

it not more important to commend the great labor which he has bestowed upon it, than to search for the little errors that are unavoidable in every attempt to cover a field extending so far beyond the possible limits of any one entomologist's experience. Our critical inclination gives way to our gratitude to Professor Packard for having accomplished so well what very few would have the courage to undertake, and fewer still the ability and preparation to execute. With the books of Professors Packard, Comstock and Sharp on his shelves, the beginning entomologist of to-day will find before him a short and pleasant path to a knowledge of his subject instead of the long and tortuous course which many American entomologists have had to pursue. With these works the 'modern morphologist,' who is often not a little proud of knowing nothing about Hexapods, can fill a gap in his library, if not in his information. The wide-awake morphologist or physiologist who turns the pages of these works will see suggestions of many great problems and of greater opportunities for work than he may be able to find in the more limited and more nearly exhausted fields of annelid and vertebrate morphology. Insects have been long and lovingly studied, but we have scarcely begun to know more than a few superficial facts concerning them. Professor Packard's book, we venture to predict, will, in the course of time, attract many American students to the study of the intricate organization and development of insects and thereby lead indirectly but surely to an increase of our knowledge.

WILLIAM MORTON WHEELER.

Pasteur. By PERCY FRANKLAND and MRS. PERCY FRANKLAND. New York, The Macmillan Company. 1898. Pp. 224. Price, \$1.25.

Of few men of science can it be said more truly than of Pasteur that the story of his life is found in his work. Judged by ordinary standards his life itself was not an eventful one, and the simple record of his scientific achievements constitutes perforce the larger part of any biography. In order to understand what significance these achievements possessed for Pasteur's contemporaries and what they mean

to his successors it is necessary to correlate the discoveries made by Pasteur both with the condition of science in his time and with our present knowledge, and the deftness with which such a relation is traced becomes a fair measure of the biographer's success. For this task the present biographers are unusually well equipped, and they have approached the subject with an appreciation of the simplicity of the man and the dignity of his undertakings that has given us a most readable account of the life-work of the great master.

Louis Pasteur was born at Dôle on the 27th of December, 1822, and was of humble origin, his father being the owner of a small tannery. By dint of great sacrifices on the part of his parents, Louis was given early opportunities for study, and the boy soon attracted the attention of his teachers through his great diligence, energy and enthusiasm. When he was twenty-one years of age he went up to Paris to the École Normale and threw himself almost at once into the work of investigation. He fell first under the influence of Biot and began that study of the crystals of tartaric acid which led to the remarkable discovery of the spatial relations subsisting between the atoms within the molecule and blazed the way for the fruitful generalizations of stereo-chemistry.

M. Duclaux, in his admirable book, '*Pasteur: Histoire d'un Esprit*,' has recently grouped Pasteur's researches under eight heads: Studies in Crystallography, The Lactic and Alcoholic Fermentations, Spontaneous Generation, Researches upon the Diseases of Wine and Vinegar, The Silkworm Disease, Studies on Beer, The Etiology of Infectious Diseases and Researches upon Vaccines, and our authors have in the main followed this grouping. It may be doubted if the history of science offers a better illustration of the way in which scientific research carries a worker irresistibly along on its own current, sometimes rendering him a foiled, circuitous wanderer, sometimes, as with Pasteur, leading from one channel into another with the horizon always widening out as the water deepens around him.

That perennially interesting subject, Pasteur's controversy with Liebig over the theory of fermentation and decay, is treated by our

authors in a thoroughly judicial way, although with a bias towards Pasteur's main contention perhaps unavoidable in the light of our present knowledge. "Those who attempt to explain the putrefaction of animal substances by animalcules," wrote Liebig, "argue much in the same way as a child who imagines he can explain the rapidity of flow of the river Rhine by attributing it to the violent agitations caused by the numerous water-wheels of Mainz, in the neighborhood of Bingen." Liebig, as is well known, was soon forced to retreat from the position that the alcoholic fermentation is due not to the activity of the living yeast plant, but to the decomposition of the nitrogenous components, and was obliged to yield to the overwhelming evidence adduced by Pasteur in support of the view that not the dead or the dying, but the live yeast-cell was responsible for the phenomenon. Liebig later acknowledged defeat so far as to admit the share of the live yeast plant in the process, but still clung tenaciously to his hypothesis of a transmission of molecular vibration, itself a modification of the view long before advanced by Willis and Stahl, while Pasteur advocated with equal tenacity the view that the yeast plant simply breathes at the expense of the oxygen of the sugar molecule. The recent discovery by E. Buchner of an alcohol-generating enzyme in the fluid pressed out of pulverized yeast-cells—a discovery, by the way, sadly in need of confirmation—can hardly be said to conclude the controversy, although bringing us to somewhat closer quarters with the real problem.

Pasteur's memorable researches upon anthrax are described at some length and in a very interesting fashion, although with an exaggeration of the hero's rôle as compared with that of Koch and others, which is perhaps more pardonable in a biographer than it would be in an historian of science. There are not lacking some other instances of unnecessary magnification of Pasteur's achievements—although one is tempted to ask oneself if they can ever really be made to bulk too large—and of French bacteriology in general. Is it quite correct, for instance, to mention Calmette's work upon the production of immunity towards abrin (p. 197) in such a way as to convey the impression that

he was the pioneer in this work? Despite some blemishes of this sort, however, and despite, too, an excess of divided infinitives and a profusion of bellicose metaphors, this biography presents a just and interesting account of the life of a great man.

The closing chapters of the book contain a vivid and picturesque description of the master's methods of work, of his founding of the Institut Pasteur, of his work on rabies and of his last years. In simplicity of life and in the patience, persistence and fire that mark the genius, Pasteur stands as one of the shining figures in the science of the century. "He makes me uneasy," said one of his early friends; "he does not recognize the limits of science; he loves only quite insoluble problems." At the dedication, on November 14, 1888, of the great institution that bears his name, Pasteur himself gave a bit of his inmost life. "This that I ask of you is what you again, in your turn, will demand of the disciples who gather round you, and for the investigator it is the hardest ordeal which he can be asked to face, to believe that he has discovered a great scientific truth, to be possessed with a feverish desire to make it known and yet to impose silence on himself for days, for weeks, sometimes for years, whilst striving to destroy those very conclusions and only permitting himself to proclaim his discovery when all the adverse hypotheses have been exhausted." Yes, that is a difficult task.

"But when, after many trials, you have at length succeeded in dissipating every doubt, the human soul experiences one of the greatest joys of which it is capable."

EDWIN O. JORDAN.

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A College Course of Laboratory Experiments in General Physics. By SAMUEL W. STRATTON and ROBERT A. MILLIKAN. Chicago, The University of Chicago Press. 1898. Pp. 100.

In a recent issue of SCIENCE a writer whose specialty is chemistry refers to the following remark in which he had indulged: "There is small doubt that, were it not for the expense of printing, every teacher of chemistry would use a text-book made by himself with either pen