humorous, historical style. One of the interesting products of the expedition was a remarkable series of photographs. Some 25 of them, mostly of buildings and streets, are reproduced in this volume. Included are such views of San Francisco, which was visited by the expedition in 1863, as the Broderick fire house. One wonders if there were not in the collection a few more photographs of scientific or geographical interest that might have been selected; undoubtedly had the book been written by a naturalist rather than a professional historian some effort would have been made, if the photographs existed, to reproduce fresh earthquake faults, animals, and so forth. In any event, a notable effort has been made to rescue from oblivion the record of a brave and creditable venture in scientific exploration.

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Biology of Populations

Topics in Population Genetics. BRUCE WALLACE. Norton, New York, 1968. x + 486 pp., illus. $14.

Textbooks on population genetics deal mostly with the mathematical foundations formulated around 1930 by Fisher, Haldane, and Wright, and with the extension of those foundations; biological observations are largely relegated to illustrating the mathematical formulations. Wallace has shifted the emphasis from the mathematics to the biological realities. To be sure, he discusses, if in a somewhat elementary fashion, the Hardy-Weinberg equilibrium and the algebra of migration, nonrandom mating, mutation, and selection. The muscle of the book, however, consists of experimental studies of animal populations. Mathematical and statistical methods are brought in to interpret and evaluate the experimental observations. In this respect *Topics* fills a serious gap in the literature.

Population geneticists have dedicated considerable effort to the study of genetic polymorphisms, that is, the presence in a population of two or several alternate genetic constitutions affecting the same character or characters of the organisms. Many polymorphisms observed both in nature and in the laboratory are balanced: the alternative genotypes coexist at equilibrium frequencies very often owing to the superior reproductive fitness of the heterozygotes over the corresponding homozygotes. Members of a Mendelian population face environmental heterogeneity of a multidimensional nature: heterogeneity of functions or roles that the organism must be able to fulfill at any one time and place; spatial heterogeneity, since such conditions as food, temperature, and competitors are not likely to be uniform even in a limited environment; temporal heterogeneity, from fertilization through sexual maturity to death and through the daily and seasonal cycles. Wallace proposes the concept of "marginal overdominance." In a balanced polymorphism one homozygous type is likely to have a higher fitness than the alternative homozygote in certain environmental situations but a lower fitness in others. If the heterozygous organisms always or in most cases have the same fitness as the superior homozygote, the average fitness of the heterozygotes in the population will be higher than that of either homozygote and will lead to a stable polymorphism. This concept is worth further experimental exploration.

The geneticists' debates concerning such questions as genetic load, rate of evolution, and population fitness are largely deadlocked, owing to the population geneticist's habit of ignoring the ecological complexities of nature and demographic realities such as population size, age distribution, and rates of birth and death. The most promising developments of population biology for the years ahead lie in endeavors to bridge the gap between population genetics and population ecology. Wallace has given attention to the ecological aspects of population genetics. The geneticist's calculations of average population fitness and genetic load bear no necessary relation to the adaptedness of the population to its environment. Introduction of a genetic polymorphism in a monomorphic population may increase the adaptedness of the population to its environment but will decrease the average fitness of its members. Wallace points out that population fitness—or, as I would prefer to call it, population adaptedness—is a concept which has escaped adequate and operationally valid definition. The average reproductive fitness per individual of a population at equilibrium size is 1. This does not mean that all populations of approximately constant size are equally adapted to their environment. Population size itself may serve as a measure of adaptedness for populations of the same or of related species of organisms. Wallace's distinction (chapter 24) between "hard" and "soft" selection—referring to selection due to genetic causes and that due to density-limiting environmental factors—may prove to be helpful in solving this problem.

As a textbook on population genetics, this volume has some obvious biases. Certain topics are ignored altogether or nearly so, notably those pertaining to plants, such as self-pollination or polyploidy. The book leans heavily on *Drosophila* studies; according to my count only 32 other species of animals, plants, or microorganisms are mentioned, most of them briefly. The author's own experimental studies are overrepresented. Wallace is aware of these biases. "I have attempted to present topics much as they might be presented in a series of seminars. Consequently, *Topics* is not a tightly knit, precisely organized textbook." For a course it may need to be supplemented by an additional text or by the instructor. In spite of its limitations, *Topics* is a major contribution to the literature, likely to be indispensable in the library of students of population genetics.

The volume suffers from insufficient editorial care. Table headings and figure legends are not always clear; misprints are frequent; at least five times the reader is referred to p. 000.

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Immunology

Biochemistry of the Acute Allergic Reactions. A symposium organized by the Council for International Organizations of Medical Sciences. K. FRANK AUSTEN and ELMER L. BECKER, Eds. Davis, Philadelphia, 1968. xii + 340 pp., illus. $12.

This volume, based on a symposium held in June 1967, is really a progress report on an interdisciplinary field shrewdly designated by J. H. Humphrey as "immunopharmacology." The participants are experts, each with a substantial record of accomplishment, speaking mainly to each other rather than to a larger audience. This monograph should be especially useful to advanced students and investigators of allergic reactions. For less specialized workers, including many immunologists,

the comprehensive reviews found in the series *Advances in Immunology* (Academic Press) or *Progress in Allergy* (Karger) will be more valuable.

Although all participants dealt with sequential reactions and chemical mediators involved in anaphylactic responses, four major themes received repeated attention. First and most obvious was the use of defined immunoglobulin fractions or distinct molecular classes rather than whole antiserum in the evaluation of biochemical events occurring in anaphylaxis. Various aspects of this topic are thoughtfully considered in papers by Bloch, Brocklehurst, Mota, and Austen *et al.* These last authors, for example, present strong supportive evidence for the function of distinctive immunoglobulins in disparate anaphylactic reactions in rats mediated either by histamine and serotonin release from sensitized mast cells or by slow-reacting substance (SRS-A) from granulocytes.

Most of the papers emphasize the topic of histamine release, especially from mast cells and granulocytes. The reports of Binaghi, Schild, Benditt, Uvnas, Lichtenstein, Prouvost-Danan, Siraganian *et al.*, and Keller taken together reveal that histamine release not only is a nice indicator of immunologic reactivity but is probably now the best-understood component of anaphylactic reactions. A third theme was the difficult subject of cell membrane changes and the kinetics of sensitization. Much interest was aroused by Binaghi's analysis of inhibition of sensitization by nonspecific gamma globulin. The key question whether the observed competition occurred at specific attachment sites on the cell surface was discussed. Studies of Levy and Osler on passive sensitization of human leukocytes, especially histamine-rich granulocytes, to ragweed pollen antigen also revealed the need to identify changes occurring on the cell membrane during sensitization if subsequent biochemical mechanisms of injury are to be clarified. The extensive studies by Feigen *et al.* of the activation energy of in vitro sensitization in relation to histamine release show, for example, that the rate of sensitization can be influenced separately by antibody concentration and by temperature. Although these results allow construction of kinetic models of sensitization, their physicochemical appeal is limited by the complex assumptions seemingly required.

Enzymes and metabolic pathways were a fourth theme of this symposium. In this connection, the reports of Bloch, Schild, Benditt, Hayashi, Prouvost-Danan, and Becker are all pertinent, even though evidence is fragmentary and far from unified. Becker's focus on the significance of antigen-antibody activated esterases suggests that an activated serine esterase may play a central role in histamine release and chemotaxis. Leukocyte lysosomal enzymes and various proteases, including mast cell granule esteroproteases, are also implicated in immunologic injury, but their association with the anaphylactic release of histamine is still unclear. A lucid and persuasive paper by Lepow *et al.* deserves special mention for its extension of our understanding of the role of serum complement in inflammatory responses. Fragments of complement components, specifically cleavage products of the third (C3) and fifth (C5) components, are shown to possess biological activities compatible with those classically designated as "anaphylatoxin." Moreover, C5 emerges as "the anaphylatoxinogen which is implied in the anaphylatoxin literature of the past 57 years."

The published discussions after each paper are a valuable addition to this book, since they identify or clarify more controversial aspects for the reader. This well-edited volume has the added bonus of a final "General discussion," comprising the last 22 pages. Here the frontiers are identified and some lively areas of contention are revealed.

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A Way of Thinking

Discovery, Invention, Research, through the Morphological Approach. FRITZ ZWICKY. Translated from the German edition (Munich, 1966). Macmillan, New York, 1969. xii + 276 pp., illus. $6.95.

An astrophysicist at Caltech and the Mount Wilson Observatory, Fritz Zwicky is undoubtedly an active and original thinker; he has made important contributions in several fields (the mass of a cluster of galaxies, frequency of supernova explosions, compact galaxies, and intergalactic material). At an age when most men retire, Zwicky has recently been very active in formulating his philosophy based on morphological thinking—consideration of *all* possible solutions to a problem, or routes to a given goal, or goals themselves. The word "morphology" is extended from its classical context, the interrelation of structures, to "the interrelations among phenomena, actions, concepts, and ideas." This emphasis on totality produces some surprises characteristic of Zwicky's research contributions, and examples in this book range from making out income-tax returns to studying languages and computing energy transformations in astrophysics.

At first glance, this may seem confusing and hopelessly disorganized, but morphological thinking in Zwicky's mind includes systematic coverage of the total field of possibilities in each problem. In this, and in many other aspects of his morphology, Zwicky adheres to the traditions of science; his morphological approach is close to the techniques of operations research developed by P. M. S. Blackett, Philip Morse, Ellis Johnson, and other scientists working with the military during World War II. In 1967 this similarity was notable at the Caltech Conference on New Methods of Thought, which was similar to a recent one on Hierarchical Structures (*Science*, 14 March 1969). As the structure of society and human knowledge becomes more complex and more divided into separate specialties, one might expect broader disciplines of thought to emerge—and Zwicky notes that similar ideas occurred to Paracelsus in A.D. 1530. In this book, in his publications over the last ten years, and in his International Society for Morphological Research, Zwicky is clearly seeking to establish his philosophy among younger scientists.

In the course of applying morphological reasoning to the design and use of astronomical telescopes, Zwicky covers some interesting history of the Mount Wilson and Palomar Observatories and of more recent space probes. In much of this he is critical of tactical errors, and makes strong recommendations to future planners. In similar vein, he criticizes automobile design, postage stamps, extrasensory perception, and the teaching of mathematics.

Zwicky recounts several of his achievements: restoring scientific books and journals to libraries damaged in World War II, review of German wartime science, and developments in jet propulsion. He treats energy conversion, the legal aspects of space explo-