ever held on taphonomy, the book is of considerable intrinsic interest. But what does it tell us of the state of taphonomy today? Glaringly apparent is the lack of critical review and synthesis. Olson, in his historical overview, fails to provide the former and despairs of achieving the latter. In his opinion, each taphocoenosis represents a "singular historical event" with unique characteristics. Surely the fact that one can compare the taphonomic mode of an American Jurassic deposit (Morrison Formation) with an African Pleistocene one (Koobi Fora) and contrast both with a Canadian Cretaceous formation (Oldman) and one from the Pakistani Miocene (Siwalik Series) offers hope that, at the appropriate level of generality, taphonomic features will be seen to transcend accidents of time and space. We are told that the grand synthesis must await the collection of still more facts—but is this really the structure of scientific progress? In fact the danger is that taphonomy will collapse under the weight of "sheer phenomenology." There will always be room in taphonomy for thoughtful controlled observation. Hill, however, epitomizes taphonomists who collect facts—in this case 13 pages of raw uncontrolled data—from which almost no useful conclusion is drawn. Good taphonomy, in common with all good science, necessarily involves the formulation of resolvable questions so that focused observations are used to support or eliminate competing hypotheses.

The editors proclaim the book the first comprehensive bibliography of vertebrate taphonomy and paleoecology. With the reservation that the papers do not reflect work done since 1976, it comes commendably close to being comprehensive. The essays lack abstracts, in default of which good summaries should have been required. The book is well indexed by author and poorly by subject. It is printed from double-spaced typescript, but here is one case in which the price clearly justifies the inexpensive appearance. The University of Chicago Press and the senior editor, who did much of the tedious editorial work herself, are greatly to be commended.

The book should be read by those interested in the ecology of the modern fauna of East and South Africa and in its fossil antecedents and by those interested in the methodology of taphonomy—but a critical mind is recommended.

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Star Charts

The Sky Explored. Celestial Cartography 1500–1800. DEBORAH J. WARNER. Liss, New York, and Theatrum Orbis Terrarum, Amsterdam, 1979. xviii, 294 pp., illus. $70.

When Alessandro Piccolomini (1508–1579) wrote his modest book *De le Stelle Fissi Libro Uno* in 1540, he wrote in Italian in a vernacular style, in order to bring his science from ecclesiastical and university confines out to the people. (He also advocated higher education for women.) Today his book is a landmark because it contained the first printed star atlas: 48 woodcut star maps, one for each Ptolemaic constellation. Piccolomini is just one of the nearly 200 entries in *The Sky Explored: Celestial Cartography 1500–1800*. This encyclopedic work lists alphabetically each author of a star map during this period and gives a few facts concerning his life, details of the publications and of the science contained on the charts, the antecedents of the work, and a bibliography. It does not make for easy reading, but for students of celestial globes, charts, and atlases it is a gold mine of information and a joy to peruse or to study.

The casual student of maps may know of the two beautiful sky hemispheres (1515) of the Nuremberg artist-mathematician Albrecht Dürer but will now know that the maps were the result of a three-man collaboration of Johann Stabius, who drew the coordinates, Conrad Heinfogel, who positioned the stars, and Dürer, who drew the constellation figures and cut the wood blocks. And the work of Bayer, the Amsterdam Blaeus (father and son), and the London Senex may be familiar. But there is much more to be learned among the unfamiliar. In 1733 Christoph Semler, a Protestant clergyman in Halle, published *Coelum Stellatum*, an atlas of 35 maps showing white stars on black sky. We learn that the copy of Semler's atlas at the Library of Congress has the penciled notion "Given to Whitney Warren . . . 1913 and used in designing the ceiling of the New York Central Terminal."

To lovers of old books, collectors, and students of star maps, this is almost as much fun as locating an old star map. It joins two earlier works on the subject, both now collectors' items (but each recently reprinted): E. L. Stevenson's *Terrestrial and Celestial Globes* (published for the Hispanic Society of America by Yale University Press, New Haven, 1921) and Basil Brown's *Astronomical Atlases, Maps and Charts* (Search Publishing Co., London, 1937). *The Sky Explored* is expensive, the quality of some of the many reproductions is poor, and, sadly, none are in color. Sources for all reproductions are given, however, and the serious reader could spend many delightful hours searching out the originals in the Library of Congress or in other major collections. But let the reader beware: the search for old globes and star charts is habit-forming.

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Atomic Collision Physics

Coherence and Correlation in Atomic Collisions. Papers from a workshop. H. KLEINPOPPEN and J. F. WILLIAMS, Eds. Plenum, New York, 1980. xiv, 706 pp., illus. $59.50. Physics of Atoms and Molecules.

In 1978, at age 70, Harrie Massey, who personifies atomic collision physics, was honored in London by an international workshop on coherence and correlation in atomic collision physics. The editors of this handsome volume, the fourth in the publisher's series on the physics of atoms and molecules, have produced more than a routine collection of conference reports or dedicatory essays. The 55 papers in the book (almost half from Germany, a third from the United States) present a comprehensive, up-to-date review of a very active field and contain a reasonable amount of experimental detail, with theoretical advances, admittedly not as impressive, given less weight.

The term "correlation" has several different technical meanings in physics, but as it is used in the book it mostly refers to the measurement of angular and polarization correlations, although correlations of a related but more conceptual kind, such as the effects of the inclusion of interactions among electrons in describing atomic structure, are also discussed.

In an atomic collision experiment, a beam of particles (positive or negative electrons or ions, or photons) is directed at a gaseous or solid target, and some or all of the collision products are observed. In the early days, nothing more was measured than the attenuation of the incident beam as it penetrated a thickness of target material, and inferences were drawn about the overall efficaciousness (total integrated cross section) of the collisional interaction. Great advances in beam, detection, and data-col-

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 se-