matrices and linear dependence, are also included. On the whole, the book is thoroughly modern and pedagogically excellent. It is a valuable addition to available books in the field.

The third book falls in a somewhat more advanced field, being suitable for a junior or senior in college or a first-year graduate student who has had no systematic training in differential equations. A special effort has been made by the author to avoid mere formalism and to see that the student gets at the heart of the matter. This effort will undoubtedly be amply justified in the way of increased understanding on the part of students who make use of the book. The fundamental notions and theorems of analysis that have special significance in discussing the solutions of differential equations, such as the Riemann definition of the integral, the varied behavior of functions as to continuity and existence of derivatives, the widening of a class of functions by considering indefinite integrals of such functions, are introduced early in the book and effectively used thereafter. The choice of problems is excellent, and many of them furnish a good introduction to important applications of the theory.

A valuable feature of the book is the excellent discussion of Picard's method of successive approximations, both as a method of solving equations and as a means for proving existence theorems. This discussion includes the treatment of equations of higher order and of systems of equations. It rounds out in excellent fashion the theoretical side of the work.

From every point of view Professor Agnew's book is a noteworthy addition to available texts for an introductory course in differential equations. Its appearance will be welcomed by those who have occasion to conduct such a course and by students who need to pursue the subject on their own initiative.

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BIOCHEMISTRY AND MORPHOGENESIS

Biochemistry and Morphogenesis. By JOSEPH NEEDHAM. 785 pages. Cambridge: At The University Press. New York: The Macmillan Company. 1942.

ALTHOUGH this book is not a continuation of Dr. Needham's classical work in three volumes on "Chemical Embryology," published in 1931, it is a timely and worthy successor, still concerned with the relation between morphology and chemistry. There are many references back to the earlier work in lieu of repetition, and the present book includes within its treatment most of the advances in the field of chemical embryology that have occurred since 1931. It thus serves as a sequel to bring that subject up to date. It does more than this, however. The present book goes well beyond a descriptive account of the biochemistry of the developing embryo; it goes about as far as the present state of knowledge permits in attempting to analyze the causal aspects of morphogenesis by explaining the unknown in terms of the known or better known, including specific substances when possible. In effect, an integration of chemical embryology and experimental embryology is attempted, which means a meeting on common ground of biochemistry and morphology.

Since the beginning of the present century, and even earlier, it has been shown repeatedly by amputation, transplantation and other types of experiments on many kinds of embryos (and regenerating adults) that the developmental fate of a part of the egg or embryo may be profoundly affected by its physical proximity and relation to other parts. This dependence in differentiation has in many instances been taken to imply the existence of morphogenetic hormones. Morphogenetic hormones have indeed also been found in plants, in which they have in certain cases been more quickly and more readily identified than in animals. The influence of one part of an animal embryo on another is strikingly shown in the "inducing" or "organizer" action of the cells of the dorsal lip of the vertebrate blastopore, which impose the main primary pattern of differentiation of the embryo upon neighboring cells with which they come in contact. In 1931 Spemann demonstrated that destroying the living integrity of such cells by crushing had little or no effect upon their inducing activity, and Holtfreter and others soon found that the inducing activity survived boiling, which destroys enzymes. These far-reaching experiments banished the last remnants of any basis for the mysticism still occasionally associated with the inductor agencies and stimulated intensive attempts both to isolate inductor substances, in which Dr. Needham himself took the lead, and to further understand their action. Substances of known composition were found that possess inducing activity, although it is not yet certain whether they are the same agents that act naturally or whether they stimulate or release the natural agents.

The second and longest part of the book is devoted to a comprehensive and penetrating consideration of morphogenetic stimuli and their actions. There is clear recognition of the great rôle of the reacting systems that respond to the stimuli in ways not yet clearly understood. The account shows that great advances have been made and that many more are yet to be expected. It also reveals the great intricacy and complexity of the processes of development that have for so long intrigued, baffled and fascinated the mind of man.

In Part 1 the morphogenetic substratum is consid-

ered from the point of view of the chemical raw materials available for development. The lucid account of nutritional and other problems that eggs and embryos have solved in adapting to the limitations of their environment is a most interesting and valuable contribution to the study of evolution and natural history. Part 3 is devoted to the morphogenetic mechanisms, including the special metabolisms of embryonic life with its sequence of energy sources, etc., and also such general questions as dissociability, growth, polarity, etc. In considering growth, attention is focused on the relative proportions of constituent materials at different stages in the development of the individual and in widely different species.

The treatment is broad and inclusive throughout. While the book is primarily concerned with recent facts and concepts, these are constantly projected in perspective against historical and philosophical background. A spirit of optimistic mechanism pervades the treatment, and an old subject is admirably treated in the light of current knowledge under the picturesquely modern heading, "The Liquidation of the Entelechy." The concept of levels of organization is stressed, and finally a parallel is drawn between organic and social development.

Cancer and teratomatous tumors are considered in relation to the organizer phenomena. Striking chemical similarities and overlapping functions are noted among certain substances acting as sex hormones, carcinogens and primary organizers (evocators). Cancer appears to involve the problem of anomalous differentiation or lack of differentiation, and thus to be related to phenomena studied in experimental and chemical embryology. Students of cancer will wish to familiarize themselves with Dr. Needham's account and point of view.

The book is abundantly and well illustrated, and a convenient system of numbering the sections or subjects is employed. The quality of the paper, as in most recent books, is not up to pre-war standards. An interesting side-light on the creation of books in England under conditions of war was shown this winter at the Yale University Library when copies of the various steps in the preparation of this book, the manuscript, galley, page proof, microfilm of the corrected page proof, etc., were put on display. These copies had all been sent as they came into being to Dr. Ross G. Harrison as insurance against destruction of the originals.

Throughout, attention is called to probable future trends in research and to needed experiments yet undone. The bibliography is the most complete and extensive in existence since "Chemical Embryology" and includes references to recent reviews. This book represents a great accumulation of facts and a masterly synthesis of knowledge. It will be indispensable to the investigator and teacher alike.

DOUGLAS WHITAKER

SPECIAL ARTICLES

THIOURACIL IN THE TREATMENT OF THYROTOXICOSIS[1]

RECENT interest in the possible medical treatment of patients with thyrotoxicosis has been stimulated by the observations that certain sulfonamides, as well as thiourea[2, 3, 4] and its derivatives, induce a hypometabolic state when fed to rats for several weeks. The evidence that has been accumulated suggests that the lowering of the metabolic rate results from a decrease in the production of the thyroid hormone, which is presumably due to the action of these drugs on the thyroid gland. The latter becomes enlarged and hyperplastic, but its content of colloid is greatly depleted. The changes in the thyroid do not occur if the animal is fed desiccated thyroid or if a hypophysectomy is first performed. The above drugs do not interfere with the elevation of the metabolic rate induced by thyroxin or desiccated thyroid. The pituitary gland responds with the same type of hyperplasia as follows thyroidectomy.

Astwood[5] found that of a large group of sulfonamides and thiourea derivatives which he tested, thiouracil was the most effective in inhibiting the production of thyroid hormone. He used thiouracil in the treatment of three patients with thyrotoxicosis and in each case the metabolic rate returned to normal and the symptoms were relieved. However, when the drug was discontinued after one or two months, the manifestations of the disease reappeared. The course of one patient was complicated by the development of agranulocytosis.

During the last few months, we have used thiouracil[6] in the treatment of nine patients with thyrotoxicosis. This substance is a thiourea derivative with the following formula:

[1] From the Thorndike Memorial Laboratory, Second and Fourth Medical Services (Harvard), Boston City Hospital, and the Department of Medicine, Harvard Medical School, Boston.

[2] Julia B. Mackenzie, C. G. Mackenzie and E. V. McCollum, SCIENCE, 94: 518, 1941.

[3] C. G. Mackenzie and J. B. Mackenzie, *Endocrinology*, 32: 185, 1943.

[4] E. B. Astwood, J. Sullivan, Adele Bissell and R. Tyslowitz, *Endocrinology*, 32: 210, 1943.

[5] E. B. Astwood, *Jour. Am. Med. Asn.*, 122: 78, 1943.

[6] Thiouracil was supplied through the courtesy of the Lederle Laboratories, Inc., Pearl River, N. Y.