bottles have been out only a very short time, 150 have already been recovered. The longest drift so far recorded is that of a bottle released off Port San Luis, California, and recovered by a fishing vessel at Guadalupe Island, Lower California, thirty-eight days later. This bottle had traveled some four hundred miles at an average speed of about ten miles per day.

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SCIENTIFIC BOOKS

Atomic Spectra and the Vector Model. By A. C. CANDLER. 2 vols.: Vol. I, vi + 237 pp., 4 plates; Vol. II, 279 pp., 4 plates. Cambridge: at the University Press. New York: The Macmillan Company. 1937. Set $8.50.

THE quantum-mechanical interpretation of the nuclear atom-model, in a fairly satisfactory state at the present time, has been presented in a number of treatises of varying simplicity. Such volumes are entirely adequate for those research workers and students who possess the necessary mathematical background. There is, however, a group of physicists and astrophysicists who prefer an account in terms of an easily visualized model. For such a treatment, Fowler's *Report* and Hund's *Linienspektren* are no longer adequate, since their notations are now antiquated, and since there have been a host of new developments in the realm of atomic spectra during the past decade.

To meet the needs of practical workers in the field, Mr. Candler has presented the work of Fowler and of Hund from the standpoint of the vector model, using modern notation, and with the inclusion of much of the more recent work on atomic spectra. The keynote of the presentation is simplicity and complete freedom from mathematical complexity. There are copious references to the results of laboratory investigations; these results are freely compared with vector-model expectations, and frequent comparisons are made with the predictions of quantum mechanics.

Volume I deals with series in line spectra, particularly with the important researches of Fowler, Millikan and Bowen, and Landé on the spectra of the alkali doublets and alkaline earths. The treatment of Zeeman and Paschen-Back effects is fairly complete and is recommended for its clarity and simplicity. Two short chapters on "Atomic Magnetism" and the Stark effect are followed by a detailed account of the ordering of the elements in the Periodic Table, and the explanation in terms of electronic structures and the Pauli exclusion principle.

Volume II describes the results of laboratory analyses of complex spectra and their vector-model interpretation. There is a useful description of the methods of coupling the various electrons of a configuration to yield the resultant set of terms, and a comparison of Hund's empirical rules with the observational results from the short and long periods of the elements. In addition the author describes the intensity measurements of Ornstein and Burger, Harrison and others on the lines of complex spectra, and the theoretical intensity relationships in multiplets and supermultiplets. The volume is concluded by a not too up-to-date discussion of Hund's limits, and by chapters on hyperfine and nuclear structure, quadripole radiation and fluorescent crystals.

It is to be regretted, in view of the potential usefulness of a work so free of mathematical techniques, that so many errors and omissions occur throughout the two volumes. It is perhaps difficult to avoid a good many typographical errors in a first printing, but the numerous incorrect statements that are present are more serious. To mention a few of the most objectionable ones: in volume II, p. 136, the author makes the statement that intermediate coupling has no advantage over the simpler jj coupling in accounting for "abnormal" spectra. To say that jj coupling is "the only alternative to that postulated by Russell and Saunders," even for purposes of simplification, is to exhibit a total disregard for the good agreement with experiment achieved by Shortley and others in calculations based on the theory of intermediate coupling. In the chapter on quadripole radiation, one reads that all violations of the Laporte parity rule are due to quadripole transitions. There is no mention of magnetic dipole radiation, which quite frequently violates the Laporte rule. In the chapter on "Intensity Relations," it is stated that the simple Kronig formulae "should compare the intensities of any two lines arising in a transition from one configuration to another. . . ." The formulae by themselves are applicable *only* to lines within a multiplet. Also, it seems strange that nothing is said concerning the recent work of Shortley, Condon and Ufford, Johnson and others in deriving formulae for the relative strengths of multiplets in a transition array in LS coupling. There are occasional lesser errors. It is puzzling to read that "More than a century ago Fraunhofer named a number of dark lines which Newton had noticed in the spectrum of the sun." Wollaston was the first to call attention to the dark lines in 1802. There is no evidence that Newton ever observed more than the continuous spectrum.

Viewed broadly, Mr. Candler's work will be welcomed by those who wish to see the results of physical investigations expressed in simple language, unham-

pered by a maze of mathematical symbols. To accomplish such a feat of simplification in the interpretation of atomic spectra is not a simple task, and the author is to be commended for the facility with which he carries through his plan.

LEO GOLDBERG

HARVARD OBSERVATORY

AN APPEAL FOR MATHEMATICAL UNDERSTANDING

Mathematics for the Million. By LANCELOT HOGBEN, F.R.S., London School of Economics. Illustrations by J. F. Horrabin. W. W. Norton Company, Inc., New York. xii + 647 pages. $3.75. 1937.

THE title might suggest that here is another "mathematics made easy," a short-cut course in technical tricks for the apprentice computer. On the contrary, this is a reasoned appeal for common sense and understanding on the part of educated readers for the application of the mathematical discoveries of the race toward the solution of present-day problems. The earlier British edition stirred wide interest. For the wealth of historical and social contacts, for the pervasive philosophical motivation, for the breadth of sympathy and vigor of attack upon entrenched apathy this book is outstanding. It is not designed to inform the specialist, since it contains little material on pure mathematical theory with which any competent instructor in college mathematics is not already familiar. No brief list of its twelve chapters can do the work justice. Perhaps the most unusual are Chapter III—"The Grammar of Size, Order and Number, or Translating Number Language," and Chapter XII—"Statistics or the Arithmetic of Human Welfare," which strike notes that traditional text-books seldom suggest. Undoubtedly even the little mathematical technique assumed will discourage or repel many scholarly persons. Yet the lively, informative and gracious style and suggestive illustrations will maintain the average reader's interest through its six hundred and fifty pages, leaving him eager for more, and thrilled with a new sense of the power and flexibility of mathematics as a method of thinking.

ALBERT A. BENNETT

SPECIAL ARTICLES

DIGITALIS AND CALCIUM SYNERGISM[1]

EXPERIMENTS were published by Gold and Edwards[2] in 1927, which showed that hypercalcemia resulting from the injection of calcium chloride or the parathyroid hormone rendered the normal dog more susceptible to the action of ouabain. This was confirmed by the experiments of Lieberman[3] in which another digitalis glucoside and calcium gluconate were used. That digitalis and calcium act synergistically in animal experiments has been known for a long time and observations have been published indicating a similar phenomenon in man (review of literature, Berliner, 1933).[4] Bower and Mengle[5] reported two cases in which patients under the influence of digitalis died after an intravenous injection of calcium gluconate. They ascribed this to synergism between the two drugs and performed experiments in dogs which led them to the same conclusion. Their animal experiments, however, are not very convincing because of the large doses of digitalis they injected, although their conclusions are in accord with the work of others.

A discordant note is struck in a more recent report by Nahum and Hoff,[6] who tested the effect of intravenous calcium chloride in rabbits which had received digitalis in the form of digifoline. A careful examination of their paper, however, shows that in those animals in which no additive effect was observed, there is reason to believe that the animals were no longer under the influence of digitalis, and furthermore, in those in which there is reason to believe that the animals were under the influence of digitalis, a very strong synergistic effect with calcium may have been present.

Two significant facts which Hatcher[7] demonstrated in 1912 appear to have escaped consideration, namely, (1) that the rabbit excretes digitalis with extraordinary rapidity and (2) that the rabbit is very tolerant to digitalis. In the experiments which we performed (see Table I), it was found that approximately three to seven times the largest doses of digitalis used by Nahum and Hoff were excreted completely or almost so within less than eight hours (experiments 4 and 5). It must be concluded therefore that in the eighteen rabbits in which these authors observed no additive action between digitalis and calcium, there was little or no digitalis present, because the dose (0.5 to 0.75 cat unit per kgm subcutaneously) was administered eighteen hours prior to the calcium, and the probability is that during that period most or all of it was excreted.

Another group of their animals was treated in a somewhat different manner. In addition to the subcutaneous dose of digitalis eighteen hours previously, they received a dose of 0.25 cat unit per kgm intravenously one half hour before the calcium. This treat-

[1] From the Department of Pharmacology of Cornell University Medical College, New York.

[2] H. Gold and D. J. Edwards, *Am. Heart Jour.*, 3: 45, 1927.

[3] A. J. Lieberman, *Jour. Pharmacol. and Exp. Therap.*, 47: 183, 1933.

[4] K. Berliner, *Am. Heart Jour.*, 8: 548, 1933.

[5] J. O. Bower and H. A. Mengle, *Jour. Am. Med. Assn.*, 106: 1151, 1936.

[6] L. H. Nahum and H. E. Hoff, *Proc. Soc. Exp. Biol. and Med.*, 36: 860, 1937.

[7] R. A. Hatcher, *Arch. Int. Med.*, 10: 268, 1912.