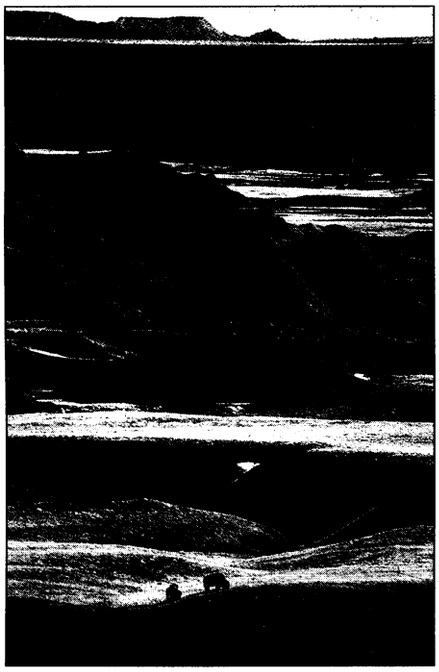
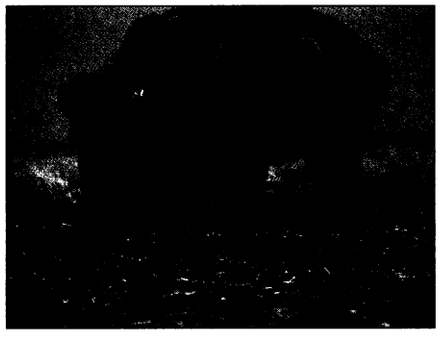


Two bison bulls "form a temporary association during late winter." [From *Bison*]

Bison cow and calves on shortgrass prairie, Badlands National Park, South Dakota. [From the cover of *Bison*]



Female bison with 20-minute-old calf. [From *Bison*]

last century and the isolation of closed populations in this century, is subject to genetic problems. The goals of the book are to present new data about the behavioral ecology of bison, to analyze those data so as to aid bison conservation, and to show that behavioral ecology can be applied to the conservation of large mammals in general.

The study was conducted at Badlands National Park in South Dakota from February 1985 through October 1989. The authors and their crews logged some 8750 hours of observation of an expanding herd of 300 to 775 bison, including about 200 individually recognized animals. Results included detailed data sets on individual reproductive success (male and female), gestation periods, birth synchrony, effective population sizes, loss of genetic lineages, and apparent physical defects that may be linked to inbreeding.

The book does not quite live up to the claims on the dust jacket that the study "resolves such complex questions as how does nondispersal affect populations, to what extent does a lack of predators affect behavior, and how much genetic diversity has been lost since the nineteenth century?" It does a thorough job of evaluating these daunting issues and contributes substantially to the understanding of them, but they will not be resolved scientifically until considerably more research has been completed.

Nevertheless, the results are thorough and well presented. The book is rich with statistical analyses, the details of which are nestled neatly at the end of each chapter next to the chapter summary. The concluding chapter contains recommendations for the application of Berger and Cunningham's research findings to the management of bison. Among their recommendations are the encouragement of bison "migration" where area permits, further evaluation of the "buffalo commons" idea fostered by Frank and Deborah Popper, and the management of public herds as a metapopulation through the systematic exchange of females. Other recommendations include guidelines for studies of the behavioral ecology of large mammals in general.

This book is a must for bison specialists and is highly recommended for conservation biologists and for behavioral ecologists interested in large mammals. Bison managers will find the book useful through both the recommendations and the 600 literature citations, probably the single most complete source for the biology and conservation of bison. Berger and Cunningham have made a major contribution to the biology of bison and to the conservation biology of large hooved mammals everywhere.

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Eukaryotic Origins

Tracing the History of Eukaryotic Cells. The Enigmatic Smile. BETSEY DEXTER DYER and ROBERT ALAN OBAR. Columbia University Press, New York, 1994. xiv, 259 pp., illus. $50 or £43; paper, $24 or £20. Critical Moments in Paleobiology and Earth History.

The origin of eukaryotic cells with nuclei, microtubules, and a host of other specialized organelles from their prokaryotic ancestors was one of the most remarkable and critical steps in evolution. It made it possible for a cell to manage the huge genomes needed to code for multicellular organisms and to reshuffle those genomes during sexual reproduction. Without this step, intelligent life could not have arisen. But the origin of eukaryotic cells is hidden in the past, over two billion years ago, and must be pieced together by combining clues from chemistry, geology, paleontology, biochemistry, molecular biology, cytology, genetics, and evolutionary theory. The subject is huge, and it is a daunting task to become sufficiently expert in all these areas to write about it clearly, accurately, and critically. The authors of the present work have been only partially successful.

The book is packed with interesting facts, intriguing speculations, and unanswered questions. It gives the reader a good sense of the field as active, controversial, and full of exciting questions for future research. In a nice touch, the authors asked a number of active researchers in the field what they think are important questions for future research directions; their answers form an interesting chapter. Written at a level just above introductory college chemistry and biology, the book should provide a stimulating overview of the problem to a wide audience of educated readers. Most of the exposition is clear, although the poor illustrations and sometimes over-simplified explanations will frustrate a reader who seeks a deep understanding.

Unwary readers may also be misled in some areas. The discussions of the relative rates of transfer of genes between nuclei and mitochondria, changes in mitochondrial code, and the inheritance and recombination of mitochondria and plastids are seriously flawed. For example, an erroneous description of translation termination in animal mitochondria is used to explain why animal and fungal mitochondria have been able to evolve a modified genetic code. A section on sexual reproduction is preceded by the assertion that the search for evidence of a selective advantage for sexual reproduction over asexual reproduction has yielded "almost nothing." But in fact many advan-

tages are known, and the problem is to determine which are most important and how they balance against the known disadvantages of sex. A section on the relative virtues of diploidy and polyploidy fails to mention the increased genetic load of detrimental mutations with increasing ploidy. Fortunately many of these errors or omissions have no apparent relevance to the main themes of the book.

Phylogenetic analyses of gene sequences played an essential role in establishing the symbiotic origin of organelles and continue to be the principal tool for tracing the history of both prokaryotic and eukaryotic cells. The authors recognize this and repeatedly mention ribosomal RNA gene sequences, but do not tell the reader how they are used. An appendix listing criteria for establishing the symbiotic origin of an organelle omits phylogenetic analysis of organelle genes. The entire book contains only four phylogenetic trees of gene sequences, with no explanation of how they were made. One tree is unrooted, but the authors do not explain why it looks different from the others. The difficult problem of determining whether the closest relatives of eukaryotes are eubacteria or archaebacteria is precisely a problem of rooting. The sources of error in the construction of trees and in the use of molecular clocks are discussed, but the numerous validations of these procedures are not. Consequently the naïve reader will not understand, and may even distrust, one of the most important sources of information about evolutionary history. In fact readers ought to distrust the "phylogeny" in figure 8.6, because it attempts the logically impossible task of combining a phylogeny of the genes coding for five different molecules, three classes of organelles, mitosis, and meiosis.

Though this book provides an interesting overview of a fascinating and important evolutionary problem, readers should beware of using it as a source of definitive information.

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