

mental laws of thermodynamics, giving the relations between temperature and entropy, the study of cycles, entropy computations, applications to vapor and gas-engines, and closing with elaborate illustration in discussion of the results of a steam-engine trial. The discussion of the physics of steam by this method is particularly complete and valuable and the tables appended will be found useful on many occasions. Within the sixty-six pages of text there are to be found abundance of suggestions and instruction and the whole is written in a thoroughly scientific and systematic manner, without waste of words or loss of energy in diffuse explanation.

It should be noted by the readers of these little treatises that, occasionally, in the diagrams, an error will be noted in the assignment of a quantity of entropy to a mixture of steam and water less than that of water alone.

The interested reader of this collection of brochures should complete his work, if not already familiar with them, by examining the added list of papers. Professor Gibbs, as the real pioneer in the use of this interesting method, Linde as the first to apply it to the refrigerating machine, Gray as the writer whose enthusiastic and painstaking elaboration of the system first brought it to the attention of engineers in such a manner as to insure its careful examination and later general use, Willans, the pioneer in its application as a regular process of reduction of observational data to form for deduction, and Sankey, his co-laborer, also, are entitled to distinction only less than that accorded to the founders of the science which this system illustrates. Professor Durand, illustrating talent as an instructor as well as familiarity with the state of the art to date, presents the most complete and intelligible exposition of the theory of the entropies—for he shows that there may be an indefinite number—and, availing himself of suggestions by Ancona in a very notable paper in the *Zeitschrift* of the German Society of Civil Engineers for 1897, produces diagrams which are read with great ease and interpreted as readily. This is a luminous and clear as well as concise exposition of the subject.

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*Alternating Currents of Electricity and the Theory of Transformers.* By ALFRED STILL. Whittaker & Co. 8vo. 1898. 179 pages.

*Alternate Currents in Practice.* Translated from the French of Loppé and Bouquet by F. J. MOFFETT. Whittaker & Co. 8vo. 1898. 372 pages.

In the application of science to engineering the scientific principles involved have usually been very fully developed beforehand by the student of pure science. In the engineering applications of alternating currents, however, our educational and scientific men have been behindhand. The fundamental mathematical principles of alternating currents have indeed been developed mainly by men outside of the engineering profession, as exemplified by the epoch-making book of Bedell and Crehore, but the theory of actual engineering apparatus, such as the transformer, the rotary converter, the induction motor, etc., has been developed mainly by the engineer, and during the past few years our electrical engineering instructors have been looking eagerly to the manufacturing electrical engineer, not only for the details of design and construction, but also for the full and complete theory of their machinery as well. The engineer who has contributed most in this line is perhaps C. P. Steinmetz.

The electrical engineering instructor has now access to literature containing very complete developments of fundamental principles and very complete theoretical analysis of actual engineering machinery, and the problem which confronts him is to adapt this wealth to the requirements of instruction.

Instruction in electrical engineering should consist of two parts, as it seems to us, namely, an elementary part in which the general principles of the various branches of the subject are systematically developed, and a more practical part devoted to the design, construction and operation of machines, appliances and installations. In some branches of electrical engineering, indeed, the elementary part is little more than a course in theoretical electricity, but in alternating currents a great variety of principles arise which are not properly included in any general course in electrical theory, and it seems proper for the student to

be taken through a course of study in the analytical theory of the alternator, the transformer, etc., before beginning the practical study of alternating current appliances.

The separation of theoretical and practical treatises seems to us to be highly desirable, for our experience is that nothing obscures an elementary treatise (that is, the elementary part) so much as the introduction of practical matter not needed for purposes of illustration, and we conceive that nothing is so annoying to a well instructed engineer as to have his engineering literature highly diluted with elementary matter.

*Alternating Currents*, by Alfred Still, is an excellent, clean cut, elementary treatise. Pages 1 to 116 are devoted to the general principles of alternating currents and the remainder is devoted to the theory of the transformer. In reading this book one has a desire to know what the author might have to say of the synchronous motor and rotary converter, and of the induction motor, so simply and satisfactorily is the theory of the transformer worked out. One cannot of course judge whether or not the author realizes the paramount importance of these machines and the need for a simple exposition of their theory.

In speaking of the expression  $B = \mu H$  the author says that "the point which is not generally clearly explained is that there is no necessity whatever, to consider the iron core removed, or even to imagine longitudinal holes drilled through the mass of the iron in order to understand what is meant by  $H$  in the above relation." However, we do not know what actually takes place in magnetized iron and in the specification of the state of magnetization of a rod we can, and do, specify only what is happening outside the rod or in holes drilled through the rod.

In speaking of magnetic leakage the author devotes his attention mainly to that case in which the *trend* of the useful magnetic flux would be but little altered by the removal of all iron parts the flux being, of course, reduced in value. In this case the magnetic leakage generally decreases with increasing excitation. The most frequent case in practice, however, is that in which the *trend* of the useful flux would

be greatly altered by the removal of the iron parts, as for example in the dynamo. In this case the magnetic leakage increases with increasing excitation.

Mr. Still's book "has been written not only for engineering students, but also for those engineers who are but slightly acquainted with alternating current problems." We cannot agree with the author that for this class of readers analytical methods are unsuitable for the solution of alternating current problems. The engineer who attempts the graphical method soon finds it to be impracticable except only as an aid in the formulation of analytical solutions. Steinmetz' method seems to us to be the simplest method for obtaining numerical results and the only method to be called practicable.

*Alternate currents in practice*, translated from the French by Francis J. Moffett, is a good discussion of a great variety of practical alternating current apparatus with comparatively little useless or misplaced elementary matter. Mr. Moffett says that to the best of his knowledge there is no work in existence in England at the present time which treats in a practical manner the whole range of alternating currents of electricity and we do not know of any such work in America for the admirable works of Bedell, Jackson and Steinmetz are distinctly theoretical.

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*Das Tierreich Sporozoa.* By ALPHONSE LABBÉ.

Eine Zusammenstellung und Kennzeichnung der rezenten Tierformen. Herausgegeben von der Deutschen Zoologischen Gesellschaft. 5 Lieferung. Protozoa, Sporozoa. Berlin, Friedländer & Sohn. 1899. Pp. xx + 180.

As indicated by the descriptive title of *Das Tierreich*, a zoological dictionary of which Franz Eilhard Schultze is the chief editor, it is no part of the undertaking to give a general account of the classes of animals considered, but merely recognizable descriptions of all known species. For the present volume—the *Sporozoa*—a better man than Alph. Labbé could not have been chosen, and, so far as the sporulation is concerned and the determination of species through spores, or the hosts of the