Low Temperature Physics

The Helium Liquids. Proceedings of a NATO Advanced Study Institute, St. Andrews, Scotland, July 1974. JONATHAN G. M. ARMITAGE and IAN E. FARQUHAR, Eds. Academic Press, New York, 1975. xii, 512 pp., illus. $41.50.

Liquid ^{4}He becomes superfluid near 2°K. Its spectacular properties have been explored in hundreds of papers. Each time it appears that the subject is nearly exhausted, some new discovery stimulates new interest. In spite of all the activity in the field, there is still no really fundamental theory of ^{4}He standing on the same basis as the Bardeen-Cooper-Schrieffer theory of superconductivity. Five of the lectures in this summer school proceedings treat various aspects of ^{4}He, including a general introduction by G. V. Chester, which discusses both ^{3}He and ^{4}He, and lectures by G. Rickayzen on many-body theory of ^{4}He, by S. Putterman on quantum fluid hydrodynamics, by L. J. Campbell on film flow, and by A. Eggington on various aspects of superfluidity in restricted geometrics.

For many years after the introduction of the Bardeen-Cooper-Schrieffer theory, it was confidently expected that liquid ^{3}He would become a superfluid at a low enough temperature. Finally, superfluid ^{3}He was produced experimentally at Cornell, but at a temperature 1000 times lower than that which produces the transition in ^{4}He. And it is thought that the superfluid state of ^{3}He both is anisotropic and has a hydrodynamics in which spin degrees of freedom will appear. Developments have come so quickly in this field that readers will appreciate this effort to set the history of the subject in order and provide some perspective on the development of theory and experiment. The book includes lectures on ^{3}He by A. Ron, by J. C. Wheatley, and by P. W. Anderson and W. F. Brinkman. Anderson and Brinkman remark that, in spite of the simplicity of the ^{3}He and ^{4}He atoms, the condensed phases of these substances exhibit properties as complex as those of any inorganic system and "perhaps the most challenging intellectually and complex phenomenologically are the recently discovered anisotropic superfluid phases of ^{3}He." The experimental evidence for this statement is carefully summarized in Wheatley's lectures. As in all rapidly moving fields, there have been important developments since the lectures were written, but they stand as examples of fine reporting on a complex new subject.

The final lectures are on dilute solutions of ^{3}He in ^{4}He at low temperatures, by Gordon Baym, and on the Kapitza conductance, by L. J. Challis. These fields are relatively well established, and each of the lectures is a mature account of its subject with extensive references to the literature.

There are many volumes of proceedings of conferences in low temperature physics. I'll shelve this one with my other longtime favorites: the Fermi Summer School of 1961 (*Liquid Helium*, G. Careri, Ed., Academic Press, 1963) and the Sussex Quantum Fluids Conference (*Quantum Fluids*, D. F. Brewer, Ed., North-Holland, 1966). The book is not likely to appeal to beginners, but it should be of great value to anyone working in the field or wishing to learn the status of advanced research. It includes proper references and complete subject and author indexes.

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Plasmodesmata

Intercellular Communication in Plants. Studies on Plasmodesmata. Papers from a meeting, June 1975. B. E. S. GUNNING and A. W. ROBARDS, Eds. Springer-Verlag, New York, 1976. xvi, 390 pp., illus. $29.60.

Multicellular plants generally contain small intercellular channels, 30 to 50 nanometers in width, roughly circular in cross section, and frequently containing a central rod, so that bulk transport must occur through a cylindrical annulus. The entire structure is called a plasmodesma. The channels are thought to be filled with endoplasmic reticulum (desmotubules). Being virtually ubiquitous in multicellular plants, plasmodesmata have long presented obvious questions with regard to function. For example, how structured is a solution moving in a pore of such dimensions, and are the viscosity and wall effects appreciably different from those that occur in large structures? What of surface tension and surface solute concentration? Do plasmodesmata even permit bulk flow?

The intriguing aspect of the book under review is its even-handed approach to these questions. After a brief look at the hydrodynamics of model plasmodesmata, the properties of plasmodesmata in higher plants (frequency, dimensions and the difficulties in determining them, microstructures, and possible functions) are discussed in detail. Plasmodesmata in algae and fungi present a different problem. Not only are there a variety of intercellular connections other than plasmodesmata, but the mechanisms for photosynthate transport have evolved very little as compared with those in higher plants. (In the Pinaceae, where the absence of phloem fibers points to the importance of plasmodesmata for long-range photosynthate transport, intensive study has been initiated only relatively recently.) It is therefore understandable that studies of plasmodesmata in algae and fungi are still primarily descriptive (though there are distinct exceptions, as in the case of *Chara*). Indeed, the primary and secondary formation of plasmodesmata, their frequency, and their structural regulation are still important subjects of research in these phyla.

After the plasmodesmata have been thoroughly described both physically and phylogenetically, the question of transport as a major function is addressed. It has been shown that known rates of longer-distance transport are hydrodynamically possible in pores such as plasmodesmata. Electrical conductivity, fluorescent dye markers, and radioactive tracers are among the means used to assess plasmodesmatal transport. Ion fluxes in *Chara* nodes and root meristems provide vehicles for the study of symplastic movement requiring plasmodesmata. More recently, cytochemical probes of electron microscopic sections provide strong evidence of transport, especially of inorganic ions. It has long been known that viruses with dimensions larger than plasmodesmatal cross sections cannot cross midrib barriers in higher plants and are nevertheless transported to other parts of the plant through the phloem. The question is whether they are loaded onto and unloaded from the phloem through plasmodesmata. If they are, does it follow that the nucleic acid is the only actively transported viral solute?

The book ends on a challenging note; the present state of knowledge is viewed against the background of the past and in the light of unsolved problems. Do plasmodesmata compete with membranal transport processes (active transport, facilitated transport)? Are plasmodesmatal fluxes alone adequate for long-range transport in lower plants, and if so what is the driving force? Can movement in plasmodesmata be bidirectional? What of the plasmodesmatal annuli: how are they made and what is their function?

The text shows its origin in a conference. The chapters are reviews, though often with original data, followed by questions. The reviews, however, are of remarkably high quality, and the questions are pertinent and carefully answered. References are numerous and recent. The text is reproduced photograph-

ically from typescript. The diagrams and half-tones are of good quality.

Despite the admissions of ignorance it contains, this is the nearest we have to a definitive work on the subject. Indeed, there is no other to compare with it in detail. It is a necessity for all students of plant transport, whether they are concerned with metabolic or with informational molecules.

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Soviet Endocrinology

Thyroid Hormones. Biosynthesis, Physiological Effects, and Mechanisms of Action. YA. KH. TURAKULOV, A. I. GAGEL'GANS, N. S. SALAKHOVA, A. K. MIRAKHMEDOV, L. M. GOL'BER, V. I. KANDROR, and G. A. GAIDINA. Ya. Kh. Turakulov, Ed. Translated from the Russian edition (Tashkent, 1972) by Basil Haigh. Donald H. Ford, Transl. Ed. Consultants Bureau (Plenum), New York, 1975. xii, 318 pp., illus. $42.50. Studies in Soviet Science.

Physiology in the Soviet Union has developed in partial isolation, despite the language skills of the Russians and even though translations of Western scientific publications are available to them. The fact that Russian papers are rarely cited in English-language publications in physiology implies an even more formidable barrier in the opposite direction. The appearance of this excellent translation provides a rare opportunity to appreciate the orientation and status of research on thyroid hormones in the Soviet Union.

The book is the work of seven authors from two institutes, one in Tashkent (Institute of Biochemistry) and one in Moscow (Institute of Experimental Endocrinology and Hormone Chemistry). Unfortunately, the vista it provides is not completely clear, since the book was originally published in 1972 and thus represents the field as it was in 1971.

The three sections of the volume deal with thyroidal hormonogenesis and its regulation, certain systemic and metabolic actions of thyroid hormones, and actions of thyroid hormones at the cellular level. They are detailed and well-organized. Because 1521 bibliographic items are referred to and discussed in the text, the book reads more like a review than a textbook. About 20 percent of the authors cited are Russian, and to this reviewer it seems remarkable that work of such breadth is so rarely mentioned in the English-language thyroid literature. Most impressive is the very large volume of Soviet research on responses of mitochondrial biochemical systems to changes in thyroid state.

If Soviet research in neuroendocrinology has a Pavlovian slant, this orientation is most obvious in the first chapter of the book, in which "the generally accepted view of the existence of control over thyroid function by the cerebral hemispheres, based on numerous indisputable clinical observations" is briefly discussed. This attention to "parahypophyseal regulation of thyroid function" is accompanied by a much more complete discussion than can be found in reviews in English of direct autonomic influences on thyroid function. This short and relatively vague section, which cites research principally from B. V. Aleshin's laboratory, ends with the statement: "A final solution to this problem [of] confirmation of the role of the sympathetic parahypophyseal regulation of thyroid function ought desirably to be obtained from other laboratories."

Another Pavlovian statement is found as an opening remark in the second chapter (on physiological effects of thyroid hormones), and it is one that would be most unlikely to be found in an English-language review:

> Two opposite views are held on the action of thyroid hormones in the intact organism. Some workers assert that the mechanism of the effect of thyroid hormones is nervous and that the hormone affects the state of neurons of the central nervous system either through a reflex or directly, and that it exhibits its peripheral action through the activity of the CNS cells. Another group of workers insists that these hormones reach the body tissues by the humoral route and exert their effect directly at the cell level.

There is no such controversy among Western physiologists, and to be fair one must add that Turakulov himself expresses doubt concerning its importance in a later paragraph.

Aside from the occasional expression of such attitudes, *Thyroid Hormones* differs in no important way from reviews by authors outside the Soviet Union. Unfortunately, thyrotropin releasing factor is treated cursorily. The discussion of the nature of the thyroid stimulating hormone molecule fails to mention its subunit structure. The wealth of new information concerning plasma T_3 and T_4 levels under various circumstances, made possible by recently developed techniques, is absent. The new approaches provided by radioimmunoassay of thyroid stimulating hormone and thyrotropin releasing hormone are missing as well. Were it not for its age, *Thyroid Hormones* would be a useful reference and summary. However, even the third edition of Werner and Ingbar's *The Thyroid* (1971) is in many ways more modern, and a new edition of this excellent book is about to appear.

We must nevertheless be glad to have this evidence of the excellence of Soviet thyroid research. In particular, work that has provided insights into the relationship between the thyroid and the central nervous system, a subject emphasized by Russian endocrinologists, deserves close reading and should be cited in the Western physiological literature. This translation makes it impossible to use the unavailability of such data in English as a pretext for ignoring them.

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Behavioral Physiology

Hormones, Behavior, and Psychopathology. Papers from a meeting, March 1975. EDWARD J. SACHAR, Ed. Raven, New York, 1976. xviii, 308 pp., illus. $24. American Psychopathological Association Series.

Only slightly more than a decade ago, when biologic psychiatry had just begun to emerge from the "hunt and peck" system of chemical analysis, the contents of this book would have been seen as unbelievably advanced. The book stands as a landmark, revealing advances in techniques for hormonal assays, advances in research strategy, and recognition of the complexity of the relationships among the various hormones, behavior, stress, environmental conditions, and cognitive states.

Often in a volume with many contributors papers tend primarily to reflect the individual participants' own research or pet theories. That is not the case with this volume. Although there are papers that are focused on narrow technical issues, they serve to exemplify the state of the art and to illustrate problems. The broad review papers are the strength of the volume. The reader will not find a wealth of detail about research methods, but they are taken into account in the bibliographies that follow each chapter.

In the first section of the book, Hormonal Influences on Brain and Behavior, there are a number of papers that will be of interest to the clinician. The review by A. J. Prange *et al.* of hormonal alteration of imipramine response, Bardwick's paper on psychological correlates of the menstrual cycle and oral contraceptive medication, and Whybrow and Hurwitz's account of psychological distur-