

circumstances permit, of the principles and practice of the progressive gardener. This is very obvious to those conversant with the state of commercial horticulture, as contrasted with the condition of the corresponding department of agriculture, and it will be brought home to the thoughtful reader by the perusal of some of Mr. Paul's pages. It is interesting, too, to see that matters at which some minds would still be inclined to scoff as unpractical, or which they would regard as mere means of affording agreeable recreation, are the very departments in which the greatest practical successes have been achieved in the past, and which are of the best augury for progress in the future.

Biologically speaking, Mr. Paul has been not only a keen observer but a careful experimenter on a very large scale, and over a very long period. It is true his experiments have not been and could not have been made with the exact accuracy which we expect in the laboratory, but they have been made under conditions far more akin to those which occur in nature. Moreover, they have been made, although with a definite aim, yet without reference to any particular theory. The reader will accordingly find in these pages records of work and inferences from carefully planned experiments directly bearing on many subjects now attracting the attention of naturalists, such as hereditary transmission, variation from seed or from bud, selection, fixation, close fertilization, and the various degrees of cross-impregnation. Incidentally these subjects receive illustration in many chapters of Mr. Paul's book; but the address on "The Improvement of Plants," which was read in 1869 before the provincial meeting of the Royal Horticultural Society at Manchester, contains a summary of Mr. Paul's views on these subjects, which we strongly commend alike to the notice of naturalists and of agriculturists.

It is very interesting to compare what he says about selection and variation in plants, such as the Camellia, the Chinese Primrose, or the Hollyhock, which are the offspring of what we regard as pure species, with the corresponding processes in the Rose, the Pelargonium, or the Chrysanthemum, which are veritable mongrels. In this connection we may in passing allude to the power which the gardener has, of course within limitations, of creating new forms. The orchid cultivator, for example, inferred parentage of certain hybrids met with in a wild state, but he has since proved the correctness of his inference by actually producing in his orchid-house many of the same forms that occur in the forests of the tropics. Another very striking case (not specially alluded to by Mr. Paul) is the production and development of what are known as tuberous Begonias. These have been evolved by the art and patience of the gardener within the last quarter of a century from repeated crossing between certain Andean species of Begonia and their descendants. The result is the establishment of a race so totally distinct from anything yet known in nature as would justify a systematic botanist in forming a separate genus for their reception. Many an accepted genus is based upon less important points of distinction than those which characterize the tuberous Begonias, and which, indeed, have been gathered together by Fournier under the genus *Lemoinea*. The degree of permanence of this artificially formed genus is, of course, unknown; but we

do know already that the peculiarities are reproduced from seed, and that each year the plants are, as the gardeners say, becoming more "fixed." We have alluded to these as illustrations of the kind of work upon which Mr. Paul has been engaged for half a century. They may be taken as examples of the material he has gathered together in this book, which is not merely presented for the delectation of the ordinary lover of flowers or the profit of trading horticulturists, but is also calculated to increase the productive resources of the country, as well as to forward the progressive development of our knowledge of the natural history of plants.

As a further illustration of Mr. Paul's method we cite in conclusion a passage which will, we think, justify us for recommending to scientific readers the perusal of a book which they might be disposed, from its title, to think had little in it to interest them. "My experience in selecting, hybridizing, and cross-breeding tells me that he who is seeking to improve any class of plants should watch narrowly and seize with alacrity any deviation from the fixed character, and the wider the deviation the greater are the chances of an important issue. However unpromising in appearance at the outset, he knows not what issues may lie concealed in a variation, sport, hybrid, or cross-bred, or what the ground newly broken is capable of yielding under careful and assiduous cultivation. If we would succeed in this field we must observe, and think, and work. Observation and experiment are the only true sources of knowledge in nature, and while observing and experimenting we should above all things guard against prejudices."

MAXWELL T. MASTERS.

LIFE IN MOTION.

Life in Motion; or, Muscle and Nerve. By John Gray McKendrick, M.D., F.R.S. (Adam and Charles Black, 1892.)

UNDER this title Prof. McKendrick gives us the gist of six lectures delivered by him during last Christmas holidays to a juvenile audience at the Royal Institution of Great Britain; and, judging from this little work, it is evident that no pains was spared by him to render these lectures as instructive and interesting as abundant illustrations and experiments could make them. In presenting these lectures to the public in book form he places us under an obligation gratefully to be acknowledged, for professional physiologists stand alone amongst their colleagues in other departments of science in their disdain of any attempt at the production of attractive and simple scientific literature. In very pleasing sympathetic style the reader is introduced to the world of motion and to the special motions of the living muscle. He is shown how the movements of a muscle are recorded by the physiologist, and the apparatus used for its stimulation. Artificial tetanus is described, the muscle sound and its elasticity referred to, and a perhaps too short description given of amœboid and ciliary motion. The physiology of the nerve is then discussed, and the production of heat in muscle. In the fifth lecture is a short account of the sources of muscular energy, a comparison is drawn between a muscle and the steam-engine, and a comparatively detailed account of muscle fatigue is given.

The sixth and final lecture deals with the electrical phenomena of muscle and with a very curious group of fishes termed "electrical."

The arrangement of the book is excellent, yet we are inclined to think that it shares with many other works on physiology one common fault. What we all want to know more about is the life and activity of the organism, and the physiologist very rightly spends much of his time in experimenting in every conceivable way, and generally with isolated parts of the organism. His apparatus is often of the most varied and intricate kind, and his experiments yield him definite results. Many of these results, however, are at present of little value in shedding light on physiological processes, and should not, we think, obtain the prominent position they now occupy in the text-books. To take an example, the experiment to demonstrate the muscle curve, in which the muscle is isolated and stimulated electrically, is one of the stock experiments minutely described in every text-book. In this experiment the muscle is separated from its antagonistic muscles, stimulated in quite an unnatural way, and the result of the experiment is totally different from what takes place in a contracting limb. It is certain that in nearly every text-book the reader will find that from this and similar experiments he is apt to obtain incorrect and misleading ideas. He no doubt learns something regarding very interesting electrical machinery, but very little physiology. Of recent years far more attention has been bestowed upon the movements of muscles in the limbs, and comparative physiology is at last asserting its influence. It is to be hoped that when this knowledge finds a more prominent place in text-book literature, "muscle and nerve physiology," in the proper sense of the term, will be more satisfactorily taught.

Returning to what more exclusively concerns Prof. McKendrick's book, we may point out a slip on page 81, where it would appear that the muscle sound corresponds in pitch to the fundamental tone of a body vibrating 19.5 times a second, instead of to one vibrating at twice that rate, and that Prof. McKendrick does not interpret this sound on the lines followed by Helmholtz and others. On page 91 the modern view of a "cell" is represented in a drawing, and the nucleus has inadvertently been omitted. On page 31 a long and short circuiting key is represented, while a simple key is described in the accompanying text. These, however, are but trivial faults to find in an excellent little work, which is most admirably got up and beautifully illustrated by nearly one hundred excellent figures.

The reader will, we think, obtain a good insight into a department of physiology, and will be stimulated to further research in the literature of this interesting subject.

J. B. H.

PLUMBING.

Principles and Practice of Plumbing. By S. Stevens Hellyer. (London: George Bell and Sons, 1891.)

THOSE who are acquainted with Mr. Hellyer's larger book on domestic Sanitation, "*Dulce Domum*," will not find much new matter in the present volume, but

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the subjects are treated less discursively, and are fairly well brought down to date.

There is no trade which has been more discussed in recent years than that of plumbing, and if plumbers are not impressed with a sense of their responsibilities, it is certainly not the fault of the architects and engineers who employ them. The manual skill necessary to perform the most ordinary operations is in itself so difficult that many workmen fail to acquire it; and, on the other hand, many experts in the details of the craft are never properly educated in the principles of sanitation which are necessary to make their work effectual from a sanitary standpoint. It is the combination of both kinds of knowledge in the writer which makes Mr. Hellyer's books of exceptional value. It matters little whether it is an architect on one hand, or a working plumber on the other, who studies them, because they are of equal value and of equal interest to both. The present handbook is specially valuable in these respects because most of the information upon matters of practical workmanship is given concurrently with the reasons which should control the details and the principles which should be in evidence when the work is finished.

No one unacquainted with the practical difficulties which frequently crop up in sanitary practice can realise how much knowledge and experience is necessary to overcome them. Houses in London often present the most puzzling problems, and an intimate acquaintance not only with the principles and practice of the subject, but also with all the most recent appliances, is required for their successful solution. The ventilation of all the different parts of a complicated drainage system, including that which is necessary to prevent the syphonage of traps, sometimes requires an amount of thought and attention which a layman would think was uncalled for in the face of its apparent simplicity. It is no wonder that there are frequently failures to meet the highest standard of excellence, especially when incompetent persons are employed to design and superintend the necessary operations. On the other hand, there are thousands of houses in London in which no such difficulties occur, and in which the drainage and plumbing arrangements ought not only to be extremely simple in themselves, but intelligible to the ordinary householder. When such cases are entrusted to a builder, or an intelligent plumber, the first requisite is the manual skill required to carry out the various details, and this must be acquired by the workman through apprenticeship, or from his having acted as the assistant or "mate" of a journeyman for several years. The next requisite is that he should have a clear knowledge of what he is going to do and why he does it. This may be acquired to a great extent from his being familiar, in his capacity as a workman, with the designs of an architect or engineer under whose directions he has been employed, and it is to such men that Mr. Hellyer's text-book should be specially valuable. By studying its pages he will avoid many mistakes. He will know what sort of joint to make, what kind of trap to avoid, how to secure the traps from syphonage, and how generally to complete his work so as to pass the latest standards of excellence. We can equally recommend it as a text-book for architects