SCIENTIFIC LITERATURE.

Electro-Physiology. By W. BIEDERMANN, Professor in Physiology in Jena. Translated by FRANCES A. WELBY. Macmillan & Co., London and New York. 1896. Vol. I. Pp. 522.

The perusal of such a work rather 'takes it out of one' under the most favorable conditions. With regard to the present treatise, a great deal may be said in praise of the patience with which the material has been collated, and the soundness of the conclusions which have been drawn from experimental facts. Indeed, the scientific independence of the author is evinced in the homogeneity of the work, which is far from being a mere compilation. On the other hand, the intrinsic difficulties of the subject are much increased by the labored style of their presentation; the sentences are frequently huge in length, and the noun substantive is commonly required to be carried in mind through several successive paragraphs. The pedagogic error, so common with investigators, of presuming too much on the ability of the student to read between the lines, is here too constantly illustrated. Another practical defect of the work is the lack of topical subdivisions of its subject-matter, by which device the reader might have been enabled to refer at once to any desired point of the discussion. Also, in a book designed chiefly for the use of investigators, a more complete bibliography of the subject than that which has been given might fairly have been expected. In all these respects the work is far less admirable than that which pertains to the same subject in Hermann's *Handbuch der Physiologie*, published seventeen years ago, and is much inferior in the presentation of its histological sections to the corresponding parts of *Quain's Anatomy*.

The name 'Electro-Physiology,' by which the book is announced, is ill-chosen and by no means denotes its scope, as is evidenced by the following chapter divisions of the subject:

1. Organization and Structure of Muscle, pp. 51.

2. Change of Form in Muscle during Activity, pp. 199.

3. The Electrical Excitation of Muscle, pp. 156.

4. Electro-motive Action in Muscle, pp. 122.

5. Electro-motive Action of Epithelial and Gland Cells, pp. 57.

After giving due weight to these criticisms, it is only fair to say that, since the appearance of Hermann's *Handbuch*, there has been no such approach to providing the student of physiology with a complete exposition of present knowledge of the field covered, as is made by this treatise of Biedermann.

When the reader has become familiar with the intricacies of his style it is clearly seen that the author is master of his subject; he has succeeded to a singular degree in linking his data into a continuous story, which, now and then, is summarized to show what general truths have been gained and whither they lead. It is the opprobrium of our knowledge of nerve-muscle physiology that, though its study has developed a vast number of experimental facts, it is well-nigh impossible to sift those that pertain essentially to the living organism from those of purely instrumental origin. Professor Biedermann, while giving full treatment of the experimental processes lying at the base of his conclusions, has done much towards providing a philosophical exposition of our knowledge. The author is at his best the greater the intrinsic difficulty of the subject he expounds; while, *e. g.*, his description of the comparative histology of muscle lacks much in clearness, his account of the intricate optical changes undergone by the contracting tissue is admirable. The statement, p. 55, that a single muscular twitch is characterized by 'rapid contraction, with much slower subsequent elongation,' is certainly misleading as regards the action of fresh muscle under tension. The so-called 'latent period' of muscular excitement, or the time elapsing between the application of a stimulus and the beginning of muscular shortening, which was first announced by Helmholtz to have the value of about .01 sec., has gradually been reduced by subsequent investigators.

The author's discussion of this subject is one of his best. It is strange, however, that the mechanical factor involved in the latent period is neither here nor in other works more clearly expressed. As the strength of a single stimulus is gradually increased, so as to produce a series

of contractions varying from minimal to maximal in amplitude, the latent period is observed to become progressively shorter. The weaker waves of submaximal contraction do not pass through the full length of the muscle, and the unexcited part of the tissue acts simply as an elastic band whose tension must be increased to a definite degree before visible shortening of the whole muscle can take place. It can readily be seen that the time lost through the extensibility of the uncontracting part of a muscle fibre largely accounts for the 'latent period of stimulation.' The adjective 'Subliminal,' used by the translator to express a stimulus too weak to excite contraction, is not to be found in Webster.

Errors of type and expression in the work are not numerous; but in the figures of tracings representing the effect of rest on the curve of muscular fatigue the increased height in the contractions immediately following an interval of rest is not represented. Also, on page 540, the terms hilus and hilum are used indifferently.

Certain views which are implied, rather than expressed, should not be admitted without specific inquiry. Thus, the author assumes a likeness in kind between those summations of stimuli, each stimulus by itself being ineffective, which, on the one hand, produce tetanus in certain slowly moving muscles, and, on the other, cause reflex action from the spinal cord when applied to a sensory surface (p. 119). It is a satisfaction to find, at last, an author who gives true value to current *density* as a physiological stimulus rather than to current *intensity*; a current of given intensity has very different stimulating powers according as it is led to the tissues through broad or narrow electrodes. To the younger student, the explanation that physiological kathode, or point of excitation by the electric current, is at the place where the current *leaves* the irritable tissue, will clear up many obscure results of experiment. The author draws, perhaps, too close an analogy between the polar excitation effects shown by some protozoa on the passage of a constant current through them and the excitatory phenomena of muscle and nerve. There is nowhere to be found a more complete discussion of du Bois-Reymond's law of the excitation of irritable tissues. The law asserts, in brief, that it is not the absolute intensity of the stimulus which determines its irritating value, but fluctuation in intensity. Biedermann shows that the prolonged contraction manifested by muscle during the passage of a constant current through it forms no true exception to the law. He also calls attention to a needed amendment to du Bois-Reymond's law, in that "not merely the *local* changes at the seat of excitation, but still more the propagation of the excitatory process, *i. e.*, the discharge of a wave of excitation (contraction), are dependent upon the *variations* of current intensity, and the steepness of the same, in the case of tissues in which conductivity is adequately developed. The 'universal law of excitation' refers, therefore, less to the manner of the excitatory process, and effectuation of the changes of the excitable substance fundamental to it, *at the seat of direct excitation* (physiological anode and kathode), than to the conditions of the propagation of the excitatory process by conduction" (p. 314).

It is a disappointment to find that, as yet, there is little light to be shed upon the relations between the excitatory and contraction waves of muscle.

Much abtruse and technical literature would have to be culled in order to reach the results so ably summarized in the sections on electromotive action in muscle; particularly satisfactory are the pages devoted to the 'Positive variation of the muscle current.'

It is a worthy reward for all the thought and labor that for nearly fifty years have been devoted to electro-physiology, to find that here the facts are pointing to a physiological generalization which was first conceived in another field of the science. A decade ago Gaskell, as the result of a masterly series of researches, concluded that to each contractile tissue there were supplied two forms of nerve fibre, a motor and an inhibitory branch, the former exciting to functional activity and the latter bringing the organ to rest. As motor action, representing evolution of energy, is a result of chemical disassimilation, so inhibition is coincident with absorption of energy by a tissue and its chemical change is one of assimilation. This theory, arrived at by a study of the phenomena

of muscular contraction, is now supported by results obtained through the study of the electrical changes set up in muscle by artificial stimulation. In brief, the chemical changes of disassimilation, coincident with functional activity, which are brought about by stimulation of the motor nerve, cause the active part of the tissue to become electro-negative to the resting part.

On the other hand, certain other efferent nerves, having an inhibitory effect, cause, when stimulated, the part of the muscle under their influence to become electro-positive to the resting part. In all probability these nerves also excite chemical assimilation and the absorption of energy.

It is approaching an anti-climax to turn from such a conception as this to the arid field of glandular electricity. Here the mechanical difficulties in the way of experimentation have affected the purity of results to such a degree that little of physiological importance can, as yet, be predicated from the work. In conclusion, a word of admiration is due the translator to whose fortitude we are indebted for this work in its present form. The rendition seems, for the most part, to be excellent; and the bookmaking by Macmillan is, of course, of the best.

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The Coming Ice Age. By C. A. M. TABER. Geo. H. Ellis. 1896. Pp. 94.

The difficulty of accounting for the Glacial period is so great and the disagreement of glacialists is so profound that one cannot but welcome any sincere effort to shed additional light upon the subject. Especially is one inclined to give a candid hearing to an experienced navigator who has been led to study the effects of ocean currents upon climatic conditions. Such is the author of this little volume, who, in his extensive voyages had his attention directed to the subject at an early date, and in later years has made his personal observations the basis for collecting a large body of facts otherwise attainable.

The theory of the author is that a land connection between Patagonia and the Antarctic Continent, or a great diminution of the channel between those lands, would produce an effect upon oceanic currents favorable to the glaciation of both hemispheres. In supposing such a land connection he is in company with many zoologists who have inferred the same from the unique distribution of the plants and animals of the southern hemisphere.

Assuming this extension of land from Patagonia to the Antarctic Continent, the effect upon the currents would be, according to the author, as follows: The prevailing westerly winds in the south temperate zone would pile the waters up against the western side, and would drive them away from the eastern side of the southern part of this continent. The shape of the continents and the general direction of ocean currents are such that during this condition of things there would be a movement of water towards the south pole in excess of that moving toward the north pole. This accumulation of water about the south pole would be increased by the attraction of the water until there was a submergence of the isthmus connecting Patagonia with the Antarctic Continent, such as to allow a free passage from the higher levels of the Pacific to the lower levels of the Atlantic in that latitude. This water from the Pacific, being a cold current, would displace that which had formerly been drawn down from the tropics on the east side of South America, and thus lower the temperature of the Antarctic Continent and produce conditions favorable to glaciation, such as exist at the present time. These conditions he believes to be cumulative.

This very general statement of the theory passes over many details, and it may be that it does not in all respects fairly represent the author's views. But we are compelled to confess that his style is so obscure, and his digressions are so frequent, that we have found it difficult to be sure that we have comprehended his meaning. The author's confidence in the stability of the earth's crust is such that he is not willing to grant the moderate changes of level in the sea-bottom south of Patagonia which would be necessary to secure the submergence there which his theory demands; therefore, he is compelled to throw the whole burden upon the winds and the augmenting attraction of the