ment, time, and material"; "Planar and linear structures and jointing"; "Faults"; "Folds"; "Tectonic analysis of folds"; "Cleavage"; "Major structures and tectonics"; "Igneous rocks"; "Structural petrology" (written by E. Den Tex); and "Geomorphology and morphotectonics." This organization of the subject matter is very effective.

The style of presentation detracts from the overall merit of the book. In the preface Hills states that "Particular attention has been paid to definitions . . . [and that readers will find this] far from being dry as dust material for rote learning. . . ." He succeeds in maintaining such a sharp focus on definitions that one often wonders whether the book is a textbook or an expanded, well-illustrated glossary. This lackluster effect is reinforced by the author's unwillingness to commit himself to any theory or groups of theories that would form a unified basis for the presentation of the material. The result is a disjointed presentation that is sure to defeat even the most concerted effort to keep one's mind on the subject. In the preface it is also stated that the reader will witness "as much discussion of pros and cons as is possible within the limit of a text book." Instead, references to genesis, comparative environment of formation, and other underlying principles are commonly restricted to a single clause or sentence immersed in a much larger volume of purely descriptive material; or such references are presented in separate sections so that they will not jeopardize the presentation of the descriptive material. The net result is a very antiseptic treatment of the material.

Owing to the slow progress in the field of structural geology during the last few decades, one would expect new textbooks in the field to be up to date, particularly with respect to any attempt to present a quantitative description of the genesis of structures. Yet such work is not covered to any degree in this text. The two notable omissions are (i) the buckling analyses that relate fold wave lengths to rock type and physical environment (by Biot; Curie, Patlode, and Trump; and Ramberg) and (ii) the thermodynamic studies on the crystallization of minerals in stressed environments, which are basic to a quantitative understanding of petrofabrics (by MacDonald; Verhoogen; Kennedy; and Kamb).

Regardless of these shortcomings, the scope and organization of the material presented and the abundance of illustrations and references should make this a good text around which to build an introductory course covering the traditional subject matter of structural geology.

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## Chemical Technology

**Physical Chemistry of Petroleum Solvents.** W. W. Reynolds. Reinhold, New York; Chapman and Hall, London, 1963. x + 211 pp. Illus. $10.

This handbook on the physical properties of petroleum hydrocarbons which characterize their solvent characteristics in practical systems such as resins, paint films, and printing inks resulted from a ten-year study carried out at Shell Oil Company's Wood River Research Laboratory under the supervision of the author, W. W. Reynolds. Few of us realize how, in recent years, advances in petroleum technology have provided a "spectrum of solvents and hydrocarbons extending from essentially pure isoparaffins to pure aromatics." Their use and adaptability in a variety of practical solvent systems has not been fully exploited, and this is essentially the message and purpose of this small volume.

Chapter 1, largely written by the author's colleague, G. W. Waters, contrasts the physicochemical properties of the three main categories of hydrocarbons—the paraffins, the naphthenes, and the aromatics—with practical properties or criteria of acceptable solvent behavior—solvency, viscosity, volatility, and odor. The data of the American Petroleum Institute's Research Project 44 on pure hydrocarbons are extensively quoted in this section. The second chapter very briefly reviews the thermodynamics of binary solutions, *a la* Hildebrand and Scott, together with the elementary Flory-Huggins approach to the thermodynamics of polymer solutions. The remaining seven chapters deal with more practical aspects of the nature of paint resin solutions, their flow properties, and the final characteristics of surface coatings. The treatment throughout is essentially thermodynamic in nature, and it is unfortunate that the author has not devoted some space to the importance of the kinetic aspects in this area.

The choice of solvents and compounding will remain an art until modern advances in theories of liquids and their mixtures can be reduced to a more useful semiempirical basis. This volume will be very useful to those who work in the area of solvent technology and should stimulate physical chemists to make a greater effort to understand the fundamentals of solvent behavior.

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## Astronomy

**The Solar System.** vol. 4, *The Moon, Meteorites, and Comets.* Barbara M. Middlehurst and Gerard P. Kuiper, Eds. University of Chicago Press, Chicago, 1963. xxii + 810 pp. $15.

In this fourth volume of a five-volume series on the solar system, 28 authors present 22 chapters that are up-to-date and authoritative. Twenty percent of the book is on the moon, 60 percent on meteors and meteorites, and 20 percent on comets. The book can be recommended without reservation to all who are interested, professional astronomers as well as amateurs. Its appearance is especially timely now that exploration of the solar system by means of rockets has begun in earnest. The final volume of the series, on planets and interplanetary material, should soon appear; it will also deal with such subjects as selenography, tektites, the origin of meteorites, and the primordial composition of the solar system.

Two remarks by the late F. G. Pease on lunar observations made with the 100-inch telescope at Mount Wilson are worth quoting: "The photos do not begin to show the exquisite detail that is seen visually when we have good seeing. They really do not tell the truth. The smoothed surface about Copernicus becomes a billion crater pits, each showing typical crater shadows at low sun; rifts become sharp and angular sometimes with acute angles; the light streaks appear to be but a series of very low mounds touched here and there with white. The dark streak in the rim of Aristillus is a veritable maze of fine threads." About the Mount

Hadley rille Pease wrote: ". . . in fine weather one has the sensation of looking down upon a Grand Canyon as sharply cut in structure and as angular in its turning as that of the Colorado River. Abrupt bends forming acute angles occur in its length and small side canyons enter into it at these points."

The Soviet account of photographing the far side of the moon is especially interesting, and so is E. A. Whitaker's somewhat different interpretation of the Soviet photographs. Although taking these photographs was a magnificent technical achievement, I tell my graduate students that they had better do better, or else! It is surprising that nothing more along this line has been accomplished during the last 4½ years, but it may well be that new and better photographs will appear about the time this review is published. Detailed close-up exploration of the bleak lunar landscape should be one of the most exciting events of the 1960's.

The two major meteorite falls of this century were in Siberia, and in this volume they are treated by a recognized Soviet authority (in chapters 7 and 8). His conclusions are that the Tunguska fall (in 1908) was a collision with a small comet, while the Sikhote-Alin meteorite (in 1947) was probably a small asteroid.

The delayed acceptance of the impact origin of lunar craters has been caused, in part, by the fact that apparently such craters do not exist in any number on the earth. The discovery of several large fossil meteorite craters in Canada, by C. S. Beals and his associates, is therefore a major breakthrough. The Brent Crater in northeastern Ontario, an explosion crater some 2 miles in diameter, is at least 400 million years old and probably much older. These discoveries were made by examining aerial photographs, and it is likely that extending such investigations to the entire earth's surface would be richly rewarding.

Meteorites are chunks of primordial matter that have been collected and, in some cases, venerated by men since prehistoric times. We would know a great deal more about early planetary and preplanetary history if we could understand completely the curious structures of, and the chemical and isotopic variations in, meteorites. Until a decade ago, meteorites were studied by mineralogists; more recently important contributions have been made by geochemists and nuclear physicists, and the subject is one of explosive growth that is well told from the different points of view in this volume.

The relationships between meteors, meteorites, and comets are still somewhat obscure, because such totally different processes as asteroid collisions and comet disintegration by sunlight give rise to similar phenomena in the earth's atmosphere. There are probably at least 100 billion comets "in" the solar system, in a cloud that extends to distances comparable to the distances of the nearby stars. The nuclei of these comets should be stratified like geological sedimentary strata and should give the oldest and least disturbed record of ancient processes. For these reasons, Fred Whipple proposes a space probe that will land on the nucleus of a nearby, passing comet.

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## Chemical Kinetics

**How Chemical Reactions Occur.** An introduction to chemical kinetics and reaction mechanisms. Edward L. King. Benjamin, New York, 1963. xi + 148 pp. Illus. Paper, $1.95; cloth, $3.95.

The improvement of science courses in secondary schools requires a corresponding improvement at the college level to avoid the undesirable prospect of subjecting college freshmen to instruction that is less informative and stimulating than that which they have already completed. In the case of general chemistry, King has helped meet this challenge with his introduction to chemical kinetics and reaction mechanisms for beginning students. His monograph accomplishes the difficult feat of presenting a mature, correct approach without being too advanced for freshmen, and it is a welcome contrast to many dull treatments that have been simplified to the point of being incorrect and abbreviated to the point of saying little.

In the text of *How Chemical Reactions Occur*, the author clearly and repeatedly emphasizes the difference between the macroscopic (empirical and phenomenological) rate laws, which are used to express experimental results in analytical form, and reaction mechanisms, which interpret the rate laws on a microscopic (molecular) basis. There are abundant examples and problems to help the student appreciate the distinction and to impress him with the fact that the elucidation of a correct mechanism is an accomplishment of relatively high scientific importance. In addition to logical development of the usual collision theory for bimolecular gas phase reactions, King emphasizes the role of intermolecular forces in any theoretical treatment. In this way he is able to treat properly the energy of activation as a potential barrier that separates the system of reactants from the system of products. Finally, chemical kinetics is shown to be a currently exciting subject by the discussion of recent sophisticated experimental procedures, such as relaxation methods and flash photolysis, for the quantitative study of reactions with half-lives that may be of the order of microseconds or less.

For a number of years I have taught chemical kinetics to college juniors, seniors, and graduate students. I would be happy indeed if these advanced students retained an understanding and appreciation of the fundamental concepts stressed by King.

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## Note

### Genetics

For 23 years the first and second editions of **An Introduction to Medical Genetics** (Oxford University Press, New York, ed. 3, 1963. 297 pp. Illus. $7), by J. A. Fraser Roberts, have served as outstanding textbooks for both medical students and clinicians. This third edition maintains the very high standard of the earlier volumes. The author has added an excellent chapter in which he clearly presents the new and very important developments in our knowledge of human chromosomal aberrations and their clinical implications. He carefully describes the recently discovered sex-linked blood group system and extends and amplifies, with fresh new examples, the treatment of biochemical genetics. The book is still the best of its kind.

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