ten papers, mostly reviews of original work in the authors' laboratories.

Experiments bearing on the exciting question of the etiology of muscle disease are reported in several papers. Hereditary muscular dystrophy is an affliction that strikes young children and cripples them to the extent that most die by age 20. Despite the efforts of hundreds of researchers and physicians, the root cause of the disease remains a mystery. It was long dogma that skeletal muscle lacked the ability to regenerate, until Studitsky and his school in the Soviet Union made the remarkable observation that implanting minced muscle fragments into the original muscle bed results, a few months after the operation, in a new, full muscle. In this book Carlson summarizes his own research and gives a full bibliography for this phenomenon, studies of which are not well known in the United States. Shafiq *et al.* compare the morphological aspects of human (Duchenne) and chicken muscular dystrophy. They find a muscle hypertrophy in the early stages of the disease which may also be related to the regenerative activity of the muscle. Current theories on the pathogenesis of hereditary muscular dystrophy assume either a myogenic or a neurogenic origin. Engel and Warmolts, impressed by small groups of regenerating myofibers typical of early Duchenne dystrophy, put forth the novel suggestion that the disease may be related to a defect in microcirculation. Shafiq *et al.*, using a battery of histochemical and electron microscopic techniques for comparison of various fiber types, find no difference between normal and dystrophic muscle; this speaks against the neurogenic origin of the disease.

A half-century of research on the relationship between heat production in muscle and the breakdown of adenosine triphosphate and phosphocreatine is expertly reviewed by Mommaerts, whose laboratory contributed much to this field. Stainsby and Barclay summarize the rather small quantity of literature on oxygen uptake measurements in muscle energetics. Brady, a pioneer in the analysis of force-velocity relations in heart muscle, discusses reasons why these are considerably more complex than the hyperbolic equation of A. V. Hill, which is the cornerstone in the physiology of skeletal muscle.

The dynamic area of muscle biochemistry is a neglected part of the book. Taylor and Lymn present high-quality studies on the pre-steady state of the myosin adenosine triphosphatase, and relate their results to the mechanism of muscle contraction.

Smith and Ovalle review intrafusal muscle fibers, to date a largely neglected subject. In contrast, Marshall's work on adrenergic neurotransmitters in the uterus adds to the already extensive knowledge on this tissue. Finally, Goldberg describes attempts to study growth and atrophy of skeletal muscle in terms of amino acid metabolism and protein turnover.

The individual articles often serve as good starting points for learning about a specialized area of muscle biology. This book is a useful reference.

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Blood Formation

Haemopoietic Cells. D. METCALF and M. A. S. MOORE. North-Holland, Amsterdam, and Elsevier, New York, 1971. xiv, 550 pp., illus. $41.50. Frontiers of Biology, vol. 24.

The authors present in a comprehensive manner modern concepts relating to hemopoietic cells and their development. One of their major intents is to delineate advances in the investigation of hemopoiesis that have prompted radical revision of formerly established views regarding the origin of blood cells. In addition, emphasis is placed on the mechanisms, both humoral and nonhumoral, concerned with the control of hemopoietic cell differentiation, proliferation, and maturation.

Previously held ideas that fixed populations of cells arise and develop in the blood-forming organs appear no longer tenable. Description is given of the relatively new evidence that continuous replacement of hemopoietic cells (with the possible exception of the bone marrow) occurs by migration of stem cells between different compartments of adult and embryonic hemopoietic organs. Since difficulty is still being encountered in identifying morphologically the spectrum of stem cells, it is natural that assiduous attention has been given in this volume to the description of techniques for exploring the functional potentialities of these primitive cells. These procedures include the in vivo spleen colony technique for detection of multipotential stem cells, the polycythemic mouse assay for the assessment of erythropoietin-responsive cells, the in vitro granulocyte-macrophage colony assay for determining the progenitor cells of these cell lines, and the focus test for antigen-sensitive cells derived from lymphoid precursors. The multipotential stem cell is preferably considered as an element endowed with properties for extensive replication and differentiation into various blood cell lines. The progenitor cell, also ancestral in nature, is defined as one limited to development along a specific line, an event triggered by specific humoral factors.

Emphasis in the text is placed on the role of the hemopoietic organ microenvironment in providing an internal milieu for the formation of progenitor cells from those with multipotentiality. The hemopoietic microenvironment may operate in this regard through endoderm-ectoderm inductive interactions in the yolk sac and fetal liver and between endoderm and ectoderm followed by epithelial-mesenchymal induction in the bursal and thymic environment. More complicated developmental interactions are envisioned to occur in the spleen and bone marrow, in which vascular and mesenchymal components comprise the determining microenvironment. Experiments are cited that lend support to the importance of cell-cell interactions probably involving contact with specific receptor sites at cell membranes, in establishing the hemopoietic environment necessary for differentiation of the multipotential stem cells. The suggestion is made that the microenvironment may induce the appearance of specific receptor sites at the surfaces of stem cells rendering them now responsive to only one type of humoral regulator. With regard to the latter control, the authors review the convincing evidence that humoral factors play a primary role in stimulating progenitor cell differentiation and possibly proliferation. Adequate description is given of the extraction, properties, and mechanisms of action of erythropoietin and the colony-stimulating factor. It is of interest that both of these factors are glycoprotein in nature with molecular weights in the vicinity of 45,000. This suggests the possibility that such humoral agents possess a common biologically active core with specificity of action derived from specific prosthetic groups attached to this core. Passing attention is also paid to the role of other humoral principles including the leukocytosis-inducing fac-

tor, thrombopoietin, and thymic and macrophagic factors, as well as humoral inhibitors (such as chalones).

In systems that exhibit high proliferative activity and complex differentiative pathways, derailment of such processes might be expected to occur on occasion, leading, in some cases, to neoplastic alterations. The authors probe this problem and indicate that hematologic dyscrasias of genetic origin in animals and man as well as certain of the leukemias and anemias may have as the underlying cause changes in the nature of the hemopoietic inductive microenvironment or in the hemopoietic cells themselves. Approaches to the treatment of such disease states thus could be made through attempts to correct the abnormal microenvironment and through improvement of techniques of hemopoietic cell or organ grafting. Although some of the concepts advanced by the authors are somewhat bold, speculative ideas projected by experienced workers in such a rapidly advancing field have value in that as a result of being offered clues as to the underlying mechanisms workers in different disciplines may be attracted to this important area of research.

Although the book is highly detailed, it is written in a lucid manner with interspersed succinct summaries. The illustrations are clear and the references are adequate. It is recommended not only for investigators of hemopoiesis but also for workers who wish to obtain a panoramic view of the provocative problems concerned with hemopoietic cell origin and development and their important applications to blood cell disease.

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Social History of Medicine

American Physicians in the Nineteenth Century. From Sects to Science. WILLIAM G. ROTHSTEIN. Johns Hopkins University Press, Baltimore, 1972. xvi, 362 pp. $15.

In his introductory chapter Rothstein accuses most medical historians of writing history in terms of personalities, of concentrating on medical science and institutions while failing to consider individual physicians, and of crediting advances in medical science to the regular or orthodox physicians. To remedy this situation, he proposes to make a historical analysis of the major medical institutions in the 19th century from a sociological standpoint. He then draws up a "model of analysis," complete with italicized definitions and hypotheses.

Traditional medical history has indeed been guilty of these charges, and the accusations still hold true for much of the history written by retired and semiretired physicians. Rothstein overlooks, however, the existence of a new breed of physicians with sound historical training and the advent into the medical field during the past 30 years of a number of social historians, all of whom have been and are concerned with the social implications of medicine. Erwin H. Ackerknecht, whom Rothstein cites, typifies the modern group of physician-historians now calling for a behaviorist approach to their field. Rothstein himself quotes a great many of these historians—Shryock, Rosen, Rosenberg, Bonner, *et al.*—and many of the points he makes in his succeeding chapters have been made both implicitly and explicitly by these individuals.

Once Rothstein turns from telling us what he is going to do and starts doing it, he demonstrates again that an intelligent, industrious, well-balanced individual able to express himself clearly and concisely can write first-rate history. Despite the reviewer's qualms about the first chapter, when Rothstein starts describing medical practice, licensing, education, and societies, his book comes alive. One of its major points is that the difference between the regular and irregular physicians was more a matter of medical practices than of theoretical disagreements. Rothstein argues that since many of the forms of therapy used by orthodox physicians were medically invalid, they sought mutual support by standardizing their treatment through the creation of medical institutions. The formation of medical societies and the attempts to secure licensure laws were in part a response to the profession's own inadequacies. He notes that the so-called code of medical ethics was at least as much a code of professional etiquette—a fact of minor importance, he maintains, since the code was completely unenforceable during the 19th century.

In discussing the rise of medical schools, Rothstein demonstrates clearly what other historians have merely implied, that the medical schools and medical societies had differing economic interests. By undermining the apprenticeship system, the schools deprived physicians of income and a cheap form of labor. At the same time, as schools kept increasing their enrollments, they raised the level of competition among the growing number of physicians. According to Rothstein, this conflict was a significant factor in the formation of the American Medical Association. Although it was founded ostensibly to raise standards of medical education, the AMA's primary interest was to reduce the number of medical graduates. To this purpose throughout the 19th century it established such high and impractical standards that their acceptance would have eliminated most medical schools. Not surprisingly, the AMA achieved virtually nothing in the way of educational reform.

Rothstein states that Thomsonianism, homeopathy, and the other irregular sects arose in response to the drastic bloodletting and drugging ("heroic" practice) that characterized orthodox medicine. This has long been recognized, but he brings some new insights to the matter. He has made a thorough study of the sources and presents an excellent picture of the various forms of medical practice. His brief accounts of the successive irregular sects are fine summaries of both their theoretical base and their actual practices.

The irregular sects, the author points out, were influenced by the same factors that affected orthodox medicine—lack of medically valid therapeutics, internal conflicts, and competition—all of which pushed them toward institutionalization. In the case of homeopathy, the most sophisticated of the irregular practices, scientific advances and specialization gradually forced it into affiliation with orthodox medicine. The less sophisticated sects simply disappeared. The orthodox practitioners found it in their interest to accept the better-educated irregulars, and they facilitated the integration of sectarians into orthodoxy. To secure licensure laws, the regulars discovered they needed the help of the irregulars; specialists eager to secure referrals were reluctant to antagonize general practitioners of any sect; and finally, bacteriology and other developments provided a rational basis upon which to judge medical treatment, thereby transforming medical practice from an act of faith into a rational procedure. Once this last was accomplished, there was no justification for sectarianism in medicine.