the kinds of archeological evidence necessary to make a compelling case for them.

The contributions of Mayer and Shimada merit special attention because they go beyond the substantiation and refinement of the Murra framework. Mayer demonstrates how new insights can be gained by studying the way in which groups transform Andean environment into production zones and then maintain or change them in response to fluctuating demands and conditions. This approach allows him to trace how and why linked sets of production zones become independent of each other, and it is far more satisfying than viewing these changes as the vanishing moraines of ecological complementarity.

Shimada's study of arsenic-bronze production by the pre-Hispanic Sican state likewise pays special attention to the means and relations of production. He considers the procurement of fuel, ores, and labor as well as the varying social and spatial context in which the productive activities were carried out. Sican metallurgical production is then viewed in terms of exchange relations with adjacent highland polities and other coastal groups on the Ecuadorian and northern Peruvian coast. Shimada is cautious in reconstructing organizational relationships and distributional mechanisms, but at the same time he demonstrates that problems at this scale and level of abstraction are amenable to archeological research.

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A Nexus of Transformations

Sweetness and Power. The Place of Sugar in Modern History. SIDNEY W. MINTZ. Viking, New York, 1985. xxx, 274 pp. + plates. $20.

In *Sweetness and Power*, Sidney W. Mintz has blended the methodology and theory of his discipline of anthropology with historical data to provide a provocative history of a foodstuff—sugar—and its impact upon modern British society.

According to Mintz, between 1650 and 1900 the production and consumption of sugar mirrored significant changes in the social, economic, and political structure of Britain. First used only by the nobility as a seasoning, medicine, or symbol of status, sugar had by the middle of the 19th century become a mainstay of the working-class diet. This transformation did not occur accidentally. In effect, sugar was made available to British workers for political and economic purposes.

Production of sugar within the British empire began after the acquisition of Barbados (1627) and Jamaica (1655). There planters used African slave labor to produce and process sugarcane for the British market under a protectionist system. Their endeavors not only made them rich but contributed to the fortunes of British merchants who participated in the triangular trade with Africa. Profits from that trade provided the surplus capital that allowed the industrial revolution to flourish in Britain. Moreover, the planters also developed a prototype for industrial factories, for the processing of sugar required a disciplined and efficient use of labor. Each stage of the process demanded specialization, which led to the creation of a production line not unlike that found in the early British factories. Besides yielding profits for planters and merchants, sugar benefited the bureaucrats, who appreciated its importance as a source of tax revenue.

Mercantile and bureaucratic interests continued to benefit from sugar when, during the early 19th century, protection gave way to free trade and West Indian plantations gave way to sources that provided more plentiful and cheaper sugar. As sugar supplies increased and prices dropped, patterns of sugar consumption altered. The availability of cheap sugar coincided with the appearance in Britain of tea, coffee, and chocolate. Added to these bitter drinks and to fruit preserves, sugar soon became a basic part of the working-class diet, providing both nutritional and symbolic satisfaction to the masses. For the new capitalists who emerged as the mercantile plantation economy declined, increased sales to the workers brought increased profits despite falling prices.

New foods, especially sugar, altered the lives of working people. Sweet tea and jam on bread served as quick hot meals for laborers. Thus, sugar provided a cheap and convenient source of energy for fueling the labor needed for industrialization in Britain, and, Mintz suggests, elsewhere. In this way, culture, power, and economic realities merged and determined in large part the means by which capitalism developed during the 19th century.

Mintz has not written a definitive history of the role of sugar in the British empire. Nor has he presented a typical anthropological study of the role of food in social behavior. But he never intended to do either. What he has produced is a challenging and entertaining book that should appeal to readers of many stripes and interests.

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Marsupials

Evolutionary Ecology of Marsupials. ANTHON K. LEE and ANDREW COCKBURN. Cambridge University Press, New York, 1985. viii, 274 pp., illus. $54.50. Monographs on Marsupial Biology.

Lee and Cockburn have produced in *Evolutionary Ecology of Marsupials* the first broad-scale treatment of marsupial life histories and evolution since Tyndale-Biscoe's *Life of Marsupials* over a decade ago. More important, theirs is the first attempt to place marsupial reproductive ecology explicitly in an evolutionary framework. The organization of the book, which highlights evolutionary considerations, allows the authors scope to raise and treat fascinating issues like sex allocation theory that, as they point out, have been ignored by most workers on marsupial biology.

The authors tackle a diverse set of problems, structuring their approach around six major themes. The book is best viewed as a collection of essays, though with more coherence than most collections. Lee and Cockburn argue first that food quality and dispersion influence life histories and social behavior. They then suggest that any organism's life history, physiology, and behavior are the result of phylogenetic constraints and current adaptive response to environmental pressures. For example, they argue that marsupial diversity may have been constrained by specialization for early extrauterine life (though they give no convincing argument why this specialization may have been favored in the first place) and thus marsupials may be viewed as specialized, rather than "primitive" as many mammalogists have argued in the past. Three very thorough reviews follow: of the diversity in carnivorous and in herbivorous marsupial life histories and of *Antechinus* (small dasyurids in which males are semelparous) as a paradigm. Much of the work on *Antechinus* is the authors' own. A final essay attempts to set marsupials in a coevolutionary and community ecological context. There is a heavy emphasis on non-macropod marsupials.

The strongest chapters are those that assemble in a coherent fashion the diverse information about the details of specific marsupial life histories. The authors present a wealth of data in a clear general context. On occasion, their attempts to integrate current evolutionary theory with life history information seem to me to fall short. Sometimes it is simply a matter of an opinion's being asserted without a clear supporting argument. After reviewing the possible constraints on marsupial radiation imposed by developmental specialization, for example,

the authors suggest that significant constraints may be imposed by pedogenesis—and though they acknowledge the hypothesis has little or no supporting evidence and is not currently testable they suggest (p. 84) that it may have heuristic value in interpreting life histories in an evolutionary context. Arguments of this form signal critics of the evolutionary approach that the time is ripe to attack. In other cases, the theory is presented in such a way that only those already versed in it have a hope of following the argument. The authors present interesting and important data on sex ratio and sex-specific dispersal patterns in *Antechinus*, but the review of sex allocation theory that was meant to set the stage for those data is less than clear and omits some major references.

Evolutionary Ecology of Marsupials is the most current review of marsupial ecology, bringing together both well- and little-known work, presenting detailed data with broad vision. Even if it fails occasionally to complete arguments deeply or convincingly, no other volume does so much. Both professionals and graduate students will find it a fascinating, welcome addition to the literature.

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Host-Parasite Coevolution

Ecology and Genetics of Host-Parasite Interactions. D. ROLLINSON and R. M. ANDERSON, Eds. Academic Press, Orlando, FL, 1985. xii, 266 pp., illus. $45. Linnean Society Symposium Series, no. 11. From a symposium, Keele, U.K., July 1984.

The coevolution of parasites and their hosts is sometimes viewed as a gene-for-gene arms race that matches increases in virulence by the parasite against increases in resistance by the host. However, a commensal relationship may evolve if selection favors parasites with reduced virulence and hosts with increased tolerance. The 14 papers in this symposium volume are concerned with various aspects of host-parasite associations, focusing on genetic and ecological factors that may affect coevolutionary patterns. Reviews cover diverse research programs encompassing experimental epidemiology, natural history, immunology, genetics, and theoretical ecology. Recent advances in the theoretical ecology of host-parasite associations are reviewed by May. Mathematical models developed in collaboration with Anderson reveal a variety of conditions under which a parasite may regulate the abundance of its host in steady state, in cyclic oscillations, or in chaotic fluctuations. May also combines population dynamics with population genetic models by involving both frequency-dependent and density-dependent effects. Anderson and Crombie have examined age-related changes in schistosome infections of snails and mice. Their study represents a powerful blend of experimentation and mathematical modeling.

The volume contains several field studies that attempt to address various aspects of coevolutionary models. Kennedy questions the existence of equilibrium population dynamics on the basis of his studies of helminth parasites of fish in a large lake. He claims that the parasites do not affect the abundance of their fish hosts, but he apparently equates such regulation with a steady-state equilibrium, one of several coevolutionary outcomes discussed by May. Hudson, Dobson, and Newborn find that theoretical models based on parasite prevalence are capable of predicting stable versus fluctuating populations of red grouse. Unfortunately, this and other field studies are limited in the temporal and spatial scales they sample, and thus their interpretation regarding coevolutionary models is unclear.

Experimental epidemiology of hosts and parasites provides a more tractable approach for testing coevolutionary models. Levin and Lenski review the benefits of bacteria and phage systems for modeling host-parasite associations. The existence of lytic and lysogenic phages permits the modeling of both mutualistic and antagonistic associations. I found this paper one of the most stimulating and informative contributions in the book. Scott reviews her well-conceived experimental studies of a monogenean trematode and its guppy host. Continuous immigration of uninfected fish is necessary to sustain the parasite population.

Also notable are several papers that focus on genetic variability of parasites and their hosts. Barrett questions the existence of gene-for-gene coevolution in nature, claiming that evidence for this phenomenon derives from agricultural systems that favor simple qualitative genetic responses by parasites to resistant varieties. Two papers review population genetic studies of parasites or parasite vectors. Although considerable genetic polymorphism has been demonstrated in several vector species, comparable studies of the parasites are limited by the difficulties in sampling and culture. Genetic analyses of the mammalian immune response to parasitic infection are the subject of three papers. Blackwell provides an excellent review of her genetic dissection of the mouse immune response to leishmaniasis. This detailed work reveals a complex developmental process controlling a multilocus immune response. It should be apparent that to assess the validity of gene-for-gene versus quantitative genetic models for host-parasite coevolution more work of this quality needs to be done with other microparasitic and macroparasitic diseases of plants and animals.

Overall, this book is stimulating and informative. Most important, I learned how very much we do not understand about the genetics and ecology of host-parasite coevolution. Several papers concerning mathematical models and immunogenetics are not for the fainthearted, but parasitologists can gain considerable insight into these exciting research directions. The book does not offer many new insights for population geneticists or evolutionary ecologists, but it should serve its stated purpose if it encourages these scientists to adopt host-parasite systems in experimental studies. I was surprised that none of the authors addressed the potential contribution that quantitative-genetic and developmental-genetic methodologies could make in this area of research. The covariance structure and developmental constraints of key traits involved in host-parasite associations must be known if realistic coevolutionary models are to be developed. Are parasite virulence and transmissibility positively or negatively related? What are the costs of increased host resistance to other life history traits such as age-specific fecundity and survival? It is to be hoped that biometrical and developmental approaches will provide a better bridge between ecological and genetic information.

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Active Galactic Nuclei

Astrophysics of Active Galaxies and Quasi-Stellar Objects. JOSEPH S. MILLER, Ed. University Science Books, Mill Valley, CA, 1985. viii, 519 pp., illus. $30. From a workshop, Santa Cruz, CA, July 1984.

This important volume covers the output of the Seventh Santa Cruz Workshop on Astrophysics, which was held to honor Donald Osterbrock on his 60th birthday. It is an excellent collection of papers that will prove to be essential reading for all serious students of active galactic nuclei in the second half of the 1980's. In an introduction to infrared studies Rieke notes that, as was appropriate given the occasion and the location of the workshop, the optical region was the subject most discussed, with the result