ence on the contemporary coastal landscape. Sauer gives a very useful summary of the probable history of the genus *Cocos* and points to the apparent stability of this near monoculture, which may be related to its establishment entirely on native trees. Attempts to introduce "improved" varieties from Ceylon and other sources have been failures; an analysis of the biological basis of this situation may be of the greatest importance to tropical agriculture.

Although human-induced vegetational changes have been brought about far faster than usual in the Seychelles, the object lessons in these islands do not concern only the past: "the problem of potentially infinite populations and fixed natural resources becomes wonderfully clear on tiny islands that are largely bare granite."

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Pre-industrial Technology

The Traditional Crafts of Persia. Their Development, Technology, and Influence on Eastern and Western Civilizations. HANS E. WULFF. M.I.T. Press, Cambridge, Mass., 1967. 428 pp., illus. $25.

It is a common complaint among archeologists that ethnographers pay too little attention to the technological details of the societies they study, thus depriving archeology of their essential assistance in the problem of cultural reconstruction. The lack of such documentation is only too evident in the case of modern Iran, a country with still-existing but rapidly disappearing pre-industrial crafts. The appearance of Hans Wulff's volume on the traditional crafts thus fills a double void—that of adequate ethno-technological description of existing techniques and that of auxiliary information for archeological interpretation of past remains. Based on considerable field observation supplemented with library research, the work presents a careful documentation of the basic craft techniques of Iran taken as a whole (with regional usage specified where appropriate, however). The record includes the Farsi terms used by the craftsmen themselves for equipment and processes. The report thus has a linguistic importance as well.

Various specialized crafts included in the broader categories of metalworking, woodworking, building, ceramic making, textile weaving, leather working, agriculture, and food preparation are all covered in some detail. Each section takes the reader step by step through the basic process, and most are provided with a well-chosen illustration or two (there are 423 figures) showing details of equipment or end products or providing a diagram of working parts. Some of the latter seem cramped as a result of having been reduced to fit the double-column format of the book, but all are clearly legible even so. For Western readers the labeling of the parts of these diagrams in Farsi is somewhat awkward, although all of the terms are explained in the adjacent text or may be looked up in the glossary of Farsi and English technical terms given at the back. There is also a very useful bibliography followed by a section of annotations on the more important sources. The book ends with a small map of Iran showing key place names mentioned in the text.

For anyone interested in Iranian studies, in the ethno-technology of the Near East, in the history of technology in general, or in the technological connections between the Near and Far East by way of Iran this book is an indispensable source. Its one major flaw lies in the author's attempt to give his observations historic depth through the inclusion of prehistoric archeological data. This part of his treatment is somewhat out of focus and out of date, and the reader would be well advised simply to pass over these comments (which constitute but a small part of the total text), especially as applied to metallurgy and ceramics, and go on to the rest of the well-presented material. At the very least he is cautioned to check any archeological statement against current sources.

In view of the serious disruption of World War II, the author is to be congratulated on his perseverance in reassembling and publishing his important observations. They make a major contribution to the study of Iranian technology. The M.I.T. Press is also to be congratulated for undertaking to publish ethnographic data of great value to the study of the history of technology in general. It is to be hoped that it will continue to do so.

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Chain Reactions

Liquid-Phase Oxidation of Hydrocarbons. NIKOLAI MARKOVICH EMANUEL, EVGENII TIMOFEEVICH DENISOV, and ZINAIDA KUSHELEVNA MAIZUS. Translated from the Russian edition (Moscow, 1965) by B. J. Hazzard. Plenum Press, New York, 1967. 364 pp., illus. $22.50.

The reactions of organic compounds with oxygen from the air are among the most important of all chemical processes. Respiration and combustion are most familiar, but there are also a host of less spectacular reactions that do not involve complete degradation of the organic material to carbon dioxide and water. Many of these processes occur more or less spontaneously under comparatively mild conditions. The harmful effects of such processes are apparent in the rancidification of edible fats and oils and in the slow deterioration of rubber. The beneficial effects are apparent in the drying of linseed oil paints and, particularly, in the synthesis of many valuable chemicals by the partial oxidation of relatively cheap hydrocarbons derived from petroleum.

The oxidation of hydrocarbons in the liquid phase is a free-radical chain process. Relatively unstable hydroperoxides are generally the primary molecular products, and these decompose slowly to initiate new reaction chains. The overall process is autocatalytic and is referred to as a chain reaction with slow, or degenerate, branching. Although the kinetics is not simple, considerable progress has been made in our understanding of the mechanisms of these reactions. Emanuel and his collaborators at the Institute of Chemical Physics, U.S.S.R. Academy of Sciences, have constituted one of the most active groups in this field in recent years.

The present book represents on the whole a successful attempt to collate a large body of information. The Russian literature is fully covered through 1964 and Western literature through 1961. The occasional references to more recent Western work are not always successfully integrated into the text. The chapter on inhibitors is particularly subject to this fault. Homogeneous oxidations in strong acids and strong bases are not described. The emphasis is on the fundamental reactions involved in oxidations. Mathematical treatments of the kinetics of chain reactions play a major role. Their general success sometimes obscures the fact that agreement

between theory and experiment does not necessarily mean that the theory is correct. Similarly, the sequence in which the products are formed does not unambiguously define the reactions by which they are formed. A more critical appraisal of a good deal of the work covered in this book would have been welcome. The recurring suggestion that peroxy radicals can undergo a metal-surface-catalyzed unimolecular decomposition to form an aldehyde or ketone and an alkoxy radical seems unlikely to me. Even at the comparatively low temperatures which are employed the lifetimes of the individual peroxy radicals are too short for any significant fraction of them to come in contact with the surface during a liquid-phase oxidation. The experimental data can be more plausibly explained in terms of the well-documented homogeneous β-scission of alkoxy radicals.

The translation is excellent, but there are several printing errors. The text is clear and liberally supplied with figures and tables. The authors have produced a comprehensive study of the theory, technique, and technology of a rapidly growing field of chemistry, and the book is recommended to all those interested in this field.

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The State of a Science

Changing Identity of Graduate Earth Science Education. Proceedings of a conference held in Atlanta, Ga., January 1965. CHARLES E. WEAVER, Ed. Georgia Institute of Technology, Atlanta, 1967. 184 pp. Paper. Available free from the editor.

Faced with the problem of starting a graduate program in the earth sciences, the administration of the Georgia Institute of Technology sought guidance in a conference. The 31 participants included representatives from large and small, private and state universities and colleges, the U.S. Geological Survey, and the National Science Foundation, which sponsored the meeting. This volume is a partially edited transcript of the proceedings.

I can do no better in summarizing the outcome of the conference than an unidentified participant who concluded: "I have been an observer here for two days. I have heard an analysis of what is wrong with geology rather than a real changing identity of graduate earth science education."

At the risk of taking some remarks out of context, I quote from Charles E. Weaver's foreword, which has many of the characteristics of a postmortem: "In some instances there is little relation between the titles and the actual talks. The discussions ranged far and wide and though few, if any, problems were 'solved,' many were defined and evaluated. . . . Unfortunately, relatively little thought was given to the long-range effects of some of the changes that are taking place. . . . Many will conclude that the ideas and problems presented at this conference are not representative of the whole field of graduate earth science education. This is probably true."

In spite of half a dozen sound and well-prepared presentations, the conference obviously provided a minimum of guidance for an institution about to embark on a program of graduate instruction. I have just initiated a graduate program at the University of Pennsylvania, but I did not discover the dichotomy that several of the conferees stressed between so-called "classical" and "modern" geology or earth science. Geology is still the study of the earth, whether its followers call their specialties geophysics, geochemistry, or paleoecology. The major function of geochronology is that of refining correlation and extending it from the interpretative stratigraphic correlation of sediments to the more precise dating and differentiation of other petrologic types. It is a new and exciting adjunct to historical geology.

The conferees emphasized the need for a great deal of pregraduate training in mathematics, physics, and chemistry, but what is new about this? In 1946, I berated listeners at a meeting of section E of the AAAS with an address pointedly entitled "Geomorphology—The Inexact Science." The need and the potential of mathematics, physics, and chemistry were as evident then as they are now, and had the profession as a whole been alive to the fact 20 years ago, departments of geology (or earth science)—and conferees on graduate education—would not be bemoaning the dearth of undergraduates, or the loss of the best students to other disciplines.

What is new is the instrumentation from the fields of physics, engineering, chemistry, and geology itself that provides opportunities to probe more profoundly into the physics and chemistry of the earth and thereby learn with some precision how our planet fits into the solar system, how it has evolved, and how we can live on it and with it as a dynamic body. If there is a schism, it is between the new methodology and the background training that is being provided for those who will have to comprehend the significance of tools that are still being devised. The embryonic stage in which the profession finds itself is evident from the diametrically opposed views geophysicists draw from the same sets of physical facts—witness heat flow, remanent magnetism, convection, continental drift.

I heartily agree with Weaver that "We are on the threshold of an explosive growth in the Earth Sciences," and the conferees at Atlanta were—and are—enthusiastic participants in the advancement of the field. One of the gems contributed to the meeting came from Julius R. Goldsmith, of the University of Chicago, who observed that there is a marked difference, in graduate programs, between crystallization and petrification. If Georgia Tech manages to avoid the latter, success in its graduate venture will be assured.

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Stars and Substances

Nuclear Astrophysics. WILLIAM A. FOWLER. American Philosophical Society, Philadelphia, 1967. 127 pp., illus. $3. Jayne Memorial Lectures, 1965.

In this slender masterpiece, based on a series of four Jayne lectures, Fowler ranges over a wide variety of fascinating topics that include element synthesis in the proto-universe and in the stars, age dating of the universe by nuclear clocks, supermassive stars, and the enigmatic nature of quasars. The presentation is extremely lucid, following in the grand tradition of Eddington, Jeans, and Hoyle. Characterized by vivid and nonmathematical description, this volume will appeal thoroughly to the layman. By the perspective that it affords and by the state-