ences. The entry "automated histology equipment and techniques" describes only one commercial product, yet others exist, including automatic specimen preparation and microscopy developed in England. The use of cryostats would seem to be worth more than the mere mention it gets in this entry.

The following subjects are not in the index: cinemicroscopy, deep field microscope, EOLM, integrating microscope, leptoscope, light section microscope, phosphorescence microscope, optical staining, Schlieren, television, TICAS, time-lapse, and ultrasonic microscopes, or stroboscopic analysis. Students have asked recently about these and other such subjects.

Gray's book will be of most use to college biologists and biomedical technicians for the material on specimen preparation methods and technics. Entries with reference lists are useful guides to more detailed information. The book is an encyclopedia on a small scale: Selected Topics might be a more descriptive title, because much microscopy and not a few microscopes are omitted. Within its limitations it is a useful work that does fill a need among the many recent specialized books on microscopy.

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Biochemical Tools

Immobilized Enzymes. OSKAR ZABORSKY. CRC Press (Chemical Rubber Co.), Cleveland, Ohio, 1973. xiv, 176 pp., illus. $26.50.

Immobilized enzymes are a subject of extraordinary activity in both academic and industrial circles. This book is primarily an exhaustive (through 1971) review of the literature of this rapidly growing field. It is not, however, simply a compilation of facts and reports. An attempt has been made to introduce some order and to systematize the divergent aspects of the field by definition of terms and categorization of the various topics. Thus the book should be very helpful to established workers in the field as well as to newcomers and the simply curious.

There have been numerous recent reviews on this topic, but few if any are as comprehensive as this and probably none emphasizes methodology more strongly. Partly because of a concern for leaving no major stones unturned, most aspects of the subject are not presented in great detail. This book rather summarizes, quite lucidly, the state of the art. The reader is referred to the original literature for details.

The book presents rather complete tables listing the enzymes that have been immobilized, and these are organized according to code numbers established by the International Union of Biochemistry Commission on Enzyme Nomenclature. A chapter summarizing the various chemical methodologies available for the covalent immobilization of enzymes to various supports is particularly useful. The use of multifunctional (bifunctional) reagents for the intermolecular cross-linking of enzymes, adsorptive methods of enzyme immobilization with reference to the examination of continuous catalytic processes, entrapment of enzymes within the interstitial spaces of cross-linked polymers, and immobilization of enzymes within microcapsules or semipermeable membranes are discussed separately in a systematic and succinct manner. The principal emphasis is on the general principles involved.

Immobilized enzymes are of importance in research on fundamental problems in biochemistry, and the potential value of these materials to the chemical, pharmaceutical, and medical industries is just now beginning to be realized. Enzyme reactors and a variety of immobilized enzymes can, for example, be used for the large-scale chemical processing or synthesis of substrates and foodstuffs (for example, sugars), for analytical purposes, in the therapy of metabolic disorders (for example, through enzyme replacement and removal of poisons), as continuous sources of fuel, and in selective separation procedures. Some of these are discussed by Zaborsky briefly and clearly, and the exciting future which these uses promise comes through well. A subject which is closely related to immobilized enzymes (or enzyme engineering), affinity chromatography (or separations based on biospecific adsorption), is barely mentioned, for the author has tried to limit the subject matter quite strictly to *enzyme* immobilization, especially as it relates to the continuous catalytic process.

Considerable progress must yet occur in the understanding and technology of enzyme immobilization and polymers with biological specificity before the potential theoretical and practical value of these special tools can be realized. The treatise by Zaborsky should help to focus attention, delineate problems, suggest new directions, and summarize the foundations upon which new advances will have to build.

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Metabolic Diseases

Lysosomes and Storage Diseases. H. G. HERS and F. VAN HOOF, Eds. Academic Press, New York, 1973. xxii, 666 pp., illus. $45.

According to accepted dogmas, lysosomal storage disorders are defined by the presence of abnormal deposits within a membrane-bound vacuole and severe deficiency of a specific lysosomal enzyme which is involved in the cleavage of a specific chemical bond in the stored material. This publication attempts to summarize current knowledge of these diseases and their relationship to lysosomes.

Much of the material on the individual diseases has been covered in various books and review articles by these authors or by others. In general, each chapter of the present book includes the clinical description of a disease, its characteristic pathology, the nature of the specific biochemical abnormality, and finally the genetics of and attempts at therapy for the disorder or both.

Four general groups of diseases are covered: (i) The sphingolipidoses, including G_{M1} and G_{M2} gangliosidoses, Fabry's disease, Gaucher's disease, Krabbe's disease, metachromatic leukodystrophy, and Niemann-Picks disease. A lipidosis, Wolman's disease, that is not a sphingolipidosis is also included. (ii) Polysaccharide disorders, namely, the glycogen storage diseases, the mucopolysaccharidoses, and the mucolipidoses. (iii) Mannosidosis, which does not conveniently fall into either of these classes and has been used as an example of a glycoprotein storage disease. Fucosidosis, also covered, at this time must remain unclassified since both glycopeptides and glycolipids containing fucose are present in excessive quantities in the tissues of these patients. (iv) A final category of pathological conditions

that do not meet the usual criteria, such as acid phosphatase deficiency, where there is no evidence for storage of any material, and cystinosis, where lysosomal storage occurs but an enzyme deficiency has not yet been demonstrated. An interesting chapter on neuronal ceroid lipofuscinosis is included even though the authors state that "current available data does not permit extension of the concept of lysosomal diseases to the neuronal ceroid lipofuscinosis." Aspartylglycosaminuria, lactosyl ceramidosis, Farber's disease, β-xylosidase deficiency, chronic granulomatous disease of childhood, myeloperoxidase deficiency, Chediak-Higashi syndrome, and the relationship of lysosomes and gout, silicosis, and drugs are all included in a single chapter. Heterozygote and prenatal detection using a variety of biological materials for enzyme determinations, as well as the use of suction biopsy of intestinal mucosa for cytopathological investigation, are discussed in separate sections.

Several chapters are included which document the functional role of lysosomes in the digestion of intra- and extracellular macromolecules. These are based both upon cytochemical observations in situ and investigations employing isolated intact organelles. A brief catalog of the enzymes detected and their observed hydrolytic role is provided.

The book is heterogeneous, containing 26 chapters, varying from 9 to 35 pages, by 35 authors. Certain of these chapters provide only superficial treatment of their subject matter. The editors have included essays describing the biochemistry of the sphingolipids as well as the mucopolysaccharides in order to provide the basic information required for a thorough understanding of the biochemical aspects of the diseases. These are offered presumably for the clinician or nonspecialist. A similar treatment of basic clinical pathology might have been useful for the biochemist who is not a physician.

As an attempt to relate the functional and physiological role of lysosomes to these diseases the book is not completely successful, since approximately 80 percent of it is devoted to the diseases and only 20 percent to lysosomes and their function.

The book is too expensive to be used as a primary source for any formal course. It could be useful as a general survey of the field for investigators who are not actively working in it, however. There are books available which treat these diseases in greater detail but are not restricted to lysosomal disorders. Also available are books about lysosomes that do not extensively discuss the lysosomal storage diseases. This book could bridge the gap.

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Radicals in Organic Reactions

Free Radicals. JAY K. KOCHI, Ed. Wiley-Interscience, New York, 1973. Two volumes. Vol. 1, xxii, 714 pp., illus. $37.50. Vol. 2, xxii, 906 pp., illus. $42.50. Reactive Intermediates in Organic Chemistry.

The brilliant contributions of M. Kharasch and F. R. Mayo in America and D. H. Hey and W. A. Waters in England in the 1930's proved, contrary to the then-current thought, that radicals are involved in many types of organic reactions in solution. (The pioneering work of L. Michaelis did the same in the biological field at about the same time.) Waters's monograph, the first to discuss the chemistry of organic radicals in mechanistic terms, was published in 1946; in 1957, Walling published his widely quoted monograph. Both these books offered far-reaching insights and a conceptual framework for understanding what was a novel, burgeoning field.

The 1960's saw the publication of the first textbook on radicals and an impressive series of monographs covering virtually every topic in the field. My own shelves contain over 50 books on specialized themes in radical chemistry, electron spin resonance, photochemistry and photobiology, and radiation chemistry and biology. Clearly, radical chemistry now is a mature field, and novel mechanistic insights cannot be expected in the same degree as when Waters and Walling wrote. Nevertheless, there have been many important theoretical as well as practical developments in the past decade, and a detailed rationalization and review of the wealth of new data was sorely needed. Now, however, this task is beyond the talents or time of a single author: the field is just too vast. Clearly, a series of chapters by specialists writing under tight editorial direction was called for; Kochi's volumes elegantly supply this need.

These two volumes provide an up-to-date review of virtually all of organic free radical chemistry. A series of 26 chapters, most by recognized experts, are divided into four main classes: dynamics of elementary processes; radical chain reactions; structure and energetics; and reactions with heteroatoms. Gas-phase reactions are covered only in a short, introductory chapter, as is appropriate for a work centered on the chemistry of organic radicals. More surprisingly, there is no chapter on polymerization, although some discussion of polymer data is included in other chapters. This work is, of course, aimed at organic chemists, and virtually no free radical biology or examples of the role of radicals in biological systems are included.

Most of the chapters are excellent. Some are more perceptive, better written, or of more general interest than others. Some, as would be expected, duplicate material already available in recent monographs; some provide reviews and insights into recently developing areas that are not available elsewhere.

In sum, the book is a most satisfactory effort which will be widely used: well organized and, with very few exceptions, expertly and lucidly written. Every organic radical chemist should own a personal copy of these two volumes, expensive though they are. These books will be one of the first places to look for a survey of data and theory on organic radicals and their reactions for the decade to come.

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The Arctic Region

Arctic Geology. Proceedings of a symposium, San Francisco, Feb. 1971. MAX G. PITCHER, Ed. American Association of Petroleum Geologists, Tulsa, Okla., 1973. xviii, 746 pp., illus. $30; to members, $24. AAPG Memoir 19.

Arctic Geology is by far the most up-to-date, comprehensive, and authoritative volume on the geology of the Arctic Ocean basin and its margins. The book, consisting of 70 papers selected from the symposium program, goes a long way toward achieving its goal: "integration of regional geology of the Arctic provinces." This is done