later). All these data indicate that vitamin B_{12} is a co-factor for the incorporation of amino acids into protein–protein biosynthesis. A study of the distribution of radioactivity among the liver subcellular fractions following injection of 1 microcurie of Co^{60}-labeled vitamin B_{12} showed a high percentage of radioactivity in the microsomes (46%) and the supernatant fraction (25%) as related to the radioactivity of all the fractions. This high percentage in these fractions most implicated in protein synthesis is in agreement with the hypothesis that vitamin B_{12} is a co-factor for protein synthesis indicated by the amino acid incorporation studies. Work on the isolation of the enzyme containing B_{12} is in progress.

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BOOK REVIEWS

Lectures in Immunochemistry. By MICHAEL HEIDELBERGER, Emeritus Professor of Immunochemistry, College of Physicians and Surgeons, Columbia University, New York; Visiting Professor, Institute of Microbiology, Rutgers University, New Brunswick, New Jersey. Academic Press, Inc., Publishers, 111 Fifth Avenue, New York 3, N. Y. 1956. ix + 150 pp. 14.5 × 22 cm. Price, $4.00.

The author of this short volume is a chemist who began his distinguished scientific career at the Rockefeller Institute for Medical Research in 1912. It was he who, together with the great bacteriologist Oswald T. Avery, isolated the capsular polysaccharides of several pneumococcal types and showed that they were endowed with immunological specificity. This was an achievement of no small magnitude, as subsequent events revealed.

Immunology was a lively field of investigation during the two decades prior to this discovery. Although the science was relatively new, chemists were already beginning to make important contributions to an understanding of the processes involved in immune phenomena. The monumental work of Karl Landsteiner concerning the specificity of proteins, and his discovery of the specific blood groups, an achievement for which he later received the Nobel Prize, were but two of the great contributions of this period. The classical studies of Arrhenius and of Madson on the quantitative aspects of the toxin-antitoxin reaction had brought a new interpretation of a phenomenon which, but a few years before, had scarcely been conceived of as a chemical reaction.

The discovery in the early twenties of the specific bacterial polysaccharides and of the role which they played in antipneumococcal immunity added a new, imposing milestone to the progress which both the chemist and the bacteriologist have made to our understanding of immune reactions.

Six of the lectures found in this volume, delivered in 1954 at the University of Tokyo, are a summation of the contributions which the author has made to the modern field of chemical immunology. These lectures deal for the most part with his quantitative studies on the precipitin and agglutination reactions, with the chemical nature of complement, and its role in the hemolytic system, and with the relationship between the chemical constitution and specificity of proteins and of carbohydrates. Three other lectures are included in the volume. Two of these, delivered in Europe, have to do with an evaluation of antipneumococcal immunity in humans following administration of the pneumococcal polysaccharides, while the third, delivered in New Brunswick, New Jersey, presents a study of the serological properties of native and denatured proteins.

For those who wish to obtain a broad background in the field of chemical immunology and a knowledge of the developments which have occurred in this field during the past several decades, or for those who wish to gain a broad scope in this specialized and many faceted field of biochemistry, this is not the book. However, for those who wish to learn something of the individual contributions of a contemporary and distinguished biochemist in a rapidly expanding field the volume is to be recommended warmly, although it is regrettable that many of the statements in the lectures, and in particular those regarding the work of others, are not better documented.

THE ROCKEFELLER INSTITUTE FOR MEDICAL RESEARCH
NEW YORK, N. Y. WALTHER F. GOEBEL

Enzyme Antigen and Virus. A Study of Macromolecular Pattern in Action. By F. MACFARLANE BURNET, Kt., F.R.S., F.R.C.P. Cambridge University Press, American Branch, 32 East 57th Street, New York 22, N. Y. 1956. viii + 193 pp. 13 × 18.5 cm. Price $3.50.

This monograph is an extension and revision of the author's earlier monograph ("The Production of Antibodies"[1]). It is concerned with the process of biological replication of specific patterns. Burnet is primarily interested in the replication of active proteins and presents evidence for the thesis that protein is synthesized by or on a RNA template. The content of the monograph is best summarized by the titles of the chapters and their contents.

I. Introduction: Enzyme Action and Protein Synthesis. (1) Enzyme specificity; (2) Adaptive enzymes in microorganisms; (3) Chemical aspects of the biosynthesis of protein; (4) The nature of adaptive enzyme synthesis.

II. Antibody Production. (1) The self-marker concept; (2) Antibody production after the elimination of antigen; (3) The site of antibody production; (4) Theoretical approach to antibody production; (5) Weaknesses of the present hypothesis.

III. The Self-marker Hypothesis in Relation to Cellular Proliferation and Control. (1) Immunological aspects of tumour transplantation; (2) The implications of cutaneous sensitization to simple compounds; (3) Application of Weiss's concepts of cell control to the self-marker hypothesis; (4) Summary.

IV. Virus Multiplication. Influenza Virus Multiplication: (1) Nucleic acid in relation to influenza virus; (2) An attempted visualization of the structure of influenza virus particles; (3) Process of infection; (4) Interference; (5) Incompleteness; (6) The dynamics of influenza virus multiplication in the allantoic cavity; (7) Recombination phenomena; (8) Mutation; (9) Summary.

V. The Scope of Biological Generalization. (1) Information theory in biology; (2) The application of pattern concepts to biological problems.

The monograph outlines very effectively much of the current thought on protein synthesis, antibody production and virus multiplication and, as a monograph should, it presents

(1) F. M. Burnet and F. Fenner, "The Production of Antibodies," Macmillan, Melbourne, 1949.

very strongly the views of the author himself. Burnet attempts to present both sides of arguments. He was not able, unfortunately, to include some very pertinent recent work. For example, in connection with the problem of whether or not antigen persists during the period of antibody production, as required by the template theory, he was not able to include the very important work of Garvey and Campbell[2] which indicated that immunologically active fractions of proteins containing S^{35}-labeled azobenzene sulfonate groups persist in the liver of injected animals for several weeks. This is contrary to the work in the same system quoted by Burnet, namely, that of Ingraham,[3] who was not able to find such active components.

The author presents a great deal of information on the important and currently popular phenomenon of tissue tolerance. Although the recognition unit concept as described by Burnet is an appealing one, it is difficult to see how all the component substances of an organism could have a certain self-marker unit which would be recognized by the cells. It is known that slight chemical alteration of an individual's own proteins will render them antigenic to the same individual, and it does not seem possible that any such slight alteration would always affect the recognition unit.

Burnet concludes with the statement that "the generalizations that are needed for the technical control of biological processes will not come from the elaboration either of structural chemistry or of information theory in its conventional sense. These can only provide a background against which effective working concepts can be oriented and rendered more intellectually appealing. The handling of biological material will always be the business of scientists using their own working concepts based essentially on a not very deeply analyzed concept of specific pattern with which we have been concerned."

Since many chemists require sound basis and deep structural analysis for their effective function and do not consider these factors as mere "intellectual appeal," they may be dismayed at the loose use of the term "Specific Pattern," without concern about the actual nature and configuration of the pattern.

Instead of adopting an open mind to the possible contribution of all fields to the study of living processes, *Burnet openly minimizes the past contributions of chemistry and he is pessimistic about future contributions from chemistry* as shown by the following quotations which are typical: "Without ever being able to state the precise point at which technique must break down, we can yet be quite certain that no conceivable development of organic chemistry will provide us with the detailed structure of trypsin or of the particular nucleic acid that can transfer a new antigenic quality from one pneumococcus to another." "The attempt to press the structural, physical and chemical approach to the understanding of living process seems to have reached the phase of diminishing return for the effort involved. We are approaching an asymptotic barrier and it may be that some modification in the outlook and approach of theoretical biology will soon be needed."

(2) J. S. Garvey and D. H. Campbell, *J. Immunol.*, **76**, 36 (1956).
(3) J. A. Ingraham, *J. Infect. Dis.*, **89**, 117 (1951).

ROSWELL PARK MEMORIAL INSTITUTE DAVID PRESSMAN
BUFFALO 3, NEW YORK

The Calculation of Atomic Structures. Based on lectures given under the auspices of the William Pyle Philips Fund of Haverford College, 1955. Structure of Matter Series. Maria Goeppert Mayer, Advisory Editor. By DOUGLAS R. HARTREE, John Humphrey Plummer, Professor of Mathematical Physics in the University of Cambridge, England, and Philips Visitor at Haverford College. John Wiley and Sons, Inc., 440 Fourth Avenue, New York 16, N. Y. 1957. xiii + 181 pp. 15.5 × 23.5 cm. Price, $5.00.

Calculation of accurate wave functions for atoms is an important undertaking, but it has proved to be very frustrating because of the tedious numerical work involved. Renewed interest in the problem has been stimulated recently by development of large digital computing machines, and we soon hope for improved functions for the normal and more important excited states of atoms, from which transition probabilities and energies may be derived. Methods developed and tested for atoms are also of obvious importance in the problem of molecular structure calculations.

It is fortunate that we have now, for the first time, a very detailed and complete account of methods used by Professor Hartree and others in the self-consistent field treatments of atomic structure, especially for atoms with many electrons. The present book is based on a series of lectures delivered at Haverford College and repeated later in Princeton University. The emphasis is on technical rather than on descriptive aspects of the problem, but one may obtain a general view of what has been done and see how calculations may be improved without working through the numerous mathematical results. However the book is especially valuable for the specialist who plans similar or improved computations. In this connection, Chapter 10, on "Better Approximations," is particularly important, and might well have been amplified.

The Appendix contains tables of new (and recalculated) results, and it is very convenient to have this material collected in one book. The numerous references appear to be complete and extend into 1956.

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Textbook of Polymer Chemistry. By FRED W. BILLMEYER, JR., University of Delaware and Polychemicals Department, E. I. du Pont de Nemours and Co., Inc. Interscience Publishers, Inc., 250 Fifth Avenue, New York 1, N. Y. 1957. viii + 518 pp. 16 × 23.5 cm. Price, $10.50.

This book, according to its author, was written as a text in the physical and organic chemistry of high polymers at the senior or graduate student level. It is intended that the text be expanded by lectures and supplementary reading.

The first third of the book deals with the physical chemistry of high polymers, including their physical and chemical structure, thermodynamic properties in solution, a discussion of molecular weight methods, and ends with a section on rheology and viscoelastic properties. The kinetics of polymerization occupies the next fifth of the text and includes such topics as linear condensation polymerization, addition polymerization, copolymerization kinetics and the reactivity of monomers and radicals. A short section on molecular weight distributions, and chapters on emulsion polymerization, ionic polymerization and polymer degradation follow.

The properties of plastics are next dealt with, starting with a section on polymer processing, including injection and compression molding, plasticization and reinforcement. This is followed by a series of chapters on polymers from polystyrene, the acrylates, vinyl polymers, halogen-containing polymers, linear and cross-linked condensates, cellulose and the silicone polymers. This is essentially the organic polymers section of the text, occupying about 20% of its space.

Chapters on the properties of fibers are concerned with the physical and chemical properties of synthetic and natural fibers, fiber fabrication, and after-treatment. The subject of elastomers completes the text with chapters on vulcanization and reinforcement, as well as ones on natural rubber, GRS and other synthetic elastomers. The book concludes with a complete list of symbols giving their dimensions, units, definitions and chapter where used, and an appendix of trade names and manufacturers.

The field of the physics and chemistry of polymers is so extensive in terms of fundamental work as well as applied work that no text of manageable size could possibly cover it completely. Since this text treats almost every aspect of the field, the author has been forced to present only its essentials. In this his achievements have been truly remarkable. Each of the many chapters (57 in all) had to be necessarily short (they average 8 pages), but they are all authoritative and written in an extraordinarily clear manner. This was made particularly difficult because many of the derivations depend upon a sophisticated knowledge of theory, particularly statistical thermodynamics. The bases of the derivations are explained and the important intermediate and final expressions alone presented; this is as it should be.

This text is extremely readable. The material is well organized, making it easy to locate topics. The appendices