

voted to decompression is normally a small fraction of the time invested in useful work, a desirable reversal of the usual experience in deep excursion diving. Many of the practical and biomedical problems encountered in saturation diving are described here. There is sufficient information available to indicate that the maximum depth of the continental shelf (approximately 360 meters) is within the physiologic capability of men provided with adequate life-support measures. While scientific curiosity and a need to develop an adequate rescue capability will undoubtedly provide a continued strong stimulus to further investigation of saturation diving, practical application of these concepts in commercial diving will await a clear demonstration that benefits derived exceed the considerable costs of these undertakings.

Another imaginative approach to minimizing or eliminating the problems associated with decompression is liquid breathing. No inert gas is absorbed or released by tissues, since the liquid vehicle is essentially incompressible. The current limitations of liquid breathing for man, such as inadequate ventilation, are described clearly, as are a variety of related approaches to respiration during immersion, including the use of artificial gills.

The chapters reviewing the biomedical effects of increased atmospheric pressures offer adequate presentations of current knowledge. The limitations of our understanding are evident as well. For example, the ingenious experimental studies of biologic responses to increased hydrostatic pressures in small animals do not adequately predict the effects upon man or reveal the significant mechanisms of hydrostatic intolerance. An excellent account is given of the respiratory changes associated with increased atmospheric pressures. Included are perceptive discussions of ventilatory adequacy during work and the effects of hyperbaric environments upon gas exchange. The review of oxygen toxicity is a reasonably comprehensive account of the known clinical and experimental manifestations. As is true for other subjects reviewed in this text, the basic intracellular mechanisms remain obscure. The book also contains two interesting chapters devoted to the narcotic effects of respirable gases.

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## Biological Problems at the Clinical Level

**Experience in Hepatic Transplantation.** THOMAS E. STARZL. With the assistance of Charles W. Putnam. Saunders, Philadelphia, 1969. xxii + 554 pp., illus. \$37.50.

This volume reports an experience of 29 liver transplants in human beings. Four of the transplanted livers were placed as accessory organs to the patients' own diseased livers. The longest survival at the time of publication of this report was 431 days after transplantation. Starzl, Putnam, and several other individuals who contribute chapters have given a full early account of their unique experience with this demanding exercise. Consummate skill is required at every stage from the selection of the patient through the major operative procedure to the morass of the postoperative period, where a maze of differential diagnostic possibilities exists. When a patient is surviving by virtue of a liver from a deceased donor, dysfunction of the transplanted organ may be from many causes. Infection, vascular insufficiency, sometimes due to a special situation involving kinking of the right hepatic artery, and poor function because of ischemic effects during the final hours of residence of the organ in its original donor or even because of toxic effects of the immunosuppressive drugs employed to protect it from rejection must be differentiated. Rejection, however, remains the principal danger.

These various problems are fully discussed in the light of evidence drawn both from animal experiments and from the wealth of observations made of the patients in this series. It is made very clear that the liver must be in optimum physiological condition to avoid catastrophic problems with blood coagulation deficits as well as other consequences of hepatic dysfunction. The sequence of pathological changes during the course of rejection in transplanted livers is generally quite similar to that seen in other organ transplants. The appearance of inspissated bile in the small canaliculi is described as a frequent occurrence. It has been stated that the liver may elicit rejection somewhat less than other organs; and this has been true in the case of some experimental transplants among certain pigs. Nevertheless, the clinical experience shows full well that rejection occurs only too readily in man, although it may be somewhat less virulent where the liver is concerned.

This volume is attractively produced, profusely illustrated with figures of high quality, and set out in a clear and well-organized fashion. The course of each patient is exhaustively described in somewhat anecdotal style. The fact that each patient is taken up again in succeeding chapters from the special points of view of the different authors is probably an unavoidable inconvenience. Although this work will obviously be indispensable reading for those concerned with clinical transplantation and certainly will stand as the definitive work on this subject for some time, it may not appear that it is for the general medical reader or for most biological scientists. Nevertheless, the fascination of the biological problems faced at a clinical level and the importance of the lessons it contains for management of the severely ill should earn it a wide readership.

This is an exploration in modern acute medicine at its extreme, drawing upon the new riches being produced by research in immunology and other fields. It is appropriate, as well as fashionable, these days to ask, Is it worth it? The answer is a resounding yes. Beneficial results have already been achieved for some patients, and there is promise of more to come for others. Perhaps more significant is the demonstration of the necessity for extensive interdisciplinary teamwork, which is a fairly new phenomenon in clinical investigation. Starzl and his colleagues deserve congratulations for their energy, persistence, thoroughness, and optimism.

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## One-Dimensional Systems

**Spectral Properties of Disordered Chains and Lattices.** J. HORI. Pergamon, New York, 1968. xii + 232 pp., illus. \$10. International Series of Monographs in Natural Philosophy, vol. 16.

Despite the unphysical nature of one-dimensional crystals, the study of the vibrational and electronic properties of disordered linear chains continues to attract the attention of solid state theorists. That this is so is due to the fact that the topological simplicity of one-dimensional systems, in comparison

with two- and three-dimensional systems, renders them mathematically more tractable, increases the probability of obtaining exact results, and provides a basis for testing methods that might be applicable to crystals of higher dimensionality. I stress this because, despite the reference to lattices in the title, the book under review is devoted primarily to one-dimensional systems. Since the pioneering work of Dyson in determining the frequency spectrum of a disordered linear chain, there has been a great deal of effort expended by many people, using many different techniques, in attempts to make such determinations and to solve the related problem of determining the electronic density of states of disordered systems. It has recently been recognized that a great many of the different approaches that have been used in studying the spectral properties of disordered linear chains are related, and in fact can be regarded as special cases of a theory which has come to be called the phase theory. It is to the exposition of the phase theory that the greater part of the book is devoted.

The author is one of the principal contributors to the present-day spectral theory of disordered one-dimensional crystals, and this fact is reflected in the authoritative treatment of the subject which this book provides. After two introductory chapters, in which the equations and models that form the basis for all subsequent discussions are introduced and the results of computer determinations of the spectral properties of disordered systems are presented, three chapters are devoted to a detailed description of the phase theory and its application to the determination of the spectral properties of disordered one-dimensional systems. Disordered lattices of two and three dimensions are then discussed; an interesting feature of this discussion is that it includes descriptions of applications of the phase method, or variants of it, to the study of the effects of isolated and extended defects that can occur in such crystals. The concluding chapter of the book is devoted to a description of approximate theories of the vibrational frequency spectra and electronic energy spectra of disordered crystals. This includes Green's function methods, the method of the averaged eigenvalue equation, moment expansions, and the effective mass approximation. The exposition throughout is lucid; the discussions of methods other than that of

the phase theory, and of earlier work on various disordered lattice problems, are thorough and fair, with the strengths and deficiencies of these other methods, as well as of the phase method, being assessed fairly. I cannot imagine that anyone seriously interested in the spectral properties of disordered systems will fail to have this book in his library.

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## Cold-Climate Phenomena

**The Periglacial Environment.** Past and Present. Based on the Symposium on Cold Climate Environments and Processes, seventh congress of the International Association for Quaternary Research, Fairbanks, Alaska, Aug. 1965. TROY L. PÉWÉ, Ed. McGill-Queen's University Press, Montreal, 1969. x + 492 pp., illus. \$25.

Substantial portions of the non-glacier-covered polar and subpolar land areas of the earth, characterized by perennially frozen ground (permafrost) and other cold-climate phenomena, are widely referred to as periglacial. The periglacial environment has attracted considerable scientific attention in the decades since the Second World War, generated in part by the search for and development of economic resources in the northern regions. Periglacial research has tended to be strongly interdisciplinary owing to the complex interaction of climate, vegetation, topography, and geology in contributing to present environmental relationships. Because the present characteristics of the periglacial environment are the product of both present and past climate and terrain conditions, research has been concerned not only with active processes but with historical reconstructions of past environments as well.

A broad cross-section of the types of periglacial research currently being done is presented in this volume, which is the outgrowth of a special symposium held during the seventh congress of the International Association (now Union) for Quaternary Research (INQUA). The 17 papers are contributions from 33 scientists representing 11 countries. The papers are arranged in two major groups, the first dealing largely with periglacial processes and their products, the second with cold-climate phenomena in now-temperate regions which,

because of their paleoclimatic implications, provide evidence of changes of environment through time. Although examples are drawn predominantly from the Arctic and from adjacent subarctic regions of the Northern Hemisphere, several papers dealing with the tropics and with Antarctica have also been included.

The contributions represent a "mixed bag" of topics, some far more closely related to the glacial than to the periglacial environment. Papers dealing with botanical dating of end moraines, isostatic recovery of glaciated regions, and Antarctic glaciation lie outside the main theme of the book. The remaining papers deal largely with a variety of periglacial features, including permafrost, patterned ground, soils, colluvial deposits, and loess. One gets the distinct impression that many of the paleoclimatic interpretations based on such features are made on rather tenuous evidence and that rigorous evaluation of the criteria for climate change in periglacial regions is badly needed. The significance of involutions and presumed solifluction features as climatic indicators is still largely conjectural, yet they are widely used for paleoclimatic reconstructions. On the other hand, several recent studies in northern North America have demonstrated a close relationship between modern periglacial phenomena and climate. For example, Troy Péwé has shown that distribution of modern ice wedges in Alaska is closely related to temperature, and that a mean annual air temperature of  $-6^{\circ}$  to  $-8^{\circ}\text{C}$  is necessary for ice-wedges to grow. An analysis by R. J. E. Brown of factors influencing the distribution of discontinuous permafrost in Canada disclosed that continuous permafrost lies north of the  $20^{\circ}\text{F}$  ( $-6.7^{\circ}\text{C}$ ) mean annual air isotherm, that between the isotherms of  $20^{\circ}$  and  $30^{\circ}\text{F}$  ( $-1.1^{\circ}\text{C}$ ) permafrost is discontinuous, and that south of the  $30^{\circ}\text{F}$  isotherm permafrost occurrences are rare. Furthermore, this pattern, which applies both latitudinally and altitudinally, is subject to local departures where terrain variations occur. Such observations are of great importance to the paleoclimatologist, for they permit quantitative evaluation of certain paleoclimatic parameters on the basis of modern analogues and thereby lead to more accurate reconstructions of conditions during former periods of widespread periglacial climate.

Because this volume discusses a variety of subjects and geographic areas,