combats in the skies, should have gathered in the great amphitheater of the Sorbonne, thousands of them, in the presence of the President of France and the Minister of War, not to speak of the war or to stir new zeal, but to pay homage to a great scientist and teacher, M. Berthelot. To him it is now proposed to erect an international memorial. He was foremost in giving effect to the conception that chemistry can become creative in the organic field as well as in the inorganic, and so passed from the purely analytic to the synthetic.

While Berthelot does not stand alone as did Pasteur, he was of the small group in the van, and his brilliant service to his science deserves to be remembered not by France alone but throughout the world that has been benefited by his researches. It is suggestive of his service that his influence has been extended through the researches of his pupils, among whom was M. Sabatier, a recipient of the Nobel prize, whose discoveries in pure science have found such important practical application that an American manufacturer has asked the privilege of making, through the American Chemical Society, a material recognition of one of them. It is significant, too, that the proposed memorial building which is to be a center of continued research in organic chemistry is to stand by the side of Napoleon's tomb. So are peace's renowned victories to be celebrated no less than those of war.—*The London Times.*

SCIENTIFIC BOOKS

The Physiology of Plants: The Principles of Food Production. By GEORGE JAMES PEIRCE. x + 363 pp. New York, Henry Holt and Co. 1926.

PROFESSOR PEIRCE'S new book will be welcomed by both teachers and students. It represents many improvements on the author's earlier treatise. I like its literary style and the general background of broad and liberal philosophy that shows through on every page. It presents in a very readable form an account of the subject as it appears to the author, after his many years of successful teaching and research. It is characteristically a personal account rather than an attempt to present the science in an impersonal way. "Some of the departures from the usual are by way of suggestion for the future of the science, some for the convenience of the reader," is the second sentence of the preface. A few lines below, we read, "Whatever my own opinions about disputed matters may be, I have wished to express them, not as dogma, but as hypothesis or opinion, hoping and desiring always to say what will stimulate rather than satisfy." It is indeed a book of personal notes and suggestions, which will surely be stimulating and pleasant to read, though just as surely not wholly satisfying to either teacher or student.

Some of the very features that make this volume pleasantly readable and stimulating, or even exciting in places, due to the geniality and broad facility and originality of the author, may tend to detract from the usableness of the presentation for elementary classes, but the book is intended for more advanced students. It seems desirable that beginners should first study a clearly impersonal presentation of the current, or at present orthodox, theories and modes of expression before being led far into the confessedly mischancy although stimulating realm of theoretical and philosophical criticism. The present volume includes many critical discussions of pieces of research that are not adequately described, but references to the literature are generally given, and it is intended that the reader will be familiar with the papers referred to before trying to understand the criticisms.

Fundamental physical and chemical phenomena are in many instances too briefly treated, perhaps because the reader is supposed to be already familiar with them. For one example, air is said (page 25) *to dissolve water vapor,* and the subsequent presentation of relative humidity is incomplete, with no mention of vapor-tension deficit and the allied important relations. The student who leans upon the solvent theory in studying the vaporization of water into a supernatant gas will surely find himself in intellectual quicksands if he tries to travel far.

Professor Peirce's treatment of the ascent of water in plants is extensive and should arouse critical interest, but I am sure the presentation of the Askenasy-Dixon hypothesis is far too brief and incomplete; for the existence in plants of liquid water in a state of tension, together with the logical deductions that derive therefrom, are most fundamental to many considerations in plant physiology, and it is unfortunate that so many teachers of the subject appear to avoid venturing with their students into the analysis of these fundamental phenomena. Indeed, some specialists in physics and engineering fail to grasp the full meaning of stretched liquid water, and a few seem inclined even to deny the possibility of any such phenomenon. Texts should emphasize the inevitable importance of such things, the clear presentation of which might offer opportunities for inculcating and encouraging as much of rigid logic and the principles of controlled experimentation as is possible in a science like physiology, still so hazy with opinions and superficially reasoned hypotheses.

This book is unusually praiseworthy in that energy transformations and relations are generally considered along with material relations. The living plant is a machine that receives material and energy from

the environment, transforming them in innumerable ways and turning them out in other forms. Much emphasis is placed on the energetics of metabolism, and some consideration of the quantitative aspect of this subject is included. The author seems, however, to neglect or minimize the energy supply received by the plant, as heat from the immediate surroundings (conduction) or from more distant objects (radiation). For example (page 203): "The work done in lifting the great volume of water absorbed and evaporated by trees implies application of great quantities of energy. This energy must be liberated where it is needed, it can not well be transmitted from part to part. The intracellular release of energy, by metabolic process, chiefly oxidation in the end, furnishes a great amount of energy always available, the unused portion of which readily escapes by radiation or otherwise." It is here apparently implied that energy set free by the oxidation of substances in the plant body is supposed to play a considerable part in maintaining the transpiration stream. I do not find adequate consideration of the very large amounts of heat absorbed as such from the surroundings and available for catalyzed endothermic processes in general—such, for instance, as transpirational evaporation and the resultant entrance and upward flow of water. There seems to be o doubt that most of the energy used in raising water up the plant stem is thus derived directly from the surroundings, largely by conduction but to some extent by radiation, much as is the energy used in keeping the water of a teakettle in ebullition or in melting the ice in a household refrigerator. It is certain that energy from exothermic chemical changes in the plant takes part in many processes (*e.g.*, in active secretion when and where the latter occurs), but the total amount of energy thus derived and utilized must be very small in comparison with the amount received as heat from the surroundings. At any rate, I do not think we need to resort to respiration as a source of much free energy to account for the transpiration stream in general.

The expression "substance and circumstance" is repeatedly used by Professor Peirce to indicate the combination of the internal complex of influential conditions with the external complex (the environment). On the whole, his presentation seems to conform well with our present picture of the causality of plant or animal phenomena; things physiological do not happen because of influential internal conditions alone or because of influential environmental conditions alone, but because both sets or complexes of influences act simultaneously. Physiologists and other biologists are recently coming to use this conception of causality in their reasoning and experimentation and the book before us should be a help in this direction. But the time is apparently not yet here for any book to be quite clear and consistent in these things.

Professor Peirce does not wish us to go on considering fermentation and anaerobic respiration as closely related to the process usually called normal respiration. He appears to wish respiration to be defined as a process by which potential chemical energy is rendered kinetic, without at the same time producing nutritional substances, and he is troubled because fermentation processes are in many cases materially nutritional as well as energetically exothermic. The power of carnivorous plants to capture insects, to excrete proteolytic enzymes and to absorb products of the decomposition of insect bodies, whether decomposition is by enzymes from the plant itself or by those of bacteria, etc., is discussed, with the suggestion that this power may have been generally important for the ancestors of these plants in past times, although it is of little importance now. There are in this treatise relatively few examples of outspoken teleological thinking, though "functions" and "uses" and "benefits" are sometimes encountered in the usual manner and the story of causal relations is in some instances a bit befogged by apparent implication that things may happen in plants in order that specific results may be attained. The following sentences from page 75 constitute, however, a very real concession to the rational consideration of causality and the antecedent or etiological control of processes. Owing to their wide distribution, chemical reactions, and diverse duration, the ecologist finds it hard to assign any single function to these pigments [anthocyanins], and the physiologist may well entertain the idea in this connection, as in many others, that substances are formed or things are done just because they can be, not because they are indispensable or of any especial advantage. Indeed, even the speculative naturalist should accept such a hypothesis. . . ." From this really progressive "can-be" philosophy it may perhaps be but a short step to the "must-be" that characterizes the determinism of non-biological science and even of the experimental and practical aspects of physiology. With the meaning of "adaptation" in organisms our author has gone further, even to the logical limit, as this sentence from his introduction and many other statements unquestionably indicate: "They [organisms] are said to be 'adapted' to their environment; but it is difficult to see that they are any more adapted to their environment than is a crystal of common salt, which forms or not, which grows or disappears, according to its environment, and in its own way, peculiar to, and characteristic of the material of which it consists."

There is no intended implication of vitalism anywhere, I think, nor of purposeful processes in plants.

Perhaps the most characteristic features of Professor Peirce's volume are its conversationally critical style and mode of presentation as has been indicated, but it will specially attract the reader not only through its personal tone but also through repeated emphasis on the importance of plant physiology in the every-day affairs of human life and through the many examples drawn from the out-of-doors. "It behooves us, therefore, as citizens as well as physiologists, to investigate the processes of food manufacture, and, if we can, throw new light on the problem of world-old hunger" (page 43). Many applications of plant physiological science in agriculture, horticulture and forestry receive much attention, but the point of view of the philosophical scientist is everywhere kept to the fore.

Two chapters (pages 223–296) are devoted to irritability and most of the discussion of growth is there given. Discussion of growth in the abstract is purposely omitted, for the author says he is unable to conceive of growth as a physiological process apart from the influences to which the organism is subject (preface). These influences are classified as mechanical, chemical and radiant, and the discussion of them is full of originality. Although many of what most workers in this field would regard as important features of our knowledge of plant growth and plant response to environmental changes or asymmetry are omitted or receive but cursory mention, and although some philosophical hypotheses with relatively little direct experimental evidence are suggested, yet the examples and illustrations of the various formative and tropistic phenomena are ingeniously and interestingly chosen and discussed. The formative influences of mechanical pressures (such as those occasioned by gravitation) are presented in a novel way, with special reference to such asymmetrical thickenings as occur in tree branches, annual rings, etc. It is pointed out that pressure and contact stimuli may depend not only upon the mass pressures involved and their fluctuations, but also upon molecular pressures due to adhesion (or cohesion) forces operating where two different bodies are in contact. This part of the book should be very valuable and stimulating to somewhat advanced workers on plant responses.

The volume ends with a subject index, but there is no index of authors cited, and such an index would have been useful. Well-chosen and generally adequate citations are given as footnotes throughout the book. There are no drawings, diagrams or figures of any kind.

BURTON E. LIVINGSTON

DESERT LABORATORY,
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SCIENTIFIC APPARATUS AND LABORATORY METHODS

A SIMPLE METHOD OF USING SAFETY RAZOR BLADES FOR MICROTOME SECTIONS

A NUMBER of devices designed to grip safety razor blades in such a manner that they can be used as a substitute for microtome knives are supplied by apparatus dealers. Some workers find them entirely satisfactory for small objects imbedded in paraffin, while others are unable to use them at all. The common defect is a tendency for the wafer-like blades to vibrate, particularly when sectioning large and hard objects. Moreover, they can not be used for sectioning objects imbedded in celloidin or for woody stems, roots, etc., which are commonly sectioned without imbedding by means of a sliding microtome.

The writer finds that safety razor blades can be firmly attached to the flat surface of ordinary microtome knives by means of a film of paraffin. Vibration does not occur even when cutting large blocks of hard tissues and if the blade be attached to a shanked knife, sections of celloidin blocks or of stems can be cut with a sliding microtome. The method described below is that followed when paraffin is used as the adhesive. It is possible that shellac would be more convenient.

Shanked knives of Walb or Lenz manufacture are very satisfactory, as the lower surface is flat or only slightly hollow ground and they may be used with either rotary or sliding microtomes. A thin film of melted paraffin is spread over the area to which the blade is to be attached. Care should be taken to avoid excess. The paraffin should be of a high melt point. As soon as the film has cooled a safety razor blade is laid upon it so that it projects beyond the edge of the knife by the width of its own bevel. It should be held firmly in place with cover glass forceps or suitable spring clips, while the back of the knife is passed in and out of a flame until the paraffin melts. It should then be plunged into cold water and left until completely cool. If the heating be done carefully there is no danger of damaging either knife or blade. The knife should be tilted slightly so that the molten paraffin does not flow along the edge of the blade. When clamped in the microtome, the blade should be on the side of the knife toward the object.

Gillette blades are less satisfactory than heavier blades, such as Auto-Strop, Durham-Duplex, Enders and Keen-Kutter, partly because they are so thin that they may vibrate if used on large blocks and partly because they are seldom perfectly flat, hence do not lie in complete contact with the knife. The greater length of the Durham-Duplex blade makes it more satisfactory for objects imbedded in celloidin, but its