

of the free negative charge as an electron. It is true that two chapters are devoted to the subject of radio-activity, concerning which we read in the preface:—

“ Sur la radioactivité de la matière . . . nous avons dit que des généralités. Le domaine des faits dans cet ordre d'idées est si vaste et surtout si mobile, qu'il est encore très difficile de s'y orienter.”

Ideas at the present time in radio-activity are more definite and well-grounded than in any other branch of physical chemistry, but it is clear the author's lack of knowledge in the recent and even the older work of the subject is responsible for his views. In subsequent editions this part of the work might be omitted. It follows, no doubt, the precedent set by Sir J. J. Thomson's well-known book on the conduction of electricity through gases; but what was natural enough when that book was written does not apply to a book published in 1909.

In the ground covered, the work does not differ materially from the one just quoted and many similar which have since appeared, but the treatment is interesting and lucid, and the critical examination and selection of the material chosen for presentation has been done impartially and well. The lack of any conspicuous originality is compensated for by clearness of exposition. In one respect, in that this is a French work dealing with a scientific movement which, if we exclude radio-activity, has proceeded mainly from this country and from Germany, the author is at an advantage, for the whole territory is surveyed in better perspective in consequence.

Both in the first part, which is of a general elementary character, and in the second, which deals for the most part with the mathematical theory of ions in physical phenomena, the author introduces his subject with an excellent account of the older work on the passage of electricity through ionised liquids before passing on to the newer ideas which followed the study of the discharge of electricity, first in high vacua and later, after the discovery of X-rays and other ionising agencies, in gases at various pressures. We are thankful for this juxtaposition of subjects which are usually regarded as independent owing to the fact that the one has been largely developed by chemists and the other by physicists; but at the same time it brings out the difficulties that arise when we seek to apply the newer views to the case of liquid electrolytes. The two subjects have surprisingly little connection with one another at the present time, and anyone who has to teach both must be painfully aware of the difficulties of harmonising them. In this book the newer work on gaseous ions and their properties, the various means of producing ionisation by cathode-rays, X-rays, flames, &c., the re-combination and diffusion of ions are discussed very thoroughly from the physical point of view along regular lines. In the second part an account of the electronic theories of metallic conduction and of magneto-optical phenomena is given, while the more metaphysical developments connected with the electronic constitution of matter, and the entanglement of ether by moving masses

are properly left to the end of the two parts respectively. The book has no index, and is marred by an extraordinary number of misprints, the rectification of which occupies many pages of errata at the end.

#### OUR BOOK SHELF.

*Problemi grafici di Trazione Ferroviaria.* By P. Oppizzi. Pp. viii+204. (Milan: Ulrico Hoepli, 1909.) Price 3.50 lire.

IN the preface the author tells us that although graphic methods are often used by the general mechanical engineer, they have up to now been neglected by the railway engineer. This book is intended to show how such methods may be applied to the solution of nearly all problems in connection with the working of trains on railways. In this object the author has well succeeded, and it may safely be predicted that any reader who has once used graphics in the very easy and simple manner represented in this book will never again have recourse to analytical methods. Indeed, there are cases where analysis becomes so complicated that its use by a busy engineer, even if he has the required mathematical ability, is out of the question; as an example may be cited the acceleration diagram of a train drawn by a steam locomotive. Tractive effort and resistance vary in a very complicated manner with the speed, and this, again, being the time integral of acceleration, which in turn depends on the difference between tractive effort and resistance, it is easy to see that a purely analytical treatment leads to almost hopelessly involved formulæ. Yet the author is able to solve this and many other problems by his graphics in a comparatively easy way, and with a degree of accuracy quite sufficient for practical purposes.

The book contains eight chapters, in which the following subjects are treated:—train resistance as a function of speed, weight, and type of coach and locomotive; tractive effort of locomotives of various types at various speeds, gradients, and curvature of line; speed-time-distance diagrams during acceleration; possibility of making up for lost time; running down long gradients and action of brakes; total time required for a given run; consumption of fuel or electrical energy and conditions of greatest economy; efficiency of service. In all cases the author gives numerous examples to show the application of his methods to cases which are taken from practical work, and thus even a reader whose mathematical knowledge is only elementary is able to profit by this book.

This work should prove most useful to railway engineers, and an English translation would be welcome to many. There is only one fault to find with the book, and that is the very untidy appearance of the diagrams. They have all been drawn on squared paper, the divisions being in millimetres. A page covered closely with such lines is very tiring to the eyes, and if, in addition to the multiplicity of lines, there is some writing added to the curves and the whole is reduced in rather a coarse way by photography, the effect is by no means pleasing. It would have been better if the author had omitted the millimetre divisions and retained only the lines placed a centimetre apart.

GISBERT KAPP.

*General Treatise of Meteorology.* Part i., Statical Meteorology. By Prof. A. Klossovsky. (In Russian.) Pp. xii+642. (Odessa, 1908.)

THE complete work will comprise four parts. The two first—statical meteorology and dynamical meteorology—will not necessitate a knowledge of higher mathematics; they will form the course of meteor-

ology properly so-called, while parts iii. and iv. will be devoted to the exposition of special questions and to the principles and use of instruments. A glance at the first volume of Klossovsky's "Meteorology" shows at once that it is the outcome of a long and useful career. In fact, the first meteorological labours of the author date from the year 1882, and from that time Klossovsky has not ceased to devote all his efforts to teaching at the Odessa University, and to the organisation and direction of the network of meteorological stations in the south of Russia.

Klossovsky's manual, far from being simply a work of compilation—the most complete of any now extant—is distinguished by its originality and by the wealth of the author's critical views. In many parts of the work we meet with pages where certain connections between meteorological data and those of other sciences are admirably described; e.g. at p. 179 and following pages the calorific economy of the human body is discussed. Further, original observations are met with for the first time; thus, at p. 273, the results of the actinometric observations made by Savelieff at Kiev. Again, the whole chapters devoted to solar radiation and to the study of earth temperature are interesting to read.

In no other treatise are the questions relating to underground temperature expounded in so complete a manner. The discussion of the results of the author's observations on the temperature at different depths in soil covered with grass and otherwise is especially noteworthy. On p. 334 there is a table giving for each month of the year the temperature at depths of 0.60 m. and 1.20 m. in forest and field adjoining. The forest diminishes the annual amplitude; the differences (field—forest) are  $+3.0^{\circ}$  C. and  $+2.7^{\circ}$  for the means of July,  $-0.4^{\circ}$  at a depth of 60 cm. and  $-0.2^{\circ}$  at 1.20 m. in January.

One of the characteristics of Klossovsky's work is the care with which the most recent advances have been taken into consideration; e.g. at p. 512 observations made in January, 1907, are noted, and at p. 606 the results of unmanned balloon ascents at Uccle up to April 11, 1907, are included. The titles of the chapters in this first volume are:—Composition of the atmosphere; physical properties; water in the atmosphere; the oceans; solar radiation; terrestrial radiation; earth temperature; increase of heat with depth; ocean temperatures; temperature of the lower strata of the atmosphere; atmospheric pressure; formation of hydrometeors; temperature and pressure in the upper atmosphere; abnormal departures. H. A.

*An Introduction to the Study of Integral Equations.* (Cambridge Tracts in Mathematics and Mathematical Physics.) By M. Bôcher. Pp. vi+72. (Cambridge: University Press, 1909.) Price 2s. 6d. net.

ONE main problem discussed in this tract is the following: let  $f(x)$  and  $K(x, \xi)$  be known functions, it is required to determine the function  $u(x)$  so as to satisfy the equation

$$u(x) = f(x) + \int_a^b K(x, \xi) u(\xi) d\xi.$$

Prof. Bôcher shows, mainly after Fredholm, that under certain conditions of a very general kind, a solution exists, and may actually be put into the explicit form

$$u = f(x) + D^{-1} \int_a^b D(x, \xi) f(\xi) d\xi,$$

where  $D$  is a determinate function of  $a$ ,  $b$ , and  $D(x, \xi)$  a determinate function of  $a$ ,  $b$ ,  $x$ ,  $\xi$ . That it should be possible to prove this in a simple, and at the same time rigorous manner is a good illustration of the

increasing power of modern function-theory. Prof. Bôcher's exposition is very good; he begins by a heuristic discussion, which in a way resembles the ordinary method of successive approximations. Having thus been led to a certain expression as a presumptive solution, he proceeds to verify the fact that it is one.

Other workers in the same field who receive due attention are Abel, Liouville, Hilbert, Schmidt, and Volterra; and there are various subsidiary or supplementary articles of great interest.

As No. 10 of the "Cambridge Tracts in Mathematics and Mathematical Physics," Prof. Bôcher's work thoroughly helps to fulfil the object of the series; it is brief, self-contained, and stimulating, while giving sufficient reference to original sources.

*The Scaly-winged. A Book on Butterflies and Moths for Beginners.* By R. B. Henderson. Pp. xii+115. (London: Christophers; n.d.) Price 1s. net.

THE study of entomology is always extending its range, as shown by the numerous books which continue to be published especially relating to the order Lepidoptera, or butterflies and moths, which always seems to be the most popular of all, probably because many insects included in it are attractive in appearance, and easy to collect. The study is pursued systematically in several of our great public schools, and Mr. Henderson informs us in his preface that "the entomological, like most of the other sections of the Natural History Society of Rugby School, is entered by examination," and that as he did not find a suitable book for beginners to use in preparation for such an examination, he has compiled one for the purpose.

The various chapters deal with insects in general, and the Scaly-Winged in particular; metamorphosis; Psyche (imago); the Sister States (difference between butterflies and moths); bionomics: the place of Lepidoptera in the scheme of nature; the museum; appendix: note on the vision of insects; and list of some useful books for consultation, Furneaux's "Butterflies and Moths" being specially recommended. There are twenty-two useful text-illustrations of structure and apparatus, and the instructions for collecting and preservation in the chapter on the museum are particularly good.

*Fossil Plants. Sixty Photographs illustrating the Flora of the Coal-measures.* By E. A. Newell Arber. Pp. 75. Gowans's Nature Books, No. 21. (London: Gowans and Gray, Ltd, 1909.) Price 6d. net.

It is not often that anything has been done to popularise the study of the plants of the past, a subject of which the "educated layman" is, as a rule, profoundly ignorant. This neat little volume, with its beautiful photographic illustrations of some of the most important coal-plants (club-mosses, ferns and fern-like seed-plants, horsetails, sphenophylls, and early gymnosperms) is well calculated to rouse an interest in the flora of so many million years ago. The great majority of the photographs are from casts and impressions, showing the external aspect of the fossils, and these are all admirable; we have never seen a better collection. Some of the few microphotographs of sections, illustrating the internal structure, are equally good, though in one or two cases clearer examples might have been selected. The short explanatory notes (scarcely a dozen pages in all) are, as the name of the author guarantees, thoroughly sound and up to date; they are just enough to whet the reader's appetite for more, which is all that can be expected or desired of a sixpenny nature picture-book.