Vignettes: Raisons d'Être

I am a scientist, a member of a most fortunate species. The lives of most people are filled with ephemera. All too soon, much of humanity becomes mired in the tepid tracks of their short lives. But a happy few of us have the privilege to live with and explore the eternal.

—*Robert L. Sinsheimer*, in *The Strands of a Life: The Science of DNA and the Art of Education* (University of California Press)

Each of you might find it an amusing exercise to write down twenty reasons why your science is valuable to society: anyone who accepts public monies ought to be able in good conscience to explain why he or she deserves such support. My own list ranges from developing new knowledge to enhancing national prestige to other such weighty reasons as providing an entire population class for exploitation by underemployed venture capitalists and attorneys and enabling interesting, content-laden conversations to take place at cocktail parties throughout the country.

—*Marye Anne Fox*, in *AAAS Science and Technology Policy Yearbook, 1993* (Albert H. Teich, Stephen D. Nelson, and Celia McEnaney, Eds.; Committee on Science, Engineering, and Public Policy, American Association for the Advancement of Science)

enhancing plant disease resistance. The book makes clear that we have advanced much further in our ability to manipulate plants genetically than we have in understanding the biochemical basis of plant disease; thus there remains much to learn about how to use the powerful methods of genetic engineering to enhance plant disease resistance safely.

In some instances fitness of pathogens can be manipulated by using other organisms as competitors, antagonists, or parasites. Biological control of plant disease is still in its infancy and remains essentially an empirical science. In general, we know much less about the processes involved in successful biological control than we do about how plants defend themselves against disease. It is clear that, although the genetic engineering of microbes is technically much easier than that of plants, we have made more progress in enhancing plant resistance than in developing better biological controls. In part this reflects our general lack of knowledge of microbial ecology, but it also shows the dampening effect of the initial battles over release of the ice-minus bacteria on the development of this field.

Ilan Chet has produced a balanced and comprehensive overview of biotechnological plant protection. The book suffers, however, from an absence of discussion of issues that are guiding the direction of current research, such as the safety of using recombinant DNA organisms and the potential impact of biotechnology on worldwide farming practices. Such issues are of great concern to the general public as well as to active researchers, and more attention to them would have greatly enhanced the value of the volume.

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Growth and Division

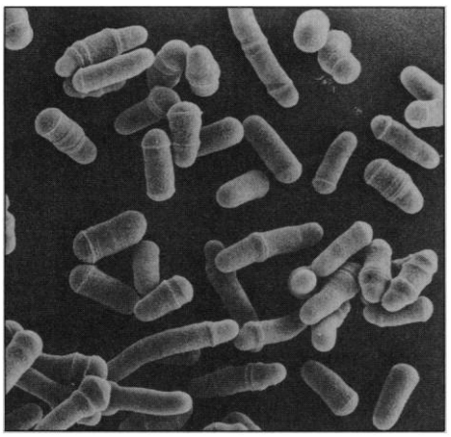
The Cell Cycle. An Introduction. ANDREW MURRAY and TIM HUNT. Oxford University Press, New York, 1993. xii, 251 pp., illus. $45 or £32.50; paper, $22.95 or £15.95.

Given the recent pace of research on the cell cycle, only exceptionally brave and hardy angels would not fear to tread the path leading to publication of a book on the subject. Fortunately, Andrew Murray and Tim Hunt have taken on the job. The result is this short and highly readable volume describing the cell cycle from start to finish and from bacteria to mammals. In addition to conveying well-established facts, the authors include a good deal of intelligent speculation. One example is a comparison between the requirement that DNA replicate only once per cell cycle and the restriction of *HO* endonuclease gene transcription in budding yeast to the late G1 phase in mother cells (we won't try to explain it, but it's fun). The authors provide teleological insight into many aspects of cell cycle control, offering explanations of why control of the embryonic cell cycle differs from that of the somatic cell cycle, why budding yeast spend longer in G1 than do fission yeast, and why protein synthesis and degradation control the "cell cycle engine." Thus what we get here is the Murray–Hunt view of the cell cycle, considered broadly and magisterially.

Recent work has made it clear that most of the transitions in the eukaryotic cell cycle are driven by a class of protein kinases called "cyclin-dependent kinases," which require binding of one of a class of proteins called cyclins for their activation. The regulation of these kinases is complex and occurs at different levels in different biological systems; best understood is the regulation of *cdc2*–cyclin B kinase activity in mitosis. In a chapter on enzymes that control mitosis, biochemical information from embryological systems is integrated with genetic identification and analysis of relevant components in fission yeast. (It is odd that the cell cycle genetics of fission yeast is discussed in this chapter rather than in the preceding chapter entitled "Cell cycle genetics," which contains a discussion of budding yeast. Perhaps the authors mean to imply that genetics should become enzymology once it is properly understood!) Related kinases control other cell cycle transitions (notably at the beginning of the cycle), although the enzymology and biochemistry of these systems is less well understood.

The mechanisms by which cyclin-dependent kinases drive cell cycle transitions are largely unknown. Throughout discussions of mitosis, mechanisms of DNA replication, and the control of rereplication, the authors consider possible substrates of cyclin-dependent kinases. For example, during mitosis, phosphorylation of the nuclear lamins, histone H1, and microtubule-associated proteins may play a role in nuclear envelope breakdown, chromatin condensation, and microtubule dynamics, respectively. During S phase, phosphorylation of the DNA replication factor RP-A may be responsible for its activation.

There is a substantial discussion of checkpoints, particularly with respect to the relationship between the somatic and embryonic cell cycles. Checkpoints are points in the cell cycle at which cell cycle progression is restrained unless certain conditions are met (for example, absence of DNA damage, presence of a functional mitotic spindle). A discussion of the possible relationships between checkpoints, tumor suppressors, genomic instability, and programmed cell death provides an



"This scanning electron micrograph shows a population of fission yeast cells. Note the uniform cell diameter, which makes it possible to estimate the mass of cells simply by measuring their length." [From *The Cell Cycle: An Introduction*; courtesy of N. Hajibagheri]

excellent framework for following current work in this fast-moving area. Here, as throughout the book, comparison of the embryonic and somatic cell cycles, as well as the yeast and mammalian cell cycles, serves to unify the abundant data into a coherent whole.

Overall, the book has an effective structure. The chapters build upon one another and guide the reader, often posing questions (for example, "How does the passage through mitosis release the block to rereplication?") and then describing experiments that have helped to formulate answers. But no one could read this book and come away feeling that all the mysteries of the cell cycle have been solved; the persistence of unanswered questions is acknowledged (for example, "Do G1 cyclins play the same role in mammalian cells that they do in yeast?"). The authors manage to convey a lot of experimental detail, both techniques and results, without assuming much background knowledge beyond basic cell biology. Instead of cluttering up the text with citations, they have ended each chapter with a mercifully short list of suggested reading that provides a good entry point into the literature. An appendix lists the genes involved (in almost any way!) with cell cycle control—certainly useful for those who do not care for alphabet soup. It would have been helpful if this appendix had been cross-referenced to the text, especially since the index is not very comprehensive. The book contains excellent and plentiful illustrations.

This is a very useful overview of our current understanding of the cell cycle. Newcomers to the field (including well-prepared undergraduates) will find it a good place to start, and researchers who work on the cell cycle and related problems should find the sometimes idiosyncratic Murray–Hunt world view refreshing and stimulating.

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