answer to the riddle of speech errors, but rather perspectives on studying them. The range of languages that have been examined is quite limited, and there is certainly a need for more cross-cultural work, especially with non–Indo-European languages. The models that have been proposed are interesting, but, as elsewhere in psycholinguistic theory, it is difficult to tell where neurology ends and metaphor begins; for instance, if speakers' linguistic systems contain a "prearticulatory editor," what are its neuroanatomical correlates?

In bringing together these papers, preceded by her own integrative introduction, Fromkin has provided a historical context for the study of errors in linguistic performance, clear examples of how to do this research, and much of what is known on the subject. The book is of general interest and will be of great value to other researchers who wish to set forth on this slippery path.

JEAN BERKO GLEASON
Department of Psychology,
Boston University,
Boston, Massachusetts 02215

Climatology

The Urban Climate. HELMUT E. LANDSBERG. Academic Press, New York, 1981. x, 278 pp., illus. $29.50. International Geophysics Series, vol. 28.

Changes in local, regional, and global air quality as a result of urbanization and industrialization are well documented. Whether or not a change in air quality by itself constitutes a change in climate is debatable, but it is now beyond debate that fouled air interacts with urban-modified fluxes of radiant energy, heat, and moisture to produce changes in the values of standard climatic variables such as insolation, air temperature, and humidity. Urban effects on precipitation have proved to be much less easily established. Urban-related climatic changes have been well known to and described by climatologists since early in the last century but widely known in ecologically sensitized industrial societies only since about the time of Earth Day 1970.

From his vantage points as elder statesman in urban climatology and leader of the international programs on the subject sponsored by the United Nations through the World Meteorological Organization, Helmut Landsberg has given us *The Urban Climate*. His book is intended to provide an informed overview of the progress of the science out of the early descriptive phase, covered so well in Kratzer's *Das Stadtklima* (first edition 1937, second edition 1956), and into the period of vigorous assault on the problems of explanation, especially the past 15 years. The book is welcome because there has been no monographic treatment since Kratzer's. It is timely because it makes a creditable, but flawed, attempt at resolution of several central points of dogma and contention that have developed in the last decade. On that, more presently.

The book includes a brief historical review and state-of-the-art summary (chapter 1) followed by a treatment of technical foundations, including air pollution (chapters 2, 3, and 4). Research results concerning temperature and wind (chapters 5, 6, and 7) and atmospheric moisture and surface hydrology (chapters 8 and 9) are followed by brief chapters on impacts and applications (chapters 10 and 11). The balance among chapters seems excellent, as does the selection of materials cited as examples and referred to as pivotal. In particular, Landsberg lays out most cogently the several recent lines of approach in the major areas of research and sets forth, as he has so well in the past, an implicit reminder to American specialists that many valuable results have been produced elsewhere by workers using relatively simple observational and computational tools.

Many of the problems with the book stem from the author's attempt to address a diverse audience while not having clearly in mind which part of it he is addressing at each moment. For example, the boundary layer meteorologists included in the intended audience scarcely need to have the mathematical expression for the Richardson number set out, as Landsberg does, and the city planners and "human ecologists" he likewise includes are unlikely to understand it. The comment that at least 25 meters is needed between the center of a roadway and a residence for satisfactory noise control by "solid surfaces with planted strips" is probably without much utility for any in his intended audience and arguably not even climatological.

Perhaps the greatest problems with the book are the results of Landsberg's having cited quite cogently and correctly some of the pitfalls of field experimentation in a milieu (probably typical for geophysical research) in which proper control is difficult to obtain and then having accepted without apparent question results that are clearly questionable on these grounds. For his neophyte readers Landsberg has thus done a disservice. The essence of the difficulty consists of ignoring the fundamental points that a correlation between two variables does not establish one as the cause of the other and that a difference between means may be due more to noise than to signal. Much dogma, mostly concerning the difficult-to-establish urban effects on rainfall and electrical storms, has developed through repetition of research wherein these points have been ignored and citation of the results of such research. Landsberg has not contributed in his own research to the dogma, but he seems to have unknowingly accepted it while at the same time warning against it.

As a research review, with all its shortcomings, *The Urban Climate* is unlikely to be surpassed. As a textbook, which Landsberg to judge by his style sees as one of the functions of his offering, it leaves room for improvement. As either, at this moment it is the only game in town.

WILLIAM P. LOWRY
135 South Davis Street,
McMinnville, Oregon 97128

Principles of Conservation

Conservation and Evolution. O. H. FRANKEL and MICHAEL E. SOULÉ. Cambridge University Press, New York, 1981. viii, 328 pp., illus. Cloth, $49.50; paper, $17.95.

In Andean Peru, Quechua and Aymara Indians customarily grow 15 to 45 potato varieties in mixed gardens of remarkable heterogeneity. These land races, with probable introgression from noncultivated taxa, harbor extensive genetic variation and persist in the center of diversity for potatoes. Peruvian government agencies encourage local growers to plant monocultures of high-yielding and blight-resistant "improved" potato varieties, despite greater market value of the local forms and despite the growers' preferences for their flavor (T. Johns, personal communication). Production increases with the improved potatoes, but so does need for pesticides and fertilizers. Where modern agricultural introductions are successful, for example in north central Peru, many potato land races are no longer cultivated, and their genetic diversity has been severely reduced. Against a background of similar stories around the world, Frankel and Soulé draw from evolutionary biology to estab-

lish unifying principles for the conservation of both natural and domesticated plants and animals.

Population genetics has a lot to say about dynamic processes in small populations, including such phenomena as inbreeding and consequent depression, bottlenecks in population size and loss of genetic variation, and breeding structure and fitness. Frankel and Soulé aim to apply these and other notions to creatures made rare through human intervention, and they largely succeed at this ambitious and important synthesis.

Both contemporary extinctions, such as that of the Stephen Island wren, and historical episodes of faunal depletion, such as occurred during the Permian, are the basis for Frankel and Soulé's ecological analysis of "precarious" taxa. Next they consider more theoretical genetics for small populations and how evolution should operate in group sizes typical of nature reserves. Although the reasoning behind these discussions seems pristine and balanced with adequate qualifiers, a reader may feel less than assured that a few of the genetic processes invoked as a basis for conservation decisions have as much firm empirical confirmation as they have force of logic. For example, what is the evidence behind the contention that populations lacking detectable genetic variation have higher probability of local extinction? Evidence is rather weak for other key principles, for instance, that small population size results in reduced heterozygosity in rare organisms. Frankel and Soulé remark often and with justification that conservationists cannot have the luxury of waiting until generalizations on small populations become universally valid. Extinction proceeds while scientists waffle. But our reasoning about the way the world logically ought to operate (as opposed to demonstrably does) may lead us completely astray. At what point do we become reluctantly content with guidelines which make perfect sense but for which even moderately sound verification is lacking? The difficulty cannot be eliminated by citation of social panic or scientific optimism, and only sound studies can replace the guesswork.

The complex controversy over whether island biogeographic theory is applicable to the design of nature reserves is presented from a balanced, nonadversarial point of view, and the treatment of reserves is one of the most skillful portions of the book. The authors then shift to the captive propagation of animals in reserves and zoos, the role of botanical gardens and germ plasm collections in conserving the genetic diversity of plants, and livestock preservation. Here the book becomes a kind of handbook, and these aspects show its originality and great potential utility to practicing conservationists. For instance, the authors provide recommended population sizes for captive animals to minimize undesirable effects of inbreeding, manipulations of breeding and social structures to maximize effective population size, and criteria for inclusion of cultivars into collections for preserving variability.

Curiously absent is a consideration of why plants and animals are threatened by extinction or why the diversity of cultivars is declining. One might say that my approach represents a reviewer's ploy of criticizing a book on the grounds that it is not what she would have written. However, Frankel and Soulé's omission of the causes underlying their central concerns creates an odd tone that permeates the book. Without an analysis of how it arises, the depletion of natural habitats or erosion of genetic variability seems to take on an inevitability, like a force of nature. Though the authors call for immediate and vigorous action from scientists and conservationists, this activity comes across as recouping from a disaster, in the manner of the Red Cross after a flood. The disappearance of tropical forests is most frequently lamented, but its causes are passed over with brief attribution: "lost to a rising sea of humanity."

From excellent recent analyses (including Norman Myers, *Conversion of Tropical Moist Forests*, National Academy of Sciences, 1980), it is straightforward to summarize why tropical moist forest is rapidly declining. The direct social and economic causes of conservation problems are often clear, for instance the timber trade in Asia or cattle production in Latin America. At best, nature reserves, germ plasm centers, and zoos are second-rate answers, as Frankel and Soulé repeatedly comment. Perhaps fundamentally different answers to the conservation of biotic diversity are possible, and scientific myopia can hinder biologists from finding them. Better solutions to the predicament of wildlife will be discovered only through the difficult but unavoidable scrutiny of the human condition and the social and economic forces that foster abuse of the biosphere.

DEBORAH RABINOWITZ
Division of Biological Sciences, University of Michigan, Ann Arbor 48109

The Biology of Hibernation

Survival in the Cold. Hibernation and Other Adaptations. Proceedings of a symposium, Prague, July 1980. X. J. MUSACCHIA and L. JANSKY, Eds. Elsevier/North-Holland, New York, 1981. xiv, 226 pp., illus. $50.

Hibernation is one of the most intriguing adaptations currently studied in physiology. An overt sign of hibernation is a precipitous drop in body temperature, which can reach near freezing, depending on ambient temperature. Usually an animal will maintain a low body temperature for several days before rewarming to normal body temperatures. The ability to arouse to normal body temperature is maintained at all times and can be accomplished without external heat. Another sign of hibernation is the regression of the gonads and ovaries in hibernating animals. The effect of the reproduction cycle on the hibernation cycle has received much attention in recent years, primarily owing to research aimed at understanding the function of the pineal gland. The pineal gland is thought to regulate gonadal function, and because gonadal function changes during the hibernation season the pineal may be involved in timing the hibernation and reproduction cycles. It is with this subject that this book begins.

The opening paper, by Russel Reiter, examines the relationship between changes in day-length and the hibernation and reproduction cycles. Reiter offers an interesting and testable model of the relationship between these two cycles in the Syrian hamster (*Mesocricetus auratus*). He argues that the reproductive status of the hamster, a hibernator, is altered by changes in day-length according to season. During short days gonads regress whereas during long days there is a period of refraction when the gonads spontaneously recrudesce. The seasonal variation in day-length is thought to influence the reproduction cycle by affecting the pineal gland's secretion of antigonadotropic hormones. These hormones, which include melatonin, act to suppress reproduction. Short days promote an increase of antigonadotropic-hormone secretion, causing gonadal involution. Long days are not necessary for gonadal regrowth, however, since the gonads can become fully functional even though animals are kept in constant dark. Reiter concludes that the photoperiod, acting through the pineal gland, synchronizes these cycles so that long-day breeding mammals do not reproduce young at a time of year when the