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.

W. H. HILDEMANN
Department of Medical Microbiology and Immunology,
University of California, Los Angeles

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-

ration, explosives, and propellants in some detail. One of his wilder ideas is the "terrajet," which digs its way through solid earth, ejecting liquid and gaseous slags to the rear. Others include the design of a manned camp on the moon, and moving the sun (and solar system) to a different location in the Galaxy.

The textual style is sometimes ponderous, giving the impression that Zwicky has thought of everything worth thinking about in the last 50 years, but no reader can doubt that he has had many original ideas, some of them highly productive.

THORNTON PAGE
NASA Manned Spacecraft Center, Houston, Texas

An Influential Pseudoscience

Mesmerism and the End of the Enlightenment in France. ROBERT DARNTON. Harvard University Press, Cambridge, Mass., 1968. xiv + 218 pp., illus. $5.95.

Like many of his scientific betters—Buffon, Laplace, Newton himself—Franz Anton Mesmer postulated a subtle, universal fluid. Linking his fluid to health and promoting his therapeutic salon with consummate showmanship, Mesmer converted animal magnetism into probably the most widely discussed theme in France during most of the 1780's. In a decade during which an equally invisible fluid could raise balloons aloft, mesmerism found easy popular acceptance.

Critique from the establishment fostered rather than weakened the hold of mesmerism on the popular mind. No matter that the royal commission condemning mesmerism consisted of notables from both the Faculty of Medicine and the Academy of Sciences, Guillotin, Bailly, Lavoisier, and Franklin among them. Several of Mesmer's closest associates, thwarted in their efforts to rise to high levels of honor, hated the scientific establishment. The pamphleteering defense of mesmerism by Brissot, Marat, Bergasse, and others pushed beyond mere pseudoscientific theory into a closely linked political theory, bringing the essence of Rousseau's revolutionary concepts into the common consciousness charged with an air of "scientific" certainty. Some of the pamphleteers, though not Mesmer, played political roles after revolution came.

Mesmerism was thus a major mediating force in the transition from "the cold rationalism of the midcentury" to "a more exotic intellectual diet" marked by a yearning for "the suprarational and the scientifically mysterious." Many Frenchmen "buried Voltaire and flocked to Mesmer." This trend accelerated after the Revolution came to an end. Elements of mesmerism stoked romantic fires. Political systems, such as the Holy Alliance, and political theorists, such as Fourier and Owen, owed debts to the radical strain mesmerism embodied. Mesmer's fluid also influenced the views on the supernatural of important writers, Dumas and Gautier, Balzac and Hugo.

Such is the argument of Darnton's excellent and exemplary study in the history of ideas. Based on a thorough study of manuscripts, pamphlets, and journals, learned in its broad setting and persuasive in its internal logic, supported by richly relevant quotations and reproductions of contemporary engravings, *Mesmerism and the End of the Enlightenment in France* provides a commendable model for those interested in the way "true" and "false" ideas interact and broadly influence behavior.

JAMES HARVEY YOUNG
Department of History, Emory University, Atlanta, Georgia

Excavator and Prehistorian

Earl Morris and Southwestern Archaeology. FLORENCE C. LISTER and ROBERT H. LISTER. University of New Mexico Press, Albuquerque, 1968. xviii + 204 pp., illus. $7.95.

Archeology is becoming of increasing interest to social scientists because of the possibilities it offers for making long-term predictions regarding human behavior and cultural processes. Hence this book appears at a moment when archeologists are reexamining their philosophies, methods, and goals. To me, whose professional life partly spans Earl Morris' career as well as the "revolution" in archeology that appears to be in the making, the book serves as a welcome reminder of the great debt that Southwestern archeologists owe to Morris and others of his generation. Morris and these others possessed extraordinary intellectual and other endowments that enabled them to create a paradigm that was to serve archeology for 50 years. Curiosity about the history of the Indians of the Southwest gave Morris courage for over half a century to forge ahead in spite of many obstacles.

Morris was trained but little in archeological field schools or in the classroom; rather, he learned archeology in a practical manner, by digging. He was launched on his career when he was about four years old by his father, who gave him a shovel and told him to dig in a nearby ruin. Retrieving antiquities and selling them was then commonly regarded as a legitimate way of supplementing income.

As a student at the University of Colorado Morris became a friend of Junius Henderson, curator of the University Museum, and through him met other great masters in the archeological world—Hewitt, Fewkes, Cummings, Nelson, Kidder, and Judd. He received field training at the ruin of Puye, the first archeological field school in the Southwest. Later he worked with Nelson, who was the first archeologist in the United States to adopt a method of sequence determination, or stratigraphy. Thus, having begun as a pothunter, Morris became a zealous archeologist trained in the most sophisticated methods of the day by one of the best men in the field. Just as contemporary archeologists are wont to criticize their elders, so Morris thought the archeological work of Fewkes was ineffectual, superficial, and destructive. In making this judgment Morris realized that there was more to archeology than digging up pottery. He was one of the first young men in the Southwest to be aware of the profounder aspects of his research.

With roughly 20 years of digging behind him plus his university training and his apprenticeship in the field, Morris was ready to launch himself on a professional career. His boyhood had been spent in the shadow of the now-famous ruin of Aztec, New Mexico, and his fondest dream of excavating and restoring it was now about to be realized. For several seasons, beginning in 1916, Morris labored to reconstruct the complex history of this site—a site that had been intensively occupied for a number of centuries. Often with inadequate funds, but always with the enthusiastic support of the American Museum in New York, Morris excavated nearly 200 secular rooms and the Great Kiva. With this success his professional standing was assured. From