encyclopedic *Bibliotheca Universalis*, his exceptional knowledge of zoology and botany, and his editing and publishing of the unfinished work of Cordus, but also for his genial personality, which enabled him to transcend the religious controversies of his time.

The author's attention next reverts to Italy in the 16th century. Mattioli, "the Brunfels of Italy," is lauded for his excellent illustrated Italian edition of Dioscorides. The first overt attempt at a classification by "affinities" (primarily indicated by fruit and seed) is credited to Cesalpino, who is thus dubbed "the father of the science of Systematic Botany." Fabius Columna, in search of an ancient remedy to cure his epilepsy, introduced a new scientific precision to the analysis of plant structures. Greene's two Flemish selections, Dodoens and de Lobel, are more familiar than many of his Italian nominees for fame. Because he was a popularizer and a commercially successful author, Dodoens is treated somewhat ambivalently, although he is given credit for considerable progress in the perception of affinities. De Lobel, hailed as "a prophet of the new botany that was to come," was "the first to engage in serious and studied effort to create natural system." But the youthful genius he exhibited in his *Adversaria Nova* was not to be fully realized. Our author accords his prime homage to Joseph Pitton de Tournefort, "whose chief work marked an epoch in the advancement of our science that has not yet had, and probably may never have, a parallel." His accomplishment was to establish a systematic key to plant genera and to "create" genera on so sound a basis and to describe and illustrate them so skillfully that all known plants could be identified and all future discoveries be properly placed.

Although the self-consciously "literary" and measured and discursive Victorian prose is a little difficult to engage at first, I think most readers will regret that the work ends here and that the third part, which was to have dealt with British botanists and would doubtless have been controversial, was never written. We can be grateful that the two completed portions have been made available in such handsome format. Everyone connected with the enterprise is to be congratulated—there is abundant credit to go around.

Edward Lee Greene remains an enigmatic figure.

LINCOLN CONSTANCE
Department of Botany,
University of California,
Berkeley 94720

An African Ungulate

A Territorial Antelope. The Uganda Waterbuck. C. A. SPINAGE. Academic Press, New York, 1982. xvi, 334 pp., illus. $49.50.

Territoriality was one of the classic mechanisms proposed by V. C. Wynne-Edwards in 1962 to limit the size of populations below the level of their food supplies. With this in mind C. A. Spinage from 1964 to 1967 studied the waterbuck, a territorial antelope in savannah Africa.

Territoriality, well known in birds, is uncommon in temperate-region ungulates. In 1964 little was known about African ungulates, and Spinage's first observations of territoriality were something of a novelty. Now we know that most African antelopes are territorial. However, most recent in-depth studies of ungulates are of nonterritorial species, so this book is still one of the few detailed accounts of a territorial species.

Spinage's aims were to find out whether waterbuck were territorial and if so whether this behavior regulated the population. His main conclusion, at least on the surface, is to reject Wynne-Edwards's thesis because females, not males, determine population levels, and females are not territorial. Females expel younger animals, bringing about dispersal to new areas. Spinage postulates that female aggressive behavior is related to population density and not to food; thus his mechanism of regulation is really one of "self-regulation." His conclusion, however, is hypothetical, for he presents no evidence to support it.

What, then, is the function of territory? Spinage suggests that it is to anchor the male sector to ensure maximum dispersal of the species. Why not abandon territory in favor of cohabitation without aggression? He answers, "To ensure the continuation of a species, selection has produced a sufficiently strong sexual drive that male competition must always result." Therein lies the grounds for the main criticism of this book, for it shows that Spinage's thinking is still that of the old-style "group selectionists." Throughout the book he refers to function in terms of benefit to the population or species, without exploring alternatives of benefit to the individual. But the data are there: only males on territories obtain matings, and those 7 to 9 years old obtain disproportionately more. Still more interesting is that some males tolerate satellite males, the latter obtaining a few matings. The significance of this is overlooked. It would be interesting to know under what conditions satellites are tolerated. The closest relatives to waterbuck are kob and lechwe, both of which have evolved mating "leks." Spinage's observations would suggest that waterbuck are in the early stages of evolving leks.

Spinage's work, done in the 1960's, will be judged in the context of more modern ideas. He is running this gauntlet to make his data available. There are chapters on growth and senescence, reproduction, parturition, population dynamics, food and habitat preferences, and the social organization of females and males. The book ends with a discussion of territorial concepts and function, which is somewhat tortuous and abstruse. Spinage's interpretations may be heretical to some readers, but his observations are valuable.

A. R. E. SINCLAIR
Institute of Animal Resource Ecology,
University of British Columbia,
Vancouver V6T 1W5, Canada

Toxicology

Cellular Systems for Toxicity Testing. G. M. WILLIAMS, V. C. DUNKEL, and V. A. RAY, Eds. New York Academy of Sciences, New York, 1983. xii, 484 pp., illus. Cloth or paper, $95. Annals of the New York Academy of Sciences, vol. 407. From a conference, New York, Oct. 1982.

Cellular Systems for Toxicity Testing results from a conference held to examine in detail the most advanced systems for the study of general cytotoxicity, genotoxicity, mutagenesis, and carcinogenesis. In the opinion of this reviewer, the objective was overly ambitious. Despite the breadth of topics covered, however, the book succeeds in conveying an excellent overview of the field and substantial "inside" detail not readily obtainable from periodical literature. Noteworthy are several chapters that begin by giving a historical perspective on the development of the major biological systems used in the field. Included among them are the papers of H. J. Evans, Sheldon Wolff, Michael J. Prival, Ernest H. Y. Chu, and Blumberg *et al.* These papers include valuable accounts of the scientific contributions that have resulted in the armamentarium of cellular systems now available.

The volume begins with a consideration of xenobiotic metabolism and the metabolic properties of in vitro systems. Dunkel contributes a concise introductory paper, "Biological significance of end points." The reports in the following section, on general cytotoxicity, are well done, but the section is rather incom-

plete and somewhat removed from the remaining contributions, which are devoted largely to genetically mediated effects. This is unfortunate, because the title of the book would lead one to expect extensive coverage of general cytotoxicity testing. Perhaps more important, the question of the relationship between general cytotoxicity and genetic toxicity is not effectively addressed except in a paper by Kurt W. Kohn, "The significance of DNA-damage assays in toxicity and carcinogenicity assessment."

The book's strength is in excellent review chapters on various short-term bioassay procedures, including DNA repair assays, cytogenetic methods, various mutagenicity test systems, cell transformation assays, and tests for tumor promoters. The mammalian cell mutagenesis assay systems are particularly well represented in concise but informative reports by Chu, David F. Krahn, David E. Amacher and Gail N. Turner, and Donald Clive. Langenbach *et al.* report interesting data on the cell-mediated mutagenesis of V-79 cells and *Salmonella*, wherein some of the deficiencies of S-9 metabolic activation are obviated. Probst and colleagues summarize extensive results on 252 chemicals using bacterial mutation and rat hepatocyte DNA repair assays. Follow-up testing is performed in the L5178Y mammalian cell mutagenesis assay and in an in vivo assay for sister chromatid exchange. Probst and his co-workers noted that the bacterial mutation and L5178Y assays tended to agree for nitro compounds and that findings for induction of sister chromatid exchange could not be exclusively linked to the role of enteric bacteria in metabolic activation.

This reviewer particularly enjoyed the innovative and insightful papers "Adaptation of the DNA-repair and micronucleus tests to human cell suspensions and exfoliated cells" by Hans F. Stich, Richard H. C. San, and Miriam P. Rosin, "Mutagenicity and carcinogenicity correlations between bacteria and rodents" by David Brusick, and "Approaches to comparative mutagenesis in higher eukaryotes: significance of DNA modifications with alkylating agents in *Drosophila melanogaster*" by E. W. Vogel.

Williams once again raises the debatable issue of genotoxic versus epigenetic carcinogens. His paper follows a report by Trosko *et al.* on promoters and intracellular communication. Williams states that "if it is established that a membrane effect is the basis for tumor promotion, this would represent a true epigenetic effect." That epigenetic effects may not always be as expected is suggested by the studies on asbestos-induced cell transformation reported by Barrett *et al.*

In a concluding section, C. A. Schreiner deals with the application of short-term tests for purposes of safety evaluation from the industrial perspective. Governmental programs are provided equal time as the National Toxicology Program is described by Errol Zeiger, and the impact of short-term tests on regulatory action is discussed by W. Gary Flamm and Virginia C. Dunkle. As with many recent conferences on short-term tests, the final full-length paper concerns the place of such tests in carcinogen risk assessment in humans. Robert Kroes concludes on the positive note that short-term tests are very important in classifying genotoxic and non-genotoxic compounds and also seem to be useful in the detection of promoter activity. Numerous short reports at the end of the volume represent the posters presented at the conference.

MICHAEL WATERS
Genetic Toxicology Division,
Environmental Protection Agency,
Research Triangle Park,
North Carolina 27711

Ion Channels

Membrane Potential-Dependent Ion Channels in Cell Membrane. Phylogenetic and Developmental Approaches. S. HAGIWARA. Raven, New York, 1983. x, 118 pp., illus. $29.50. Society of General Physiologists Distinguished Lecture Series, vol. 3.

There is scarcely a cellular function that does not have at its heart the operation of ionic channels. Perhaps the best-known example is the action potential that is produced by the activation of sodium and potassium channels in axonal membranes. The seminal description of this process by Hodgkin and Huxley has led to the discovery of many other channels in a wide variety of species. It is fitting, therefore, that Hagiwara, who has contributed so much to the ionic channel catalog, dedicates his book to his "animal colleagues."

The book is composed of six chapters written in a semihistorical, semididactic style. The history is largely, but not exclusively, autobiographical; virtually all the 48 figures have their origin in the laboratories of Hagiwara or his collaborators. Being a personal history, the book provides a glimpse of the creative process complete with wrong turns and surprising discoveries. The scientific descriptions themselves are written in a nontechnical manner accessible to the lay person. A practicing biophysicist may well be frustrated by the superficial treatment of certain topics that such a short book entails. For those wishing more, a thorough bibliography is provided, however.

The first substantive chapter describes the properties of calcium channels. These channels have some novel properties not found in classical sodium channels. The inactivation process for some preparations appears to be sensitive to internal calcium concentration. Inactivation in other preparations has the more classical voltage dependence. The conductance saturates with permeant ion concentration. The blockage of the channel by certain divalent cations as well as the selective permeation by alkaline earth cations can be neatly explained by a simple model containing binding and mobility parameters. Data on fluctuations and single-channel recording are presented without an explanatory model because "the lifetime of a model's usefulness is usually only one or two years."

The next chapter discusses the distribution of sodium and calcium channels. The ubiquity of calcium channels is illustrated in a three-page table. Calcium channels always seem to be present at the effector ends of systems, as in excitation-contraction, excitation-secretion, and fertilization. This list will, no doubt, be extended in future editions. Spatially sodium and calcium channels are not necessarily distributed in parallel. Moreover, during development the relative contributions of different channels change in complex ways. The function of these changes remains an intriguing mystery.

The sodium and calcium channels of different preparations provide still another source of diversity. Some preparations have two different calcium channels. Even the classical vertebrate sodium channel reveals different sensitivities to the potent channel blocker tetrodotoxin. Puffer fish that produce the toxin are immune. Related species show a spectrum of sensitivity perhaps related to concentration of the toxin.

Even more impressive is the diversity of potassium channels. Early outward current, the delayed rectifier, the calcium-activated potassium conductance, and the inward rectifier, not to mention synaptic channels of various sorts, create a bewildering array. The channels have markedly different biophysical properties, thus being interesting subjects for channel mechanics.

The concluding chapter describes a fascinating group of developmental