

while in the temperature range 315 to 365° the least squares probable error in \mathcal{D}_{Na} varies between 1.2 and 1.8% (40 experimental points) and that in $\mathcal{D}_{\text{NO}_2}$ lies between 0.7 and 1.1% (18 experimental points).

The following facts appear significant. The heat of activation for self-diffusion is independent of temperature in the range studied and is the same for both anion and cation within experimental error. The ratio of the absolute rates of self-diffusion of the two ions is approximately, but not exactly, proportional to the inverse square roots of their masses, reminiscent of Graham's law of effusion. We have found that the Nernst-Einstein

equation is not applicable to reliable computation of the electrical conductance of fused sodium nitrate from the self-diffusion coefficients.

Detailed information and theoretical considerations about self-diffusion in fused sodium nitrate and other molten salts will be published later.

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BOOK REVIEWS

An Introduction to Quantum Statistics. BY WILLIAM BAND, Professor of Physics, The State College of Washington, Pullman, Washington. D. Van Nostrand Company, Inc., 250 Fourth Avenue, New York, N. Y. xiii + 342 pp. Price, \$6.00

This book is written for physicists and specifically for post graduate students in physics and physical chemistry. In order to use it the reader should have the usual mathematical requirements for a physics degree and should be well acquainted with quantum mechanics. However most post graduate students in physical chemistry have also studied these disciplines and it is well worth their while to possess this volume. Especially is this true because many examples throughout this book are taken from the fields of physical chemistry, chemical thermodynamics and statistics. The arrangement of the material contained in this volume is carried out in a most satisfactory manner. The simpler cases precede the more complex topics and the latter are built closely on the earlier material presented.

Another and most valuable feature of the book is the set of problems outlined at the end of each chapter. The student who works these exercises will indeed gain most definite knowledge of the subject matter. Also located at the end of each chapter is a list of references for further study for the use of those students who wish to pursue this science in even greater detail than is portrayed in this book. The fifteen chapters carry the following titles: I, Review of Quantum Mechanics; II, The Formalism of Statistical Mechanics; III, Statistical Interpretation of Thermodynamics; IV, The Partition Function in Classical Statistics; V, Equilibrium between Phases; VI, Chemical and Dissociative Equilibrium; VII, Assemblies of Dependent Systems; VIII, Independent Systems with Quantum Degeneracy; IX, Phase Equilibria Among Quantum Degenerate Systems; X, Dissociative Equilibrium Among Quantum Degenerate Systems; XI, Quantum Degenerate Assemblies of Dependent Systems; XII, The Grand Partition Function and Its Applications; XIII, General Theory of the Liquid Phase; XIV, Some Solid State Problems; XV, Fluctuations and Nonequilibrium Phenomena.

Anyone interested in these highly theoretical and therefore most important aspects of physics and chemistry must know and possess this book. The individual who already has acquaintance with this field will be delighted by the very careful presentation of a complex subject.

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Advances in Cancer Research. Volume III. Edited by JESSE P. GREENSTEIN, National Cancer Institute, National Institutes of Health, U. S. Public Health Service, Bethesda, Maryland, and ALEXANDER HADDOW, Chester Beatty Research Institute, Royal Cancer Hospital, London, England. Academic Press, Inc., Publishers, 125 East 23rd Street, New York 10, N. Y. 1955. viii + 369 pp. 16 × 23.5 cm. Price, \$8.50.

The third volume contains a particularly lucid review by Doll of the epidemiology of lung cancer. In it appears an excellent analysis of the etiological factors including tobacco, industrial hazards and atmospheric pollution. In his concluding remarks on the carefully presented arguments concerning the role of smoking he says:

"In the author's opinion, taking into consideration the philosophical principle of Occam's razor which has already been referred to, the facts are such that the hypothesis that cigarette smoking is a cause of the main histological types of lung cancer should be accepted. They also, in his opinion, justify a strong presumption that the smoking of pipes and cigars is, in this respect, relatively innocuous. The discovery that a known and powerful carcinogen is present in tobacco smoke in significant quantity strengthens the credibility of the conclusion, but it has yet to be shown experimentally that the substance concerned has a direct action on the bronchial mucosa."

"The great majority of the observed facts accord with the hypothesis, but the picture is not yet complete. We need to know, in particular, why the mortality from the disease in the United States is so low relative to the past consumption of cigarettes; and why the association which appears to exist between cancer of the larynx and cigarette smoking has not been reflected in an increase in the incidence of cancer of the larynx comparable to that believed to have occurred with cancer of the lung. The data on the significance of inhaling are also conflicting, and it is uncertain whether the difference between the effects of smoking tobacco in the form of cigarettes and in a pipe can be attributed to differences in the extent to which the smoke is usually inhaled or whether it is necessary to postulate some other mechanism. These fields of uncertainty are, however, small in relation to the extent of established knowledge and do not justify throwing doubt on the main conclusion."

In a very comprehensive review by Morris of the experimental development and metabolism of thyroid gland tumors,

he points out two items of particular interest to those who treat patients with radioactive iodine. The first is that single doses of ionizing radiations from I^{131} have produced malignant thyroid neoplasms in rats but have failed to do this in mice, resulting instead in tumorous enlargements of the anterior lobe of the hypophysis. We may wonder whether man will turn out to be affected by I^{131} like the rat or the mouse. The second point is that as far as the capacity to collect and bind iodine in thyroid cancers is concerned, man and the experimental animal are similar. Since most cancers of the thyroid gland in man and the experimental animal "have lost much of their ability to collect iodine compared to that of the normal thyroid gland, it seems reasonable to conclude that quite similar explanations may exist for these functional changes of thyroid gland carcinogenesis in both animals and man."

The latest theories regarding the electronic structure and carcinogenic activity of aromatic molecules is nicely presented by Pullman and Pullman. In their latest thinking they are able to include the metabolic reactivity of carcinogenic hydrocarbons in their general theory by postulating a special reactivity of the K region with cell constituents. Since the L region is rather inactive, and the K region is tied up thus in cell attachment, metabolic attack occurs at still a different locus on the molecule, the M region.

"This conception establishes a bridge between the chemical and the metabolic reactivity of carcinogenic hydrocarbons, and enables us to include them both in a homogenous theory."

Some aspects of carcinogenesis by Rondoni include an interesting comparison of the neoplastic transformation of the cell with a process of protein denaturation. Since denaturation brings about a change in the shape of the protein molecule, and there is generally an increase in asymmetry, there is also an increase of reactivity of certain groups, such as the sulfhydryl groups of cysteine, and the phenolic groups of tyrosine, owing to the unmasking of these groups by the uncoiling of the chains. The denatured proteins can not be crystallized because of the disorganization of the internal structure. Here, therefore, are some of the changes, which may equally occur in the proteins of the cell subjected to malignant transformation. An increase of entropy takes place in the process of denaturation just as it most probably does in carcinogenesis.

A masterly review of all that is known about pulmonary tumors in experimental animals is given by Shimkin. Reading this review emphasized for me the great difference between human lung cancer and the pulmonary tumors in experimental animals.

The oxidative metabolism of neoplastic tissues is discussed in a superb review by Weinhouse. Beginning with the concepts of Warburg based on the observations that aerobically, glycolysis was on the average seven times as high in tumor slices as in non-growing tissues, and the mistaken concept that a disturbance of respiration was the cause of aerobic glycolysis, he traces the development of present theory. For example, because of the high aerobic glycolysis the decrease in glycolysis due to oxygen is lower percentage-wise in tumors than in most normal tissues. For this reason a low Pasteur effect has been mistakenly attributed to cancer cells. The misconception was corrected by the observations that the Myerhof Quotient for tumor tissue was by and large the same as for normal tissues. He concludes that:

"It is evident from the foregoing discussions that there is little in favor of the Warburg hypothesis. The high glycolysis of tumor tissue, whatever its cause, does not appear to be due to a radically altered respiratory metabolism—whether of electrons or carbon. It is possible, of course, that certain tumors, low in certain enzymes or cofactors of respiration, may have a 'bottleneck' in electron transport which might conceivably tend to raise the level of lactic acid accumulation. We have already seen that many are low in pyridine nucleotides and cytochromes. On the other hand, we have no idea as yet what constitutes an optimal content of enzymes or coenzymes for the proper functioning of an intact cell. There is no good basis for the assumption that a tissue containing a small amount of a coenzyme or exhibiting a low assay value for a particular enzyme has a necessarily impaired metabolism. At any rate, it is difficult to see how any such effects can play an important part in the

high glycolysis of the large bulk of tumors of the most varied origins, which have a moderate to high rate of oxygen consumption and hence have no apparent difficulty in transferring electrons."

"It seems to the author that a proper understanding of the high glycolysis of neoplastic tissue will require a knowledge of the factors which regulate and control cellular metabolism. Unfortunately, we have little knowledge of any sort as yet concerning how metabolic processes are regulated in cells. It is assumed that many aspects of carbohydrate and lipid metabolism are controlled or directed by various hormones—particularly those of the pancreas, pituitary, thyroid and adrenal glands. That these substances may not exert the same effects on metabolism in tumors as they do in the non-neoplastic tissues of the host may be considered an intriguing possibility. Unfortunately, we are faced with the fact that we still have no idea how any single hormone affects a particular enzymatic reaction. Until we learn more concerning the metabolic sites of action of hormones, it is impossible to do more than speculate concerning their possible regulatory role in cells."

The third volume is a worthy successor to its outstanding predecessors.

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Tungsten. Its History, Geology, Ore-Dressing, Metallurgy, Chemistry, Analysis, Applications and Economics. By K. C. LI, M.E., A.R.S.M., Chairman and Chief Engineer, Wah Chang Mining Corporation, and CHUNG YU WANG, M.I.M.M., A.I.M.E., Director of Research, Wah Chang Corporation. American Chemical Society Monograph No. 94. Third Edition. Reinhold Publishing Corporation, 430 Park Avenue, New York 22, N. Y. 1955. xx + 506 pp. 16 x 23.5 cm. Price \$14.00.

The demand for a revision of the second edition of "tungsten" by Li and Wang, published in 1943, is due, at least in part, to a sustained and growing recognition of the importance of the high melting refractory metals in modern technology. The operation of many electrical and electronic devices depends on the properties, such as high melting points and low vapor pressures, of critical metallic components. Tungsten, by virtue of having the highest melting point of the group and the associated properties, occupies a unique position in this field; its processing and its uses are in many respects typical of the refractory group as a whole.

K. C. Li played a major role in the discovery of tungsten ore deposits in China and his interest in its geology and ore processing are reflected in the emphasis on these topics. The chapter on geology comprises almost a quarter of the text and is an authoritative description of all important deposits, their location and geology. The chapter on ore dressing describes the use of gravity, flotation and other processes in the concentration of tungsten values and also describes in detail the methods of ore treatment used in several typical tungsten milling plants. The literature is well covered by citations of patents and technical papers.

The preparation of tungsten metal powder is discussed under three headings; the decomposition of tungsten ore, the purification of tungstic oxide and the production of tungsten powder. The processing of tungsten powder into wire is described. The manufacture of tungsten carbide and of sintered carbide composites is described, as is the production of ferrotungsten. Chapters on the chemistry of the metal and on analytical procedures are comparatively brief but are adequate.

The industrial applications of tungsten are discussed mainly in terms of the composition of a large number of proprietary alloys and materials. The economics of tungsten are discussed in a separate chapter and in appendices.

The authors are to be commended for an extensive bibliography, particularly of the patent literature. The general format of the book is in keeping with the high standards of the ACS monograph series. It is a text that deserves a place in the library of all geologists and metallurgists interested in tungsten and its alloys.

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