direct contact with Chinese has shifted attention away from broad theoretical questions about China, such as the efficacy of policy cycles, toward a number of more specific ones. In the scientific realm, can scientists be adequately trained within the abbreviated, politicized educational system that has existed since 1966? Can scientific research and dissemination long persist in the absence of such vehicles for normal scholarly contact among scientists as professional associations, journals, and meetings? Have the severe disruptions in certain research areas affected China's capacity to absorb technology? What is the situation with respect to scientists in the 35-to-50 age bracket, many with Soviet training: their numbers, location, ability, and experience? How, in fact, is science policy made?

Overarching evaluations of the sort Suttmeier attempts, admirable given the limitations of the earlier data base he uses, will have to be made anew when answers to these and other questions are secured. One hopes that as new data become available Suttmeier will continue his stimulating and leading work on China's scientific progress.

MICHEL OKSENBERG
Center for Chinese Studies, University of Michigan, Ann Arbor

Nuclear Power in the U.S.S.R.

From Scientific Search to Atomic Industry. Modern Problems of Atomic Science and Technology in the USSR. A. M. PETROSYANTS. Translated from the Russian edition (Moscow, 1972). Interstate, Danville, Ill., 1975. xii, 370 pp., illus. $16.90.

During the past year there has been a sharp increase in concern over the proliferation of nuclear power plants throughout the world. This concern is due to the production of plutonium in nuclear power reactors and its possible use in nuclear bombs. The explosion of a nuclear "device" by the government of India together with the realization that many countries are turning to the use of nuclear energy as a means of meeting their energy needs has resulted in a widespread awareness of some of the problems associated with the peaceful use of nuclear energy. Those who for 30 years have tried to convince the governments and people of the world of the existence of these problems should, perhaps, offer a vote of thanks to the government of India for its contribution. It is becoming generally evident at last that the vast capacity for overkill possessed by the United States and the Soviet Union no longer suffices to ensure the continued serene development of peaceful uses of nuclear energy.

Under these conditions it is useful to have available a broad, not too technical discussion of the Russian view of nuclear power: what the Russians think of nuclear power, how they have been developing it, their future plans, and their concerns. Petrosyants, the chairman of the U.S.S.R. State Committee on the Use of Atomic Energy, offers us a summary of such matters that should be interesting and understandable to readers of *Science* who are not specialists in nuclear engineering. In the author's words, "The book more or less systematically and consecutively expounds the achievements of Soviet scientists and specialists in the field of peaceful uses of nuclear energy."

The author begins with the Russian scientific background for the development of nuclear energy (chapters 1 and 2), discussing, among other topics, work on accelerators, high-energy physics, and nuclear fusion. In chapter 3 he discusses the background of the nuclear power industry both inside and outside the U.S.S.R. The meat of the book is in chapter 4 ("Nuclear power in the Soviet Union"), which describes, in about 120 pages, work on nuclear power up to 1972. The course of this work, as described by Petrosyants, appears to have been rational and efficient. Uranium partially enriched in ^{235}U was chosen early as the fuel for the first stages of the Russian program. Two reactor types have so far been emphasized. One is the graphite-moderated, water-cooled reactor of the so-called "channel type," which avoids the use of a large pressure vessel. In the Leningrad nuclear power plant there are two of these reactors, cooled with boiling water, each producing 1000 megawatts of electricity (1000 Mwe). Reactors of this type and size are to be used in the expansion of the Russian nuclear power industry. The Russians have also developed pressurized water reactors (PWR's), which are water-moderated and cooled, and are generally similar to American PWR's. These have also reached 1000 Mwe in capacity and will have an important place in the industry. The Soviet Union is selling PWR's at the 440-Mwe level to countries in its sphere of influence. The next stage of the Russian program is to depend heavily on fast-neutron breeder reactors in which ^{239}Pu will be the fuel and ^{238}U the fertile material. The Soviet Union is ahead of the United States in the development of this type of reactor (as are the United Kingdom and France). A fast-neutron reactor is in operation at the city of Shevchenko on the Caspian Sea. It can produce either 350 or 150 Mwe and 120,000 tons of fresh water a day.

Other chapters deal with small-size nuclear power units, nuclear-powered ships (with no details about submarines), perspectives for the future of nuclear power engineering in the Soviet Union, radioactive waste disposal, other centers of atomic science and technology, international cooperation in atomic science and technology, and the "great future" of atomic science and technology.

The technical discussion differs little from that in official or industrial American material on nuclear energy. Great effort has been devoted to ensuring the safety of power reactors and to the disposal of radioactive waste. In the matter of safety, I found no mention of secondary (building) containment, on which much emphasis is placed in the United States; much attention is paid to instrumentation for safety and emergency core cooling. According to Petrosyants there is a strong conviction within the Russian government of the need for nuclear power and of the safety of nuclear power plants. He expresses satisfaction with past work and optimism for the future. There are no hints of the existence within the Soviet Union of any groups opposed to the development of nuclear power, nor is there any discussion on international political or military questions arising from nuclear energy.

The book should be useful to those interested in the history of technology or in the social aspects of technology. There are, unfortunately, no references to more specialized literature, but the book offers insights into how a new technology is undertaken in an economic and social setting different from ours.

IRVING KAPLAN
Department of Nuclear Engineering, Massachusetts Institute of Technology, Cambridge

Organometallic Reactions

Organotransition Metal Chemistry. A Mechanistic Approach. RICHARD F. HECK. Academic Press, New York, 1974. xii, 338 pp., illus. $27. Organometallic Chemistry.

This book is intended for the synthetic organic chemist. The goal of the author is to give the reader enough background in organometallic chemistry to enable him to make intelligent decisions about the type of organometallic reagent required to effect a given molecular transformation. In order to achieve this Heck presents the reactions between certain organic (alkenes, polyenes, alkynes) and inorganic (primarily hydrogen and carbon monoxide) sub-

strates and organometallic reagents in terms of common reaction mechanisms (established or proposed). This "mechanistic approach" provides a cohesiveness that is lacking in the other two commonly encountered monographs on organometallic chemistry.

The coverage of the literature (through 1972) is not meant to be comprehensive and reflects the author's personal view of the topics he considers important and interesting. The emphasis is exclusively on homogeneous catalytic and stoichiometric reactions. Heterogeneous reactions, which are less well understood, are mentioned only in passing.

The subject is logically and systematically developed. In chapter 1 bonding, structure, and nomenclature in organometallic chemistry are briefly discussed. Ligand dissociation reactions are presented in chapter 1, and most of the other basic reactions (oxidative addition, reductive elimination, migratory insertion, alkylation via metal anions, radical reactions, and demetalation) of organometallic chemistry are introduced in chapters 2 and 3, which concern the preparation and chemistry of the metal-hydrogen and metal-carbon σ-bonds. Because of the pervasiveness of these two types of bonds in organometallic chemistry, these chapters are the key to the material in the subsequent chapters. Hydrogenation, in certain respects one of the best understood of the organometallic reactions, is discussed in chapter 4. The isomerization, addition, elimination, dimerization, oligomerization, cyclization, and substitution reactions of alkenes, polyenes, and alkynes are dealt with in chapters 5 through 8. The preparations of organic carbonyl compounds derived from the aforementioned substrates and carbon monoxide are discussed at length in chapter 9. Finally, dinitrogen, dioxygen, carbene, and sulfur dioxide complexes are dealt with briefly in chapter 10.

The mechanisms of the relatively few well-understood organometallic reactions are presented in detail. On the basis of these studies and product analyses, mechanisms for other organometallic reactions are proposed. The mechanistic rationalizations are reasonable in all instances and utilize the set of basic reactions introduced in chapters 2 and 3. At no time does the author leave the reader confused as to what is established fact and what is conjecture. The mechanisms are illustrated in reaction schemes that help the reader greatly. Despite the complexity of some of the schemes, there are no serious typographical errors. Stereochemistry and asymmetric induction by organometallic reagents are discussed where appropriate.

The treatment in chapter 1 of metal-ligand bonding, which is cursory and based entirely on symmetry considerations, does not reflect current bonding theories. For example, the reader is told that π_1 and π_3^* of the allyl anion are strongly bonding to the metal and that π_2 may also be bonding to the metal. On the basis of the energy of the ligand and metal orbitals and the structures of η^3-allyl complexes, it is more likely that the bonding between π_2 and the *d*-orbitals of the metal dominates the metal-ligand bond in η^3-allyl complexes and that π_1 and π_3^* are weakly bonding to the metal.

At the end of each chapter there is a list of more comprehensive review articles. References to the primary works are given in the chapters. There is an author index and an extensive and useful subject index.

The book clearly illustrates the versatility and potential of organometallic reagents in organic synthesis. It is a useful and illuminating introduction to organometallic chemistry.

WARREN P. GIERING
Department of Chemistry, Boston University, Boston, Massachusetts

Chondriosomes

The Biogenesis of Mitochondria. Transcriptional, Translational and Genetic Aspects. Proceedings of a conference, Bari, Italy, June 1973. A. M. KROON and C. SACCONE, Eds. Academic Press, New York, 1974. xxii, 552 pp., illus. $19.

This book is divided into three parts: Mitochondrial Transcription; Characteristics of the Mitochondrial Protein Synthetic Machinery; and Synthesis of Mitochondrial Proteins. Discussion of mitochondrial DNA and its replication is excluded. Part 1 is the least cohesive section, since it includes papers on such diverse topics as transcription in mitochondria, gene products of mitochondrial DNA as identified by DNA-RNA hybridization, the use of coupled systems of transcription and translation, mitochondrial genetics, and the characteristics of mitochondrial RNA polymerases. Part 2 is largely concerned with mitochondrial ribosomes. The best section is part 3, which deals with the participation of mitochondrial and cytoplasmic protein synthesis in the assembly of specific inner membrane components, notably cytochrome oxidase and the adenosine triphosphatase.

Perhaps the major conclusion that can be drawn from the book is that the proteins translated in the mitochondrion are limited in number, very hydrophobic, and associated with inner membrane enzyme complexes, notably cytochrome oxidase and the adenosine triphosphatase. However, these enzyme complexes also contain proteins synthesized on cytoplasmic ribosomes. These conclusions derive from the elegant experiments of Schatz and Tzagoloff on yeast and of Bucher's group on *Neurospora*. The findings pose two major questions. First, where are the messages for the mitochondrially synthesized polypeptides coded? Second, how do mitochondrial proteins synthesized in the cytoplasm enter the mitochondrion and become assembled into enzyme complexes of the inner membrane together with those products made in the mitochondrion?

Although it is generally assumed that the messages translated on mitochondrial ribosomes are largely, if not entirely, mitochondrial DNA transcripts, it is evident from the papers in part 1 that direct proof is lacking. Although mitochondrial genetics in yeast had reached a sophisticated level at the time of the conference of which this book is the proceedings and mutations had been isolated that altered components of mitochondrial ribosomes, the adenosine triphosphatase, and cytochrome oxidase, in not one instance had an altered mitochondrial protein been associated with a mitochondrial gene mutation. Similarly, the use of coupled systems of mitochondrial DNA transcription and translation in vitro has yet to reach the level of sophistication necessary for the identification of specific mitochondrial proteins. The strongest indirect evidence that mitochondrial ribosomes are principally engaged in translation of mitochondrial messages comes from Mahler's work with yeast, which takes advantage of the fact that formylmethionine-transfer RNA_F is used in chain initiation in mitochondria as it is in prokaryotes and formylmethionine is retained in the NH_2-terminal position of nascent polypeptides on mitochondrial polysomes. These experiments show that virtually all translation on mitochondrial polysomes is blocked by ethidium bromide under conditions in which cytoplasmic translation proceeds normally. If ethidium bromide is acting solely as a transcriptional inhibitor and not as translational inhibitor, these experiments show that mitochondrial polysomes for the most part transcribe mitochondrial messages.

The answer to the second question may emerge from the finding of Kellems and Butow that yeast mitochondria have cytoplasmic polysomes bound to their outer membranes that apparently engage in vectorial translation of nascent polypeptide chains into the mitochondrial membranes or intramembrane spaces.

A review such as this cannot do justice to the vast array of subjects discussed in