lection technology now make it possible to characterize sharply the state of incident beams and to observe in detail the products of single collisions with atoms, at high resolution and in coincidence with each other. Doubly and even triply differential cross-section measurements are now being made, and their results amply repay the efforts required to meet the stringent demands on beam quality and detection sensitivity.

In essence, correlation measurements can yield information about relative phases of collision amplitudes, rather than merely their absolute magnitudes, much as an interference pattern carries phase information about superposed coherent waves. Not surprisingly, many of the data plotted in the book show a characteristic oscillatory behavior. In the study of atomic collisions, as is the case in other branches of physics, coherence and the relevant phase information are preserved only if the initial state of the system has been prepared with sufficient discrimination and if the experiment has been designed carefully enough to combat the natural tendency toward an averaging over lumped quantities.

For example, as an electron impinges on an atom, it excites or ionizes the atom and is scattered off at some definite angle. If the struck atom has a nonspherical shape, it may become directionally aligned and reveal its alignment in the orientational preference or the degree of polarization of the electrons or photons emitted following the collision. A correlation is established between the directions of motion of the projectiles and ejectiles. Knowledge of the details of the collision amplitude (or density matrix) gained from these measurements makes it possible to analyze the collision mechanisms and to test competing theoretical models. In the analysis, postcollision or final-state interactions feature prominently, as do delicate forces involving the electron spin.

During the past ten years, and largely stimulated by the theoretical analysis of U. Fano and his school, many experiments have been undertaken to exhibit correlations in atomic collisions. The Massey workshop brought together most of the practitioners in the field, and the book documents their research in papers reporting on such topics as coincidence investigations of electron-hydrogen collisions in the electron-volt energy range (Weigold), electron-photon correlation in bremsstrahlung processes at kiloelectron-volt energies (Nakel), coherent excitation of ionic states by correlated collisions in a crystal lattice with million-electron-volt projectiles (Datz), scattering experiments with laser-excited atoms (Düren), and quantum mechanical phase coherence and polarization in low-energy ion-atom and ion-surface collisions (Tolk and Kraus). As it has so often in the past, atomic physics has once again become the proving ground for the inferences from quantum mechanics, and the book contains many splendid illustrations of that fact.

In discussing principles, the papers in the book are frequently repetitious, betraying their origin as contributions to a workshop, but they will serve any scientist well who wants a readable technical guide to some of the most beautiful developments in atomic physics.

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Altruism in Theory

The Genetics of Altruism. SCOTT A. BOORMAN and PAUL R. LEVITT. Academic Press, New York, 1980. xx, 460 pp., illus. $29.50.

Research in sociobiology is, despite the efforts of its proponents, tending to converge rather than to diverge. As envisioned by E. O. Wilson in *Sociobiology*, the field encompassed all behavioral interactions and was intended to disseminate the broad implications of evolutionary theory in the biological and social sciences. However, since it was already clear, as it had been to Darwin, that behaviors, including social behaviors, that were immediately beneficial to the individual would be favored by natural selection, sociobiologists have concentrated on behaviors that are apparently altruistic and not beneficial to the individual performing them. The focus of field and experimental studies has principally been on documenting how various behaviors are altruistic and to whom the benefits accrue. The focus of theoretical studies has been on explaining how altruistic behaviors could originate and how they could be maintained in a population.

The goal of *The Genetics of Altruism* is to determine the conditions under which altruistic behaviors could initially arise in a nonaltruistic species. There are three mechanisms considered: reciprocal altruism, kin selection, and group selection, with roughly a third of the book devoted to each. For each mechanism, the authors define a canonical model in terms of arbitrary costs and benefits to each individual and then construct various combinatoric models of interactions that determine the costs and benefits. All the canonical models have the same general form. The population is initially fixed for the "asocial gene." Then a "social gene" (a helpful monster?) causing some altruistic behavior is introduced in low frequency, and the mathematical conditions are found that lead to the increase in frequency of the social gene.

This book is useful in some ways because it concentrates on the origin rather than the maintenance of altruistic behavior and because it attempts to explore mechanisms other than kin selection, which has received the most attention from sociobiologists. However, because of its idiosyncratic and convoluted style and its lack of perspective, it is unlikely to have any impact on biologists concerned with the evolution of altruism.

The basic problem is one that is shared with many mathematical models in evolutionary theory. The approach taken resembles an hourglass. First, a problem of real evolutionary importance is presented and discussed. Second, a model or class of models, which are very special and restrictive in their assumptions, is introduced. This is the point at which the mathematics takes over. (As in many such studies, the special models in this example are analyzed in exhaustive algebraic detail.) Finally, the results from the narrow models are expanded into conclusions of grand importance with respect to the problem originally posed. The use of special and artificial models is not necessarily incorrect. One has to start somewhere, and starting with the most complex possible model will lead only to frustration. But the simple models can lead only to an intuitive understanding of the simple mechanisms being considered, not to a solution of the general problem. It is the intuition about evolutionary mechanisms that is ultimately of value, not the algebraic details.

An additional problem with this book is its lack of perspective in the field of population genetics as a whole. The authors pay careful attention to only a few papers and lavish excessive praise on them. They ignore other work that attempts to clarify and simplify the issues. For example, although a third of the book is devoted to group selection, there is no attempt to deal with the models of Michael Wade or D. S. Wilson or with John Maynard Smith's recent critique of the subject. Moreover, no attempt is made to clarify the basic problem with group selection, namely that group selection can be effective as long as genetic differences between populations exist but that many forces including group selection itself tend to reduce or eliminate those differences.

This book is a useful summary of the mathematical studies by the two authors. But its conclusions are mathematical rather than biological, and it will probably confuse rather than enlighten most readers.

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