possibly track increases in plant productivity during years of good rainfall.

Malhotra and Mann trace the traditional food production system in Rajasthan and the impact of demographic and technological changes, and Dhir traces the history of human activities in the area since Paleolithic times.

Tadros discusses problems raised because the design of rural resettlement for people displaced by the Aswan High Dam failed to take into consideration the lifeways of the people.

The need for a historical perspective "to allow a realistic assessment of present trends in relation to the past" is emphasized both by Dennell, who discusses the importance of archeological studies, and by Moore and Stevenson, who discuss the contributions pollen studies can make to an understanding of the processes of desertification. Both papers present the limitations imposed by the present state of knowledge in these fields.

Bharara questioned selected villagers in central Rajasthan about their recollections of drought and found that out of 80 years five were perceived as "average," with 63 poor years (58 drought or severe drought, five mild drought) and 12 good or surplus years, suggesting that better criteria for judging are required. These findings run counter to those from studies of drought perceptions in the United States that people generally underestimate the frequency of hazard (T. Saarinen, *Univ. Chicago Dept. Geogr. Res. Pap. 106*, 1966).

Not enough hard data are presented in Martin's chapter on conservation at the local level in the Tauran Plain of Iran, in Nyerges's chapter on the processes of coadaptation of pastoralists, flocks, and vegetation, or in Horne's chapter on variations in fuel demand to convincingly substantiate the conclusions the authors reach. Bhadresa and Moore's discussion of desert shrubs and Breckle's of salinity do not have a social perspective.

Since desertification generally results from social and political problems at the local and regional levels and therefore cannot be understood in global terms, it is inevitable that this volume does not present an integrated social perspective on desertification. However, the emphasis in this volume on desertification as a social rather than an ecological problem is extremely important and long overdue.

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## Genomic Reorganization

**Mobile Genetic Elements.** JAMES A. SHAPIRO, Ed. Academic Press, New York, 1983. xvi, 688 pp., illus. $65.

Though long analyzed at the genetic level, the instability of DNA arrangement promoted by mobile genetic elements has come into focus for the molecular biologist primarily as the result of work accomplished during the past ten years. The chief developments have been the detailed molecular characterization of prokaryotic transposable elements and the identification of analogous entities in eukaryotic cells, as well as a molecular understanding of specialized rearrangements such as those involved in the development of the immune system. We are now comfortable with the idea that a low but significant level of genomic rearrangement, mediated by mobile genetic elements, is probably a universal facet of biological systems.

This volume surveys mobile genetic elements in organisms ranging from bacteria to mammals. A great deal of thought has gone into the book. It is detailed, authoritative, and well illustrated. Throughout, one is solidly in the hands of experts, most of whom can write clearly. The volume begins with a discussion of controlling elements in maize, the first transposable elements studied, then proceeds in phylogenetic order, concluding with a consideration of four specialized systems involving DNA rearrangement.

The opening chapter (Fedoroff), on maize, with its color plates displaying 30 kernels, imparts an understanding of controlling elements, as well as an appreciation for the brilliance of McClintock's work. The rich genetic analysis of controlling elements is summarized, though most of the phenomena are not yet understood in molecular terms and detailed molecular explanations are not ventured. It is not difficult to speculate on how the changes in phase, state, and developmental timing will ultimately be explained in terms of differences in gene expression mediated by the elements' position, sequence, chromatin conformation, and the like. Actually, the purported uniqueness of the maize elements in sensing developmental parameters is challenged by the information in the succeeding chapters, which provide fragmentary evidence that similar phenomena occur in a variety of other elements. One comes away from the book with the impression that it is the favorable genetic system available in maize, in which clonal analysis of genetic change is possible by examining the pigmentation patterns on kernels, that has allowed the variation in frequency, timing, and intensity of gene expression mediated by controlling elements to be clearly perceived.

Fedoroff's chapter also raises a question that is pursued in subsequent chapters: what is the significance to the physiology and evolution of the organism of mobile elements that transpose with little or no target specificity? Transposable elements can clearly be adaptive in a general sense by mobilizing advantageous genes and thereby facilitating their spread, as in the dissemination of antibiotic resistance in bacteria. Furthermore, transposable elements generate variability for evolution to act upon since they constitute a sizable fraction of spontaneous mutations. Mobile elements are particularly adept at generating diversity because they typically carry transcriptional signals and introduce instability into the target region, producing a wide range of phenotypes. Many of the elements carry signals that are at least interactive with the rest of the genome. However, at present it seems more likely that mobile elements will provide useful information for understanding how gene expression is modulated than that these specific sequences are themselves mediating normal developmental change.

The ensuing chapters describe mobile elements whose molecular study is relatively advanced, beginning with a consideration of bacteriophage λ (Campbell). The discussion focuses on the genetic control of the integration and excision process, ending with proposals for its evolution. The integration of λ is likened not to transposition of prokaryotic insertion sequences but rather to the simpler, nonreplicative resolvase reaction of the Tn*3* family. It is no coincidence that only the λ integration-excision and the resolvase reactions have been successfully carried out in vitro. It is in the behavior of the virus-transposable element Mu (Touissaint and Résibois) that the importance of replication in the transposition of the prokaryotic mobile elements is most readily apparent. A comprehensive treatment of prokaryotic IS elements (Iida, Meyer, and Arber) is followed by detailed accounts of the transposons Tn*3* (Heffron) and Tn*10* (Kleckner). That transposition frequency of Tn*10* varies over a wide range of four orders of magnitude depending on the amount of transposase synthesized provides a basis for understanding how the variable frequency of transposition monitored, for example, by the pigmen-

tation patterns on maize kernels could reflect the changing transcriptional activity of the element providing transposase.

The transposable Ty elements of yeast (Roeder and Fink) exhibit sequence heterogeneity that correlates with differential phenotypic effects, and their expression is modulated by other loci in the genome; both are features first proposed in the maize system. Similarly, the phenotype of some mobile elements in *Drosophila* (Rubin) can be influenced by unlinked genes and may be developmentally moderated. The discussion of hybrid dysgenesis in *Drosophila melanogaster* (Bregliano and Kidwell) concludes with an exciting discussion of the evolution of the phenomenon in which it is proposed that mobile P and I elements have recently invaded the species and spread worldwide, perhaps in response to the selective pressure imposed by intensive insecticide use, though it is unclear that any such selective pressure is necessary.

Several structurally distinct classes of elements emerge that are, however, widely distributed phylogenetically. For example, the retroviruses (Varmus), which have been most closely studied in birds and mammals, can be viewed as transposable elements using a viral RNA intermediate. The *copia*-like elements of *Drosophila* and the Ty elements of yeast bear striking similarities, at least structurally, to the retroviruses. The P elements of *Drosophila* closely resemble the Tn*3* family and the IS elements of prokaryotes, and sequences similar in form to the foldback elements of *Drosophila* are widespread in nature. It is likely that these distinct classes of mobile elements have differing mechanisms of transposition. Most of them are characterized by at least a short inverted repeat sequence at their borders, and all create a short direct repeat at the site of insertion.

The random aspects of mobile element transposition and the uncertainties surrounding the functional importance of mobile elements are contrasted by the specialized and clearly adaptive DNA rearrangements involved in the bacteria-plant gene transfer system of *Agrobacterium* (Zambryski, Goodman, Van Montagu, and Schell), the DNA inversions involved in phase variation and related systems (Silverman and Simon), and the gene-conversion–like events occurring in yeast mating-type switching (Haber) and trypanosome antigen variation (Borst).

Considering all of these mobile genetic systems side by side offers a valuable perspective. Though the field is moving rapidly and further molecular details are eagerly awaited, this book, up-to-date through 1982, should prove useful for many years to come.

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## *Drosophila* in Its Ecosystem

**Ecological Genetics and Evolution.** The Cactus-Yeast-*Drosophila* Model System. Proceedings of a workshop, Oracle, Ariz., Jan. 1982. J. S. F. BARKER and W. T. STARMER, Eds. Academic Press, New York, 1982. xiv, 362 pp., illus. $38.

A thorough understanding of evolutionary mechanisms requires detailed knowledge in almost all areas of biology, of which genetics (in its broadest sense) and ecology are most important. It is an oft-heard lament that the higher organism most amenable to genetic study, *Drosophila*, has not been, and perhaps cannot be, subjected to ecological studies. This volume clearly shows that such sentiments are not well founded.

The *repleta* group of the genus *Drosophila* breed primarily in rotting cactus, the larvae and adults feeding on yeasts growing on the necrotic tissue. The primary person responsible for developing ecological understanding of this group has been William Heed of the University of Arizona; indeed, if he were not a contributor himself this might be considered a festschrift in his honor. Many of the contributors were his students and collaborators, including outstanding yeast and cactus systematists and a natural products chemist. The variety of fields of expertise represented by these contributors reflects the multifaceted approach emphasized in this volume. With few exceptions, the 21 chapters are very well done.

Some of the contributions will be of interest only to those working specifically with the system. A few have much broader appeal, however. For example, Throckmorton's typically critical and insightful observations on the evolutionary origin of the group contain important new information on the origin of the whole family. Wasserman's phylogenetic analysis based on polytene banding patterns is a classic example of the exploitation of the information contained in these chromosomes. Starmer's work emphasizes the interaction of cactus chemistry, yeast growth, and fitness of the *Drosophila*; Vacek adds the complicating factor of interactions with bacteria. Barker ably reviews a large amount of work done on cactophilic *Drosophila* in Australia. Markow makes some fascinating observations about the reproductive behavior of the flies. (A chapter on mating behavior and speciation would have been a useful addition.)

The volume contains no final chapter synthesizing the diverse contributions; one reason is that at the present time such an undertaking would be very difficult. This is more a progress report summarizing currently and potentially available information on this group of *Drosophila*. Any evolutionary biologist hunting around for a good group of organisms to study should read this book and carefully consider the cactophilic *Drosophila*. My research is on a different group of *Drosophila* and I was given pause to seriously consider whether I was working on the best material for significant breakthroughs in understanding evolutionary mechanisms; the contributors to this volume very well may be.

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## Stratigraphic Analysis

**Quantitative Stratigraphic Correlation.** J. M. CUBITT and R. A. REYMENT, Eds. Wiley-Interscience, New York, 1983. xii, 302 pp., illus. $54.95.

*Quantitative Stratigraphic Correlation* is a collection of papers from the Geological Correlation Programme of the International Geological Congress. These papers apply numerical methods in correlation, biostratigraphy, and lithostratigraphy. They are part of IGC's Project 148, which is the development of computer-based mathematical theory and the use of geological information in correlation. Although most of the papers are biostratigraphically oriented, they demonstrate a variety of techniques applicable to stratigraphy in general. With a single exception, the papers do not summarize available techniques but are actual applications of one or more methods. The results of the analyses are usually contrasted with information derived through non-numerical methods. This publication cannot be considered a