orthogenesis as some "inscrutable mystic force," she nevertheless believes in internally directed evolutionary trends of some sort. In the opinion of the present reviewer, all the examples of parallelism that she mentions can be explained on the assumption that similarly constructed, though distantly related, organisms will react similarly to the same or parallel changes in the environment.

To the specialist on the Pteridophyta, Dr. Manton's book will have a value approaching those of Bower and the other great authorities of the past. To the student of plant evolution in general, it will serve as both a stimulus and a challenge to produce similar studies of such high excellence in other groups of plants.

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The Perception of the Visual World. James J. Gibson; Leonard Carmichael, Ed. Boston: Houghton Mifflin, 1950. 235 pp. $4.00.

This book presents an interesting discussion of visual perception, written as only a psychologist thoroughly familiar with the language of the Gestalt school could write. It is an exposition of ideas worked out during a war research project on the visual perceptual problems of the aircraft pilot.

The essential theme is "that visual space-perception is reducible to the perception of visual surfaces, and that distance, depth, and orientation, together with the constancy of objects may all be derived from the properties of an array of surfaces." In line with the concepts of the Gestalt psychologists, who have insisted that the perception of form is a fundamental sense response, and is not merely an intellectualized summation of individual parts of the form, Dr. Gibson makes the hypothesis that the spatial and temporal changes in the retinal image patterns of textured surfaces constitute the fundamental sense response for the perception of depth and distance. The change in the angular size of the details of the texture of surfaces, such as that of the ground as it recedes into the distance, he calls a "gradient." The perception of the slant and apparent distance of the surfaces are immediately and directly perceived through these retinal image gradients.

The greater part of the book is concerned directly with the concepts of gradient, the relationship of the gradient to the retinal image as the stimulus. Not only does this include the concept of texture gradient, but also the convergence of parallel lines in perspective which is a gradient. The relative intensity of shadow or illumination on solid objects constitutes a gradient. Binocular vision and stereopsis are a response to abrupt changes in gradients. Aerial perspective is an aspect of gradient. Of considerable interest, also, is the author's discussion of change of deformations in retinal image gradient with motion; that is, motion of objects and of the observer. Even the rate of changes of motion, a rate of change in gradient, results in a psychologic correlative of acceleration.

Of special interest is Gibson's hypothesis that the so-called size constancy phenomenon (wherein objects are perceived in their true size regardless of their distances) is accounted for in terms of the gradient of textured surfaces. Associated with the perception of gradient is a psychologic size scale carried by each person which provides the basis for perception of the size of objects, the objects always being associated with the gradient of the background surface.

The last chapters cover the controversial subjects of learning, the effect of learning upon perception, and the essence of meaning in perception of form and depth.

It would certainly appear that gradients in retinal image patterns could not of themselves provide a reliable guide to absolute spatial localization. Knowledge of the nature of the detail that makes up the texture of surfaces, as well as postural influences of the individual, must be determining factors. The change in angular size of detail varies inversely as the square of the slant distance from eye to surface, and the gradient has symmetry around the foot of the perpendicular line from eye to surface. Hence, even a vertical surface can exhibit the same gradient of details as can a horizontal one for the same perpendicular distance.

This book provides much food for thought on the general problem of perception, although at times it leaves the critical reader somewhat unsatisfied, as perhaps it should. Much research, as Dr. Gibson points out, will be necessary to validate these hypotheses. The book is recommended for those particularly interested in the visual sense, but even the casual reader will find it readable and instructive.

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Plant Biochemistry. James Bonner. New York: Academic Press, 1950. 537 pp. $6.80.

The subject matter of plant chemistry would seem to be of primary importance to biology as well as to agriculture and substantial segments of industry. It is curious, therefore, that texts dealing with the chemical composition and metabolic activities of plant life have appeared only infrequently over the years; and these have not been notable for their grasp of subject matter or problems. Publication of this text by Bonner has, for the first time, presented the student and the researcher with an integrated source of relatively up-to-date information. Whatever may be found wanting among its pages, this pioneering treatment is bound to prove of substantial use to those interested in plant science and technology.

The author chose one of several possible outlines of subject matter. Indeed, the difficulty inherent in choosing any single organizational pattern is well expressed in his first chapter, ". . . the subject matter of this book is cyclical rather than linear in arrange-

ment. . . . It is merely an unfortunate geometric necessity which confines the textbook of biochemistry to a linear sequence in its presentation."

Chapter 1 treats in an extremely brief and general way of the biology and chemistry of enzymes. This is strategically the most important chapter of the entire book and yet is given the weakest treatment. Although the struggle to find room for the descriptive matter pertaining to plant biochemistry must have been great, it is equally true that almost no textbook of biochemistry, be it plant or animal, deals adequately with the principles of chemical reaction mechanism, catalysis, and modern rate theory. It will be the task of the biochemist to supply this groundwork. Until biochemistry has begun to evolve into a quantitative science, the teacher of this subject will not be able to depend upon physical and organic chemistry to supply those qualitative concepts that underlie modern theories of chemical reactivity in biological systems.

Chapters 2 through 6 contain a great deal of material on the test tube chemistry of carbohydrates that might well have been omitted in favor of the inclusion of more plant material later on. These chapters might also have been improved by the use of the Haworth formula throughout. The discussion on interconversions of the sugars in chapter 4 is well handled. Chapters 7 to 13 describe the components of the cell wall and their organization, to give perhaps the most satisfactory section of the entire volume. The author is at home with his subject matter and gives an excellent résumé of a subject that is adequately treated elsewhere only in Frey-Wyssling's monograph.

The chapters on the organic acids and plant respiration contain many excellent features, but the general treatment of this difficult field fails to achieve the degree of integration one might desire. On the other hand, the section on nitrogen metabolism is relatively complete. Particularly welcome is the chapter on purines and pyrimidines. Nitrogen metabolism of seedlings, a particularly significant aspect of plant chemistry, might have been treated more fully now that Chibnall's book is out-of-print. Chapters on proteins and viruses include much of the work of the author's own laboratory, a part of which has recently been confirmed, in effect, by Pirie. Recent work on the proteases of green leaves and on the possible mechanisms of peptide bond synthesis is either omitted or barely mentioned. Indeed, the entire problem of protein structure and synthesis is subordinated to the various aspects of protein degradation—no doubt as a consequence of the preponderance of data on protein catabolism in the literature.

The chapter on lipids and lipid metabolism is well done. This segment of plant chemistry has received embarrassing neglect at the hands of physiologists and biochemists. Aside from their significance in cell metabolism, the technological importance of the plant fats and waxes is such that thorough investigation of their biosynthesis and the quantitative aspects of their production would seem to have been a primary objective of at least some research laboratories. Yet this has not been the case, and every recurring national emergency finds us wondering why something isn't done about the oil and fat situation. Nature has given us the genes, and science the tools, but imagination in their use is lacking.

Somewhere in the book a brief treatment of the plant sterols and steroidal glycosides might well have been included, not only for the sake of their still-undiscovered biochemical activities in plant tissues, but also for their growing importance as raw materials for the synthesis of steroid hormones.

The last section deals with certain aspects of plant growth, and includes chapters on the growth hormones and the new work on photosynthesis. These topics are ably treated—the only change that one might have wished would be the inclusion of additional material on the hormonal aspects of development and the metabolic relationships of the hormones and synthetic growth regulators.

In a general sense, the point of view of *Plant Biochemistry* would seem to parallel that of classical animal and medical biochemistry. Thus, there has been a tendency to consider the properties of substances and systems more or less detached from their operational frames of reference—e.g., ontogenetic and phylogenetic development, ecological adaptation, etc. Inferences have been made, and necessarily so, concerning the nature of biochemical pathways by drawing not only upon incomplete evidence from the botanical literature but also upon analogy from animal and microbial biochemistry. Some may cavil at this speculative approach, but the fact remains that a work of this nature would scarcely have been possible otherwise.

In his preface the author thanks "students in his successive classes for aid in collection of much of the original material." This technique of book writing may perhaps explain the passing resemblance of some sections to chapters in recent volumes of certain review journals. Again, however, the very enormity of the task of sifting and assembling material for such a text from the original literature of organic chemistry and plant physiology would seem to justify such a practice. The alternative might well have been a delay of years in preparation of the manuscript.

The few typographical errors, such as the misuse of "quantum" as the molar equivalent of light energy, are obviously slips of the pen. The printing is excellent, and the composition and binding are attractive. The book is unique in being the only one in its field and should be on the desk of every botanist, chemist, biochemist, and industrial research director.

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