Book Reviews

Chemistry of the Solid State. W. E. Garner, Ed. Academic, New York; Butterworths, London, 1955. vii + 417 pp. Illus. + plates. $8.

This book interprets its title broadly, in 15 separately contributed chapters. Most of its authors are or have been at the University of Bristol, and its topics reflect the interests of the vigorous schools of physical chemistry and the physics of solids that W. E. Garner and N. F. Mott long headed there. Seven chapters summarize "the knowledge gained regarding dislocations, lattice defects, energy levels in the solid state, and nucleation phenomena," and eight chapters apply those principles. Surely it will fulfill Garner's prefatory hope of aiding "in the more rapid development of the study of catalysis, solid reactions, oxidation of metals, photographic processes, and other related subjects."

Referring to existing reviews for prior theory and experiment, the contributors write of more recent work (and provide helpful bibliographies), some more successfully than others. F. C. Frank's witty succinctness ornaments his "Chemistry of crystal dislocations." A. J. E. Welch gives in 13 pages a wise discussion of "Solid-solid reactions" from the viewpoint of structural inorganic chemistry. Careless exposition and questionable emphases mar the chapter on semiconductivity and magnetochemistry. "Acceptor levels located slightly above the conduction band" should have been caught in proof, and the description of those levels as "discrete surface energy states associated with the impurities" will confuse. Readers may regret that "magnetochemistry" does not here include the chemical aspects of electronic and nuclear paramagnetic resonance spectroscopy. But these are busy people; we must thank them all for taking time to help us approach the frontiers of their fields.

The printer and binder, busy also, could not (p. 390) always retain the running head, and in one copy left pages 306, 307, 318, and 319 blank. But beautifully printed photographs of silver in silver bromide assist J. W. Mitchell's account of the "Photographic process."

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Advances in Cancer Research. vol. III. Jesse P. Greenstein and Alexander Haddow, Eds. Academic Press, New York, 1955. viii + 369 pp. Illus. $8.50.

This well-indexed volume with contributions from four countries contains such a wealth of variegated information that those who are interested in any aspect of cancer work will have to study the book and its references.

Richard Doll's chapter on the etiology of lung cancer begins with mention of the international symposium at Louvain in 1952; the corresponding chapter in the next volume may well start with the 1954 conference of the International Society of Geographical Pathology at Washington. The reality of the increase in frequency, which was accepted at Louvain, is supported by much new evidence, and further increase may be expected (Mackenzie). The fact that in different countries the preponderance of male deaths over females has increased with the rise of total mortality from lung cancer speaks for the actuality of the increase (Clemmesen, Doll, Kreyberg). The changes in age distribution when studied with Korteweg's "cohort analysis" show that men born in successive decades have a higher death rate in all age groups than the corresponding age groups of the "cohort" born in a previous decade. This has been confirmed in different countries. It is interpreted as indicating increasing exposure to an environmental carcinogen.

Kreyberg and others divide lung cancers into endogenous and exogenous ones, the latter comprising the squamous cell carcinomas and the undifferentiated tumors. Only these show the marked increase and the preponderance in men, probably as the result of a newly introduced carcinogen to which men have been more exposed than women. The much-debated and emotionally weighted question of cigarette smoking is discussed in detail, and its etiologic importance is accepted on statistical grounds for the exogenous cancers. In the absence of smoking, the death rate may be equal for the sexes (Doll and Hill). The experimental work with tobacco, however, is not yet convincing, notably on account of the high temperatures reached in the smoking machines. The higher rate in towns is not explained, and an effect of radioactivity is not proved. The possible role of previous infections is mentioned briefly. In my opinion the findings of "scar cancer" [*Virchow's Arch. pathol. Anat. u. Physiol.* **304**, 230 (1939); **325**, 499 (1954)] deserve attention. The whole chapter is fascinating.

Equally fascinating is Shimkin's review of pulmonary tumors in experimental animals. The history of pulmonary tumors in mice—for which the cautious name *primary adenomatous pulmonary tumor* is proposed—is traced back to 1926 (Lynch) and followed through the establishment of quantitative methods (Shimkin), the clarification of histogenesis (Grady and Stewart), and the induction in the rat (Jaffe) and the guinea pig (Heston and Deringer). The use of animals larger than the mouse may facilitate physiological and biochemical studies. The tumors appear alike in different species but so far only the mouse tumors have been studied extensively. The rarity of lung tumors in other species should be verified by studying more old animals. One species of mice (*Peromyscus leucopus*) did not develop lung tumors when injected with urethane.

The constancy of occurrence in specific strains, which is greater than for breast tumors or liver tumors, indicates a small influence of exogenous factors. The genetic character of this susceptibility is attested to by the fact that its segregation during breeding was not premeditated. The tendency to develop lung tumors is obviously inherent, and the carcinogens act as accelerators. Transplanted lung tissue from susceptible and nonsusceptible strains retains its character (Shapiro and Kirschbaum). Since the mechanism of this susceptibility is not fully known, it may or may not be true somatic mutation (Heston and Schneidermann). In spite of bearing the earmarks of malignancy, the lung adenomas rarely metastasize and seldom kill. The problem of their histogenesis is bound up with the eternal dispute about the nature of alveolar lining cells.

Numerous, partly contradictory experiments indicate that direct contact of the carcinogen and the lung tissue is the essential factor. Dispersions with larger particles give a higher yield. Shimkin, like Doll, accepts the actual increase in human lung cancer and the role of tobacco. He urges public education directed toward reduction of cigarette smoking and control of atmospheric pollution. The last pages reveal a refreshingly broad-minded attitude in defining neoplasia.

Rondoni, in his chapter on some aspects of carcinogenesis, stresses the antientropic nature of normal anabolic processes and the return to the second law in carcinogenesis (Mirsky and Pauling), which probably corresponds to an *in*

vitro reproducible denaturation (despecialization) of proteins. Although the entry of fat-soluble carcinogens may be through the mitochondria and may be connected with disturbances of lipid metabolism (Hamperl, Calcutt, and Payne), the role of cell proteins is more important. Much stressed phenomena, such as rapid cell division or increased O_2-consumption (Deotto), are secondary, and changes in the redox metabolism do not yet appear significant. Interaction of carcinogenic hydrocarbons with SH-groups is likely, and infrared absorption spectra indicate modifications of nucleic acid behavior. The less specialized enzyme patterns and the decrease in catalase (Greenstein) are examples of chemical dedifferentiation. The internal configuration of the protein molecule and the association of molecules are essential, not the straight chemical composition. As Yamafugi believes, induced aberrations in protein metabolism can result in the formation of viruslike or genelike structures. These experiments should be repeated. Defects in the interaction between nucleus and cytoplasm are basic in carcinogenesis (Haddon, J. Schultz). The abnormal formation of more stable denaturation products of protein releases energy that can be used for uncontrolled cell multiplication (O. Schmidt).

S. Weinhouse in his well-organized 53-page chapter on oxidative metabolism of neoplastic tissues shows how Warburg's original ideas have dominated this field in spite of doubts Warburg himself had expressed. He winds up by stating "that there is little in favor of the Warburg hypothesis." As early as 1930, the possibility was recognized that metabolization of substances other than glucose might contribute to the respiratory activity of tumors, and it was proved by study of the RQ (Dickens and Limer). Contrary to generally accepted assumptions, methyl esters of some fatty acids, for example, are readily oxidized by tumor slices (Ciaranfi); and with the isotope tracer method, it can be shown beyond doubt that tumor cells do oxidize fatty acids. Newer knowledge of intermediary steps of catabolism and of possible interconversions force us to abandon earlier interpretations.

Glycolysis is qualitatively similar in tumor and in other tissues, and the potential rates are equal in both (LePage *et al.*). Harmonic control of metabolism is possible, but we do not know how any single hormone affects a particular enzymatic reaction, nor do we know the optimal content of enzymes or of coenzymes that may interconnect different intracellular metabolic processes. Further careful studies of individual enzyme activities may reveal differences between normal and neoplastic tissues.

Pullman's chapter on electronic structure and carcinogenic activity is an elaborate version of a lecture given before the European section of the Union Internationale contre le Cancer in 1953. This chapter can be appreciated only by the specialist.

H. P. Morris' 64-page chapter on the experimental development and metabolism of thyroid gland tumors testifies to the complexity of the problems. Seven pages deal with thyroid cancer in man. The chapter's primary concern is with data obtained in the last ten years by applying, in the animal experiment, thyroid-lethal doses or tracer doses of ionizing radiation. Attempts have been made to compare thyroid gland responses in man with similar ones in the controlled animal experiment. Morris' report on the many experiments and interpretations does not make easy reading, but it is highly instructive.

The goitrogenic effect of *p*-aminobenzoic acid probably consists in inhibiting tyrosine iodinase (Fawcett and Kirkwood). The organic binding of iodine is essentially controlled by the pituitary gland (Morton, Albert and Lorenz). Although thyroid tumors do occur in dogs and horses, they are very rare in rats and mice, which are therefore suitable subjects for experiments. Goitrogen-induced thyroid tumors in mice can metastasize to the lungs (Morris, Dalton *et al.*), but on resumption of a normal diet the activated thyroid epithelium might involute (Gorbman). Thyroid tumors developed in rats fed a low iodine diet, whether or not 2-acetylaminofluorene was added (Axelrad and Leblond).

The goitrogenic substances are not carcinogenic. When true independent carcinoma occurs after their prolonged use, is arises through overstimulation by excess TSH (Purves and Griesbach). Thyroid tumors of mice can be easily transplanted (Morris). In Bielschowsky's work with methylthiouracil-induced rat tumors, the first generation was a colloid adenoma, but the fourth was a rapidly killing anaplastic giant cell carcinoma. The decisive role of the pituitary gland in the pathogenesis of goiters (Griesbach) formed a basis for many investigations.

This interrelationship of thyroid tumors and pituitary tumors has been seen in man also (Rasmussen and Nelson). Experiments with I^{131} have given varying, partly unexplained results not depending only upon dosage (Gorbman, Goldberg and Chaikoff). Human lives have been saved by treatment with I^{131}, but many years of follow-up will be needed before we know whether or not I^{131} in this dosage is cancerogenic, and ways should be found to increase the avidity of thyroid tumors for I^{131}. Wegelin's idea expressed long ago that thyroid cancer originates from thyroid adenoma is probably correct. The study of thyroid tumorigenesis in relation to hormonic imbalance might serve as a model for studying tumorigenesis in other organs.

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Catalysis. vol. II, *Fundamental Principles* (pt. 2). Paul H. Emmett, Ed. Reinhold, New York, 1955. vi + 473 pp. Illus. $12. vol. III, *Hydrogenation and Dehydrogenation.* Paul H. Emmett, Ed. Reinhold, New York; Chapman & Hall, London, 1955. vii + 504 pp. $12.

This series of books is now emerging as an excellent summary of what is known about the theory and practice of catalysis. The books should be an important reference source for years; at least seven volumes in the series are now projected.

Volume II completes the presentation of fundamental catalytic principles. This volume appears to be stronger than Volume I. One might have hoped that the editor, with perhaps one or two others, would have written the entire survey of fundamental principles so that the whole could have been better integrated. The arrangement of topics might surprise some readers.

Volume II begins with a classification of heterogeneous catalytic vapor phase reactions by W. B. Innes. A survey of the measurement and defect of pore distribution in solid catalysts is next presented by A. Wheeler. Two chapters on the nature of catalytic surfaces and on complexes on catalyst surfaces by H. M. Hulbert are rather difficult reading for the uninitiated. General theories of heterogeneous catalysis are well surveyed in the next chapter by a group of authors. Finally, the general nature of homogeneous catalysis and of the factors that influence the behavior of homogeneous catalytic systems are given by E. L. King.

Volume III is devoted entirely to a portion of the field of catalytic hydrogenation. It is restricted to those reactions in which hydrogen is simply added to unsaturated bonds without ejecting any other molecules. B. M. W. Trapnell begins logically with the catalytic exchange reactions of hydrogen and deuterium and with the inner conversions of the ortho-para varieties. Next, the catalytic hydrogenation of ethylene is taken up by D. D. Eley. This excellent chapter makes clear that the complex nature of the ethylene molecule leads only to speculation on the mechanism of hydrogenation.

The hydrogenation of olefinic hydrocarbons, of carbon-carbon triple bonds, and of nitro compounds is then presented. Factors such as possible mecha-