eral physical science." The second alternative has interesting possibilities. Each of the new departments would be sure to offer a "general" course, each bidding for student election on the basis of being the most outstanding for some particular reason. Students not planning to major in the sciences are usually required to take toward their "liberal" education at least one course in the physical sciences, and one laboratory course in the biological sciences. Under the revised arrangement, such a student would satisfy the spirit and letter of the requirements by taking one specialized course in each—say "general mathematics" and "general physiology." In the number of class hours available, could such a student be given the insight into the biological sciences now provided in a good general biology course? Could the "insight" be provided without adding to the total of required courses? Is the "insight" worth including in a liberal arts education? Why else does the requirement exist?

Freed of any close association through offering a course in "general biology" the preference for subject-matter shown by teachers and workers tends to draw them apart. The multiplicity of biological societies and journals is a good example of this tendency. But when a botanist, a zoologist, a physiologist, etc., must work together in presenting a "general biology" course, each acts as a check on the others. The botanist does not insert specialized information on neck canal cells, nor the zoologist the terminology of homologous segments in the crustacean appendage, nor the physiologist the logarithmic relationship between this and that, delectable as these items may be. The others object. In consequence the student is given an introduction to most of the branches of the biological sciences, with few of the technical details. Borderline subjects are mentioned in relation to the different aspects of the field. Biochemistry, biophysics, biometry, biogeography, bio-ecology, etc., form unifying bonds to connect the biological sciences with the physical sciences and with each other.

Perhaps a course in "general physical science" is an excellent suggestion. If the mathematics staff, the physics faculty, the chemistry group, etc., were to sit down together and each agree on what the other offered, each trying to get the other to orient the subject-matter into some understandable relationship, would the product perhaps give a better "insight" into the physical sciences than can be gained from one course in "general physics" or one in "general chemistry?" Perhaps such a group might be led to include not only some physical chemistry, etc., but also to show in their course how much relationship there is between the physical and the biological sciences.

As a biologist who found considerable stimulation to thought in pre-war collaboration with colleagues while presenting a share in a general biology course, and as a war research investigator needing familiarity with all the biological and physical sciences, the writer can sympathize with Professor Shull, yet at the same time feel that a closer, rather than a looser coordination between these sciences is particularly desirable in both the teaching and research fields.

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SCIENTIFIC BOOKS

CYTOCHEMISTRY

Frontiers in Cytochemistry. Vol. X, Biological Symposia. Edited by Professor NORMAN L. HOERR. 334 pp. Illustrated. Lancaster, Pa.: The Jaques Cattell Press.

THIS volume represents a series of lectures given at a symposium held at the University of Chicago in honor of Professor R. R. Bensley's seventy-fifth birthday. A paper by Dr. Bensley himself, on the chemistry of cytoplasm, aptly serves as a summary of the principal contributions of the volume.

For the most part the approach of biochemists to the problem of describing the metabolic activities of living material has involved the use of techniques which disregard the heterogeneity of the cell or of the tissue being studied. It is to be expected that the only enzyme reactions to survive this treatment would be those characterized either by an exceptional and persisting activity or by the resistance of their component parts to the deleterious influences involved in breaking up cell structure.

However, due largely to the influence of Professor Bensley, a group of investigators, for the most part men who are trained as cytologists, have begun to attack the problem of localizing within the individual cell particular parts of the enzyme reactions which we write now as descriptions of the over-all metabolic process. Perhaps many of the difficulties in our present over-all schemes will be resolved when we are able to draw a precise biochemical map of a cell.

At the present time it is possible to separate or characterize cell fractions constituting the nucleus, components of the nucleus, mitochondria, a submicroscopic lipo-protein complex, Nissl bodies in the case of nerve tissue and protein fractions which apparently constitute the structural elements of the cell. Cyto-

plasm is regarded therefore as containing a structural framework (largely of fibrous proteins) embracing a liquid menstruum containing soluble proteins, metabolites and inorganic salts, in which are embedded microscopic and submicroscopic particulates of highly complex composition. Both the chemical nature and the biochemical properties of these components vary widely.

Lazarow contributes a detailed discussion of the results of the investigation of these factors carried out in the Chicago laboratory within the past ten years. Along the same lines Claude describes the distribution of nucleoproteins among the various components of cytoplasm, and Gersh and Bodian report on a histochemical analysis of the changes occurring in motoneurons of the Rhesus monkey after root section. The methods used in separating various cellular components are treated at length in an article by Hoerr on the liver cell, while Beams describes the value and use of the ultracentrifuge in studies of this sort. Mirsky and Pollister discuss the fibrous nucleoproteins of the cell, and Schmitt, Hall and Jakus describe work in which they have examined various fibrous structures (collagen fibers, cilia, flagella, etc.) by use of the electron microscope. The soluble components of the cytoplasm are discussed in an article by Stern on such macromolecular particles in cytoplasm as ferritin, the complex containing cytochrome oxidase and the cytochromes, bacteriophage, etc. Articles by Chambers, Lowry and Scott are concerned primarily with the mineral constituents of protoplasm, Chambers describing experiments using his microdissection technique, Lowry describing investigations of the type initiated by Hastings, Eichelberger and their associates, while Scott reports studies of mineral distribution using the electron microscope. Striking differences in mineral content between intra-cellular and extra-cellular fluids have been recognized for some time. It becomes clear now that there are also intracellular localizations in mineral distribution. A review by Barron discussing various features of cellular respiration and a paper by Cowdry describing in detail the histological changes involved in the development of carcinomata in mice treated with methylcholanthrene complete the volume.

There can be no question of the importance of the objectives of the research discussed in this volume. Up to now the emphasis of workers in the field has been, as Professor Bensley rightly says, on "separating things before proceeding to their analysis." While knowledge as to the enzymic and chemical composition of these various cellular components is still slight, it is clear that biochemical schemes of intermediary metabolism must eventually be expressed in such terms and reconciled with such data.

As is the case with most books of this kind there are individual statements, ranging from matters of pure error to questions of proportion and opinion, with which one may disagree: for example, QO_2 (page 18) is not the customary symbol for respiratory quotient nor can one agree, for example, with the statement (page 56) that "oxaloacetate is used . . . as the phosphorylated compound in the formation of phosphopyruvate and synthesis of carbohydrate. It might also produce isocitrate"—when the first of these reactions is supported by no direct experimental data while the synthesis of isocitrate from oxaloacetate has been demonstrated beyond question. However, these are typical of the small flaws in what is, in general, an admirable effort.

The book has been edited by Professor Norman Hoerr and includes an appreciation of Dr. Bensley's work by E. V. Cowdry and an excellent portrait of Professor Bensley as a frontispiece. In format and typography it corresponds to the other volumes of the series.

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REPORTS

PRESENT TEACHING ACTIVITIES OF THE SCHOOL OF TROPICAL MEDICINE, IN COOPERATION WITH THE INSULAR DEPARTMENT OF HEALTH

IN 1926, at the inaugural ceremony that launched the School of Tropical Medicine as the first of its kind in the Americas, Dr. William Darrach, then dean of the College of Physicians and Surgeons of Columbia University, defined the objectives for which the new school had been founded as "the study and teaching of physical and mental ills as they occur in the tropics." These objectives were further defined in an early announcement of the school, thus: "The primary aim of the school is to give opportunity to study in a tropical environment the cause and prevention of that large group of ill-defined disorders known as tropical diseases and, at the same time, to observe the influence of tropical conditions on disease in general." Again in his inaugural address, when commenting on the advantages of Puerto Rico as the site for the School of Tropical Medicine, Dr. Darrach said, "The student will have the opportunity to see not only the dark side of conditions and their distressing effect on mankind but also the brighter side of what is being done to con-