application of tolerance. Attempts to apply some of the findings discussed here to transplantation and allergy may find some direction as a result of this conference.

As for style, it seems to me that immunology, like opera singing and motor car racing, has more than its share of strong personalities. While there are rumors, conflicts, and scandals in all fields of science, cellular immunology seems to be a pacesetter. The 1968 volume, because of its discussion format, was full of the flavor of strong-headed people at work and play. As science it was good, as theater it was superb. The organizers of the 1974 conference (who also edited the proceedings) chose to have formal papers. This approach has the advantage of allowing workers in the field who were not fortunate enough to be invited to the meeting to see the data their colleagues are generating or to see new interpretations of data already published. But the discussions that follow each main section are short, and only occasionally does the fire of the real people come out. These moments, though rare, are wonderful; perhaps a compromise between the two formats can be arrived at next time. Having Macfarlane Burnet present to make a summary statement was a fine touch.

These proceedings demonstrate that the lines of research in immunological tolerance are being very clearly drawn. If the last six years gave us more questions, from this volume it looks as if the next six are likely to give us more answers.

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Nuclear Structure and Function

The Cell Nucleus. HARRIS BUSCH, Ed. Academic Press, New York, 1974. Three volumes. Vol. 1. xxiv, 668 pp., illus. $45. Vol. 2. xxiv, 564 pp., illus. $45. Vol. 3. xxiv, 584 pp., illus. $48.

Because of the complexity of the eukaryotic nucleus researchers interested in the system have tended to isolate one component or phenomenon (such as the nucleolus, DNA synthesis, or mitosis) for analysis. *The Cell Nucleus* provides a forum for presentation of the diverse problems that exist and the experimental approaches that have been taken to elucidate nuclear structure and function, and it permits rapid access to information available on the nucleus up to 1973.

The editor apparently chose to arrange the papers in order of increasing resolution, from nuclear structure to nuclear biochemistry. The transitions among the levels at which nuclear structure and function are studied might have been smoother, however, if the following sequence had been used: nuclear DNA; replication; transcription; nuclear RNA; nuclear enzymes; chromosome structure and mechanics; nuclear structure; and nuclear-cytoplasmic relationships.

Most of the papers represent active and promising kinds of research, but there are several contributions that could have been omitted or shortened without reducing the impact of the work. The replication of eukaryotic DNA has been extensively analyzed in the last few years, and significant problems that remain to be solved have been defined (for example, how are replicons turned on or off when the length of the S phase varies?). Given the sophistication of such questions, Stubblefield's superficial analysis of chromosome replication is disappointing, especially by comparison with the brief, incisive section on eukaryotic DNA replication in Strauss's article. Another paper that is not in the mainstream of chromosome research is the chapter on bird chromosomes by Shoffner. Our lack of knowledge of the function of most of the nuclear RNA's and proteins that are described at length in the two chapters from the editor's laboratory argues for a somewhat shorter treatment of these two subjects at the present time.

The majority of the papers, however, are significant and potentially of interest to nucleophiles in general, and several are outstanding. Franke and Scheer's article on the nuclear envelope is a review not only of the structure of the envelope but also of its complex relationship to the rest of the cell. The authors do not consider the envelope merely as a boundary; they treat it as one part of a multicomponent system that includes chromatin, chromosomes, RNA, cellular membranes, and other organelles. Nuclear pore complexes are extensively described, and there is an interesting discussion of the role pores may play in the translocation of ribonucleoprotein complexes from nucleus to cytoplasm. This chapter sets the stage for Goldstein's discussion of the movement of molecules between nucleus and cytoplasm. Such movement, frequently against a concentration gradient, is well documented, although selective permeability, or selective concentration, across the nuclear envelope is a sticky problem to attack because of the difficulty of setting up model systems. Goldstein's primary interest is not in the movement of molecules itself, but rather in why some proteins and RNA's prefer to be on one or the other side of the nuclear envelope. His discussion, based primarily on his work with *Amoeba*, is thought-provoking and relevant to gene expression in heterokaryons, discussed by Sidebottom, and the expression of transplanted nuclei in animal cells, discussed by Gurdon. Goldstein reiterates a popular hypothesis concerning the movement of proteins between cytoplasm and nucleus—the proteins assess changes in the cytoplasmic environment, move into the nucleus, and induce altered gene expression. Work on steroid-hormone-induced changes in RNA synthesis (mediated by protein receptors), reviewed and analyzed beautifully by O'Malley, provides experimental evidence supporting this hypothesis. But there are also RNA's that shuttle between cytoplasm and nucleus—what for? The discovery of RNA primers in DNA synthesis suggests to Goldstein that perhaps the shuttling RNA's are such molecules, a thesis that is testable, especially in light of the isolation of priming RNA's from several prokaryotic systems.

Fledgling investigators searching for an ideal eukaryotic system in which to study the metabolism of nonribosomal RNA biochemically and cytologically will do well to study the two chapters on polytene chromosomes. Hennig's chapter gives a general discussion of the structure of these specialized chromosomes when inactive and when activated (puffing), and Edström focuses on the elegant work from his laboratory on polytene chromosome transcription.

Those interested in new techniques for the differential analysis of chromosome structure will find the article on staining by Hecht *et al.* an encyclopedic source of information; the inclusion of specific steps in each of the staining procedures is welcome. One serious omission from these volumes is an account of the revolutionary technique of molecular hybridization in situ developed by Pardue and Gall and others. With the advent of this technique, molecular biology and cytogenetics become part of a single very powerful approach.

Although this collection of papers has

its weak points, it presents reviews on virtually all aspects of nuclear structure and function research. The fact that the material that appears in these three volumes is normally scattered through a variety of sources argues persuasively for the value of the work.

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Chemical Communication

Pheromones. MARTIN C. BIRCH, Ed. North-Holland, Amsterdam, and Elsevier, New York, 1974. xii, 496 pp., illus. $42.30. Frontiers of Biology, vol. 32.

In 1959, P. Karlson and M. Lüscher proposed the new term "pheromone" to replace and redefine the rather wide concept "ektohormone" of A. Bethe (1932). In their definition "Pheromones are substances which are secreted to the outside by an individual and are received by a second individual of the same species in which they release a specific reaction, for example, a definite behavior or developmental process." Some later authors found the term etymologically incorrect or too narrow, but on the whole it was accepted, not least because research on these substances was starting to flourish on a scale unknown a few years before. The main driving force behind pheromone research in insects was without doubt the expectation that these miraculously effective secretions would be a panacea to overcome the silent-spring effect of an often crude use of insecticides. The other animal groups in which pheromones have been intensively studied are the rodents, some primates, and a few other mammals. Here, pheromones have been found to regulate social life and reproduction.

The present state of pheromone biology is well demonstrated in this book: With insects we know comparatively many pheromones chemically but nearly nothing of their biosynthesis, have some information on the receptor mechanism, are ignorant of the central information processing, and know little of the details of the behavioral effects. With the mammals we know something of the behavior, very little of the pheromone composition, and nearly nothing of the biosynthesis, receptive mechanism, and central processing. Pheromone studies of other animal groups are few in spite of the reasonable assumption that most animals use the very basic means of chemical communication by pheromones.

The aim of Birch and his 28 coauthors is to present our knowledge of pheromone *biology*, which has not been well covered in some of the recent books and reviews that have emphasized the chemistry of pheromones. In section 1 of the book, 12 chapters deal with insect pheromone systems, from gland structure and pheromone production to the still-confusing multitude of pheromones and pheromone effects in social insects such as the honeybee. Section 2 treats the vertebrates. A chapter on fright and alarm pheromone responses in fish and amphibians is followed by four chapters on the rodents, one on the primates, and one on the "likelihood of human pheromones" (a reprint of A. Comfort's challenging and stimulating essay first published in *Nature* in 1971). The third and final section, Pheromones in Manipulation of Populations, is a concise treatment of problems of the use of pheromones in the control of agricultural and forest pests. Except in some special cases, the chances of effectively suppressing a pest population by the use of pheromones alone are dim, but the probability of success becomes much greater when pheromones are used as one of several factors in an integrated control program. On the other hand, survey of the development of a pest population, and thus proper timing of a necessary minimum dose of an insecticide, has already been found to be possible.

Birch and his colleagues have written a very useful book. The only major omission is a much-needed overview of the many known or suggested pheromone effects in organisms other than insects and vertebrates, beginning with bacteria, algae, and plant spermatozoids. For a multiauthor book, there is surprisingly little overlap or redundancy. Any investigator who deals with the pheromones will without doubt welcome this book, for it fills a gap in the literature. Pest control agents and perhaps some narrow-minded scientists who for one reason or another press prematurely for a quick and simple biological recipe against pests should try to understand its message: signal production and signal processing in biological systems involve a number of functions. In parallel to biochemical and biophysical research, an analysis of central processing and the details of behavior is badly needed. For this patient observations and quantitative and analytical studies must be performed. It seems to be difficult to make the trivial fact understood that the study of animal behavior is not a simple branch of biology. This is particularly true with respect to the mammals, whose pheromone reactions are by far less uniform than those in many insects.

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Polymer Chemistry

Kinetics and Mechanisms of Polymerization Reactions. Applications of Physicochemical Principles. P. E. M. ALLEN and C. R. PATRICK. Ellis Horwood, Chichester, England, and Halsted (Wiley), New York, 1974. xvi, 596 pp., illus. $43.50. Ellis Horwood Series in Physical Chemistry.

The title of this book has already been used, in one form or another, for a fairly large number of books dealing with polymerization chemistry, and it may therefore come as a surprise to the reader to find that this is not "just another book" on this topic. The subtitle more aptly characterizes the book, which is an advanced and sophisticated physicochemical treatment of polymerization reactions. It is apparently intended for the specialist. In this respect, it is almost unique, the only predecessor that comes to mind being Flory's well-known earlier treatise.

The special character of this book is at once apparent from the way in which it is organized. The first two chapters do not deal with polymerization reactions as such, but they review the general physicochemical principles that govern reactions in the gaseous and liquid states, including some references to their applications to macromolecules. The chapters cover such topics as the thermodynamic and kinetic approaches, diffusion, equilibria, and reaction rate theories. They occupy about one-third of the book.

The remaining five chapters deal specifically with polymerization reactions, including such topics as the nature of these chain reactions, the thermodynamics of chain reactions, reactivity theories, and kinetics. There is also a short chapter on the kinetics of polycondensation reactions. Both free radical and ionic mechanisms are treated