful treatment of challenges to be faced, such as the formulation of suitable FDA guidelines, as well as a description of the long and expensive process of establishing the efficacy and safety of new therapies would have been welcome. One of the near-term benefits of stem cells will be their usefulness in providing cellular models of disease for investigating disease mechanisms and discovering drugs. The authors could have explored this further and could also have examined what we might learn from the recent experience with gene therapy, another technology whose potential uses excited both hope and concern.

Leonardo's forbidden search for anatomical knowledge is a graceful framework for presenting the modern dilemmas of stem cell research. Such an epic setting, however, tends to amplify both the highs and lows—the promises and threats—of a new technology whose potential has yet to be realized. Readers of this book will enjoy the scope of the discussion, the vivacity of the writing, and the historical context. For an accessible introduction to stem cell research and a sober assessment of its current state, other titles may be more suitable. Although the authors call for "a language that clarifies a complex science for public consumption," their own efforts sometimes fall short.

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DOI 10.1016/j.stem.2008.05.004