subject, Mind; it involves a synthesis of a number of sense-data according to laws that are not deducible from the nature of the external objects, or of the physiological actions of the end-organs and central organs of sense" (p. 468).

On the affective side, the authors hold to an "almost infinite variety of, not only our complex feelings, emotions and sentiments, but also of those" simpler feelings which have hitherto resisted analysis. Pleasantness and unpleasantness are regarded as merely the "tone" of feeling (p. 515). The esthetic feelings are treated at considerable length, while the moral feelings are only briefly mentioned. The chapter on memory gives the classic results on learning and includes a reference to Freud's new method of psychoanalysis for bringing submerged complexes to the surface (p. 586). The behavior of animals in learning mazes, etc., is described, and curves of human learning and forgetting are reproduced. The mechanism of thought is the subject of the last chapter in this part.

Part III., as in the earlier edition, takes a frankly dualistic attitude. "The two existences, body and mind, may not be identified by the science which investigates their correlations. . . . They are, however, dependently connected. Each stands in causal relations to the other; although this dependence appears to be by no means complete" (p. 653).

One can scarcely overestimate the labor involved in reconstructing such a work as this, written before the neurone theory was formulated, or the evolution of the brain worked out. The revision has been thorough, however, and the "Elements" becomes once more a standard reference-book for the experimental psychologist.

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A Text-book of Physiological Chemistry. By OLOF HAMMARSTEN, Emeritus Professor of Medical and Physiological Chemistry in the University of Upsala. Translation from revised seventh German edition by JOHN A. MANDEL, Sc.D., Professor of Chemistry in the New York University and Bellevue Hospital Medical College. Sixth American edition. New York, John Wiley & Sons. 1911. 8vo. Pp. viii + 964. Cloth, $4.00 net.

No familiar text-book of physiological chemistry published in recent times presents the interrelations between chemistry and physiology, between organic structure and function, in the effective way that Professor Hammarsten has followed through many editions. To the organic chemist a presentation like that of Röhmann's "Biochemie" may appeal because of its distinctively chemical viewpoint; but to the biologist and physician who are interested above all in the activities of living organisms, the emphasis upon function rather than composition is more acceptable and inspiring.

While others have compiled in cyclopedic handbooks of considerable magnitude the individual chapters of biochemistry prepared by diverse eminent contributors, Professor Hammarsten has continued to retain that comprehensive grasp upon the literature of this subject which has enabled him to condense into a single volume the essential facts of the science. To say that most workers in this field still turn to Hammarsten's "Text-book" as the readiest exponent of both the permanent acquisitions and tentative ideas in chemical physiology, is to pay a just tribute to its author's useful contribution as an educator.

There are signs of the expansion of the details of the science beyond the grasp of one individual. For the first time, a chapter (Physical Chemistry in Biology, by Professor S. G. Hedin, of Upsala) has been prepared by a collaborator. It is a readable presentation of topics—such as osmotic pressure, colloids, catalysis, enzymes, ions and salt action, in their physicochemical bearings—which are not always offered to the untrained appetite in a palatable form.

Without referring in detail to a book of which the essential features must be familiar to many, the reviewer ventures the opinion that the excellent chapter on metabolism is

not as widely appreciated as it deserves to be. There are few comparable or equally comprehensive outlines of the subject published in English. This chapter may serve also to illustrate the effectiveness of the revision which has been practised in the new edition. Not only are new facts introduced (American investigations not being overlooked), but discarded and unsubstantiated views have been conservatively eliminated. For example, there are found detailed allusions to the studies in "artificial" nutrition, Michaud's experiments on the protein minimum, Rubner's recent discussions on nutrition, Murlin's study of gelatin feeding, and the disputed problem of the specific dynamic action of foods. The discussion of obsolete obesity "cures," etc., has been omitted.

In the translator's preface Professor Mandel writes: "The work of translating and editing has been a labor of love, inasmuch as I feel that it will be of aid in the advance of this department of chemical science." He is right, and deserves a renewed expression of appreciation from biochemical workers for the faithful and correct execution of an uninviting task.

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SPECIAL ARTICLES

On the Nature and Seat of the Electromotive Forces Manifested by Living Organs[1]

1. When an organ of an animal or a plant is injured an electromotive force develops between the injured and the non-injured surface, the latter being, as a rule (if not always), positive to the former. Loeb suggested in 1897 that this difference of potential might be due to the fact that the injured spot formed an acid and that on account of the H-ion moving faster than the anion a difference of potential was produced. This assumption accounted for the sense of the E.M.F. in a partially injured organ. It was, however, pointed out that the order of magnitude of such diffusion elements is too small to account for the E.M.F. found in living organs. Wilhelm Ostwald had suggested the possibility that living organs form concentration elements with a solid phase interposed, the solid phase —the membrane—being permeable for certain ions only. Bernstein starting from Helmholtz's conception of free energy conceived the idea that measurements of the effect of temperature on the E.M.F. of a partially injured muscle or nerve might indicate the nature of the elements to which these systems belong. He reached the conclusion that the partially injured muscle belongs to the type of concentration element in which a solid phase—the membrane—separates the two liquids, the solid phase being only or more permeable to kations than to anions, thus corroborating Ostwald's suggestion.

Bernstein found that the E.M.F. of the muscle rises in general with the temperature and that it approaches a value in proportion to the temperature. The agreement was, however, not as good as should be desired to put the theory of concentration cell of the muscle current on an absolutely safe basis. Moreover, experiments on nerve were less satisfactory and in both cases accessory assumptions were required to make the actual results agree with the theory.

2. Muscles and nerves are, perhaps, too variable or rather perishable to investigate quantitatively with any degree of satisfaction the nature and origin of their E.M.F. We selected for this purpose a hardier and more constant object, namely, apples, the surface film of which is strong and which remains sufficiently constant during such an investigation. Instead of testing the effect of temperature on the E.M.F., we selected the effect of the concentration of the solutions in contact with the apple. The limit within which the temperature can be safely changed without injuring or modifying the living organ is very small and this is one of the reasons why Bernstein's figures are not quite satisfactory, as he himself recognized; while we can change the concentration on such living ob-

[1] Preliminary communication.