cerned with agents influencing myocardial contraction: catecholamines (7 papers), cardiac glycosides (7 papers), and hormones (7 papers). Surgical and immunological sympathectomy are described as useful techniques for clarifying the role innervation plays in the physiological and pharmacological action of these substances. The diversity of interpretations regarding the inotropic mechanism of action of cardiac glycosides and their interaction with catecholamines clearly points to the need for experimental reevaluation. The quantitative importance of the effects of hormones on cardiac contractility remains to be elucidated; different results have been obtained with different techniques, preparations, and species.

The organization of the material within each section does not allow the reader to follow the articles sequentially. There are several related papers which should have been presented consecutively and cross-referenced for the sake of clarity and continuity. The informative discussions of the Gordon Conference are lacking. However, the editors have organized and conveniently assembled accounts of a broad array of topics related to cardiac contractility. The volume should be useful as a supplementary reference book in institutional libraries. The publishing delay, the cost of the book, and subsequent extensive publications by several contributors detract from its current value for specific needs of personal libraries.

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Coronary Circulation and Energetics of the Myocardium. Proceedings of an international symposium, Milan, Italy, 1966. G. MARCHETTI and B. TACCARDI, Eds. Karger, Basel, 1967 (distributed in the U.S. by Phiebig, White Plains, N.Y.). xvi + 320 pp., illus. $18.

The theme of this publication is the identification and ultimate quantitation of the parameters concerned with myocardial energetics. It contains recent data as well as a review of previously published information of several American and European investigators interested in myocardial bioenergetics. The book is somewhat unusual in that it includes structural, hemodynamic, metabolic, electrophysiologic, pharmacologic, and clinical data on the normal and ischemic myocardium. Also discussed are relevant clinical advances in the management of patients with myocardial ischemia.

Of timely interest are the data on the transmural distribution of myocardial tissue pressure in relation to blood pressure and regional tissue flow in the inner and outer cardiac shells, the response of the coronary circulation to various physiologic and pathological stresses and drugs, the relationship between myocardial metabolism and energetics, the electrophysiologic changes due to beta blocking agents and the electric field surrounding the heart in experimental myocardial ischemia. A limited attempt has been made to integrate the material in the discussions of the papers by the participants.

Those interested in the parameters which determine myocardial energetics and, ultimately, quantitative models of ventricular contraction, especially in relation to ischemic heart disease, will find this book interesting.

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Rocks Studied in situ

Metamorphic Petrology. Mineralogical and Field Aspects. FRANCIS J. TURNER. McGraw-Hill, New York, 1968. xii + 403 pp., illus. $13.50. International Series in the Earth and Planetary Sciences.

This book is in many ways essentially an amplification and revision of the last chapters of *Igneous and Metamorphic Petrology* by Turner and Verhoogen (1951, 1960) and of Turner's earlier Geological Society of America Memoir on *Mineralogical and Structural Evolution of the Metamorphic Rocks* (1948), but to dismiss it as this and no more would do the author a considerable injustice. The three volumes taken as a series do, however, provide an interesting example of the evolution of one scientist's thinking in the field of study in which he is most at home. The first was a highly organized synthesis of metamorphic petrology as it then stood, the second a simplification and codification thereof, primarily for students, and the last is a comparatively mellow reassessment of the field with many reinterpretations necessitated by recent experimental and theoretical studies.

The emphasis in the present volume is on those aspects of the subject in which the author's personal experience is most extensive, namely the information that can be gleaned from the direct study of rocks as they occur naturally in the field. In this it is far more complete and up-to-date than its predecessors. The treatment of the several metamorphic terranes selected for special discussion, however, is of rather uneven quality, and in a way that correlates fairly closely with the degree of firsthand experience that the author has had in a given region. Students of New England geology, for example, will undoubtedly be surprised to read (page 29) that: "Over much of this area, biotite, garnet, and staurolite crowd so closely on one another that separate zones for each cannot be distinguished." The documentation accompanying this highly inaccurate generalization is meager, creating in addition an incorrect impression that little has been done in this region. The Scottish Highlands and the South Island of New Zealand, on the other hand, are given a thorough treatment (at least to this reviewer's provincial eye) that reflects the author's long experience with each.

There is, in the second and third chapters, a discussion of certain thermodynamic aspects of metamorphic petrology but, as in earlier collaborations by Turner and others (Turner and Verhoogen, 1951, 1960; Fyfe, Turner, and Verhoogen, 1958), the happy union of rocks and thermodynamics is not quite accomplished. It can never be, of course, if the treatment is limited to simple reactions among pure substances. More elaborate approaches are referred to in the author's introduction in a somewhat apologetic way, but are in fact necessary to cope with the real equilibria among complex substances such as the rock-forming minerals. It is unfortunate in this regard that the work of D. S. Korzhinskii and coworkers goes wholly unmentioned, although apparently referred to indirectly in a brief and highly parochial discussion on page 59.

Pertinent experimental investigations and the graphical representation of mineral assemblages are fairly well covered. An error in figure 5-8, page 181, however, may create some confusion unless corrected: Three-phase (really five-phase) field (5) is in fact identical to (4), rather than as indicated, and is simply a part of (4) that projects negatively. The error is repeated in figure 7-26, page 312.

A welcome change in the present

book is a greatly simplified system of nomenclature for the principal metamorphic facies. The complex system of subfacies found in Turner's earlier works is here abandoned with the recognition, following Miyashiro and others, that each sequence of facies, and possibly each facies, is unique. A facies can, in this view, be fully characterized only by the total array of mineral assemblages found in it. Under such circumstances the possibilities for subdivision are virtually endless, and this reviewer agrees with Turner that any useful generalized nomenclature must be a simple one.

The last three chapters of the book will perhaps be the most valuable part to most readers. They contain an updated summary of naturally occurring metamorphic facies as found in various parts of the world, followed in the last chapter by a discussion of the temperatures and pressures required for their development, and of their geologic setting both in time and space. Turner concludes here (and this reviewer agrees) that the ultimate source of the energy needed to produce metamorphism on a regional scale must be in the deep crust or upper mantle. In this view the granitic plutons characteristic of most metamorphic terranes are to be regarded as the ultimate end products of the metamorphic process rather than as its cause.

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Craniology

The Human Face. An Account of the Postnatal Growth and Development of the Craniofacial Skeleton. DONALD H. ENLOW. Illustrations by William L. Brudon. Harper and Row, New York, 1968. xvi + 304 pp., illus. $20.

In this interesting book the author sets out "to describe and illustrate a particular, fundamental mode of approach to the study of cranio-facial growth." This method, based extensively on the interpretation of variations of osseous histology, has been described previously by Enlow in some detail, and the present work is a compilation and an extension rather than a presentation of new concepts. Abundantly and clearly illustrated, the text provides a vivid description of the author's thoughts and deserves to be widely read by all students of craniology. Indeed, the clarity of the exposition tends to conceal certain hazards to those readers who have an empirical, clinical need to know but who may be less than firmly grounded in the totality of current craniofacial theory.

The decisive point of Enlow's argument derives from his definition of growth: "Overall enlargement in the size of any bone involves two basic processes: growth and remodeling. Growth itself represents the sum of actual increases in size," while remodeling is a process of "sequential, progressive adjustment that functions to maintain the shape and proportions of the bone. . . ." The text specifically states that combinations of osseous deposition and resorption are the only processes involved in growth according to this restrictive definition. The author goes on to establish a dichotomy between "displacement" and "growth." This is precisely the issue of criticism. Although Enlow acknowledges that "virtually all changes that a bone undergoes during growth are brought about by the various soft tissues associated with the core," it is evident that these same soft tissues are conceived of as operating only by means of their effect on osseous depositions and resorption. The thesis of this book is that changes in the size and shape of bones are brought about by the functional activity of soft tissues, but that changes in the spatial position ("displacement") of these same bones are only a secondary result of these same osseous processes. Other current theories of cranial growth present a more comprehensive definition of growth which includes not only changes in size and shape brought about by periosteal activity but also changes in spatial position. Further, these same theories emphasize that such "displacements" of bones occur passively, being brought about by the volumetric expansion of the functioning neural, orbital, oral, nasal, and pharyngeal spaces. When Enlow's description of direct, active periosteal transformations is added to the concepts of indirect, passive spatial displacements of these same bones, a unified and essentially correct picture of cranial growth is obtained.

Although the secondary, compensatory nature of sutural area growth is correctly recognized, as is the current devaluation of the concept of cranial "growth centers," there is still an equivocation in Enlow's account of the role of the cranial cartilages in facial growth. Admittedly this is a subject of active investigation and contention, but here again the "particular approach" of the author leads to a less than complete discussion of the available data.

This important book should be widely read. It is regrettable that it is not more comprehensive in its outlook. Recognition of its self-imposed limitations will do much to increase its usefulness as the clearest presentation to date of one half of the story of cranial growth.

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Refractory Materials

High-Temperature Materials and Technology. IVOR E. CAMPBELL and EDWIN M. SHERWOOD, Eds. Wiley, New York, 1967. xii + 1022 pp., illus. $27.50. Electrochemical Society Series.

Advances in important areas of technology such as power generation, aerospace propulsion, and materials production depend critically upon the behavior of materials at high temperatures. This book, a revision of the earlier *High-Temperature Technology* (Wiley, 1956), attempts to cover the properties, phenomena, and techniques characteristic of temperatures so high that many room-temperature solids would be molten, but below the point where only gases or gases and liquids remain (melting point of hafnium carbide, 4160°K; boiling point of tungsten, 6200°K). Beginning with a section on the fundamental thermodynamics and chemistry, the text proceeds to a series of chapters on the important classes of refractory materials, a series on various aspects of technique such as attainment of high temperatures, containment of hot matter, and fabrication, and a final series on measurement of temperature and of mechanical and other properties at high temperature.

The two editors have assembled 27 chapters prepared by two colleagues at Westinghouse, eleven at Battelle, and other contributors at the Air Force Materials Laboratory (three), General Electric (three), five universities, and eight other corporations. The book must be viewed as a committee product, in the knowledge that systems designed by committees are sometimes deficient in virtue. The consequent catechism elicits moderately favorable responses: Is the content complete, accurate, and up-to-date? Reasonably so;