blank pages, thus forming a very original Icones Algarum.

The history of the book has been described by Hollick[1] and interesting excerpts are given by him from Durant's notes, which now form an invaluable commentary on the floristic (and faunistic) communities of New York Harbor and Raritan Bay before pollution had destroyed them.

It is possible that still other copies are hidden away in our older libraries and can yet be retrieved.

ARTHUR P. KELLEY

RUTGERS UNIVERSITY

SCIENTIFIC BOOKS

Manual of Meteorology, Vol. I. By SIR NAPIER SHAW, with the assistance of ELAINE AUSTIN. Cambridge University Press, 1926, pp. XX + 340, 121 illustrations. Price 30s. net.

THIS volume is part of the monumental work planned by Sir Napier Shaw when he retired from the directorship of the Meteorological Office. That the last shall be first receives a striking confirmation in the issue of the four volumes constituting the work, for the final volume (IV) was handed to the printer on Armistice Day, and duly made its bow to the reading public in 1919. It dealt primarily with wind and pressure; though perhaps pressure should come first, since difference in pressure initiates air flow or wind.

Volume I now appears, and from a personal letter we know that Vol. III is ready for the press. Vol. IV had 166 pages; the present volume (I) has just double that number, and naturally the price also is doubled; but the increase will not be grudged. The present volume carries as sub-title "Meteorology in History"; and the text justifies the heading.

The author gives his viewpoint when speaking of what was expected of him as his bit, during the World War. He says, "It became my duty to supply or alternatively to train officers for various meteorological services." The director was working in an environment "which contained within its own experience or on its shelves almost all that there is to know about the weather"; yet he had to send responsible officers into the services, "with a formula by which they could carry on in place of the knowledge that would enable them to become a part."

This and the feeling that the atmosphere should be studied as a whole led to the conception of a compendium of what had been done by workers in many lands. Furthermore, there lurks in the author's mind a feeling that the study of the atmosphere, that is, aerography, should be thrown open to amateurs, whereas it is now to all intents and purposes limited to a professional few in official harness. He says truly that the study of weather, "which in so far as it is specialized is devitalized," ought to be an attractive subject for amateurs. It is to furnish amateurs with the necessary historic background that this big piece of work was attempted.

The present volume has fifteen chapters, and in every chapter there is plenty that is filling and on the whole easily digestible. The menu ranges from Aristotle's Meteorologica to the equipment of a modern observatory, including radio-integrators, pyranometers and pyrgeometers. The illustrations are abundant and, considering the age of many of the originals, have come out well. The personal touch is shown in photographs of some of the international meteorological congresses.

The pioneers in meteorology were all good-looking men, although running largely to whiskers. In the Paris conference photograph not one of the thirty-four faces is clean shaven. How fashion changes! To-day in a group of fifty airmen there would not be a single face adorned with excess pilosity.

There is one American meteorologist whose face is missing; that is William Ferrel, due probably to Ferrel's modesty. Langley and Maury are present; but Franklin and that earliest explorer of the upper air, Dr. John Jeffries, are missing. Robert Boyle might have been included, for certainly the author of the "Spring of the Air" did a lot to advance knowledge of air pressure.

There is little to criticize in the book, for it is evident that the utmost care has been taken to get dates, names and facts correct. A reviewer can only applaud the author and those who assisted him, for both quality and quantity of work. The type work is excellent, and the Cambridge University Press lives up to its high standard. The book contains 121 illustrations, 95 of which are cloud photographs. No one interested in aerography, the science of the air, can afford to be without the book.

ALEXANDER MCADIE

An Outline of a Reclassification of the Foraminifera. By JOSEPH A. CUSHMAN. Contributions from the Cushman Laboratory for Foraminiferal Research, Vol. 3, pt. 1, 1927, pp. 1–105, 21 plates. Published by the author at Sharon, Mass.

DR. CUSHMAN'S latest work upon these important micro-organisms will be welcomed by all students of this class and particularly by those employed in economic geology. In a former article, issued by the

[1] Hollick, Arthur. "A Quaint Old Work on Seaweeds," Proc. Staten Island Assoc. Arts Sci., vol. 5, parts III and IV, 1915.

Smithsonian Institution in 1925, Cushman dealt with the methods of study and other features of general interest in addition to presenting a bibliography of the most useful works and descriptions and illustrations of important genera. The present article, which in an outline preliminary to a larger treatise, aims to bring order out of the former classifications and to arrange the many genera in natural grouping. Cushman is particularly well fitted for this task, with his twenty-five years of experience in active work upon fossil and recent foraminifera from all parts of the world.

This is the first complete classification of the formaminifera based purely on the study of the ontogeny and phylogeny in conjunction with the geologic history. The form of the adult test has been used as the basis in most previous classifications, but this is not alone sufficient because it is only the earlier stages that give the true relationships. Even then these stages should be observed in the microspheric form, as this is retrospective, repeating in its young many of the ancestral stages. The megalospheric specimens skip many of these earlier stages, thus arriving earlier at adult development and even assuming later characters undeveloped in the microspheric form. These two forms of the same species, the microspheric, with the small initial chamber reproducing asexually, and the megalospheric, with large initial chamber producing zoospores which fuse as in sexual reproduction, have caused much confusion in earlier work.

Instead of the ten families used in recent years, Cushman employs forty-five, due to a stricter limitation resulting in more concise grouping. The number of genera recognized has also increased, but the closely defined genera will be more easily identified than the nine inclusive groups hitherto recognized, which often contain remotely related forms. The work of many writers on the group in the past twenty years has been adopted wherever possible and the author's own studies have been largely drawn upon. The development from simple undivided forms to chambered ones is followed and the chitinous and arenaceous species are recognized as primitive, as has been done by many writers in recent years. The paper is illustrated by a table and twenty-one plates of drawings showing the relationships of the families and genera.

The publication of similar outlines of classification in all branches of biology would be not only a great stimulus to the study of natural history but also a corresponding relief to the specialist burdened with nomenclatorial problems.

R. S. BASSLER

U. S. NATIONAL MUSEUM

SPECIAL ARTICLES

NOTES ON THE MECHANISM OF FERMENTATION[1]

INVESTIGATIONS in recent years have cleared up important parts of the chemical processes in which different fermentations are concerned. Without having found final explanations, Harden and Young or L. Iwanow, for instance, have proved the necessity of the presence of phosphoric salts in the case of alcoholic fermentation. On the other hand, in 1910 O. Neubauer was in a position to show, on the basis of experiments, that in a later phase of the breaking down of sugar, which is initiated by enzymes, pyruvic acid appears to be an intermediate product. However, several years earlier Magnus Levy indicated that acetaldehyde is a probable product of the disintegration of sugars. In fact, the acetaldehyde could be intercepted and fixed by the process of Connstein and Lüdecke,[2] furnishing in the following years, especially through the activities of several investigators,[3] and recently by Willaman and Letcher, significant analytical insight into the mechanism of the breaking down of carbohydrates by means of enzymes and different microorganisms.

However, none of these investigators have given an account of the processes which are doubtlessly indispensable in explaining the physico-chemical[4] mechanism which is involved. Probably assuming that the combination of the hexoses with inorganic salts, which is supposed to initiate the real decomposition of the sugar molecules, takes place outside of the cell, Paine, in the laboratory of Harden, investigated the permeability of yeast cells to hexosephosphates. These experiments have been interpreted very differently and very strangely by different workers. According to Harden, himself, "the yeast cell is at all

[1] From the Division of Agricultural Biochemistry, University of Minnesota, St. Paul, Minn. Presented before the meeting of the Minnesota Section, Society for Experimental Biology and Medicine, on December 15, 1926.

[2] German patent, No. 298593/12o (1915); German patent, No. 298594-6/12o (1916).

[3] Comp., F. F. Nord, *Die Naturw.*, *7*, 685 (1919).

[4] F. F. Nord, *Chem. Rev.*, *3*, 60, 76 (1926). (This paper on "Chemical Processes in Fermentations" contains a bibliography to which the reader is referred for many of the literature citations used in the present paper. There was expressed in the same paper (p. 69) the opinion that in view of the assumed relations between thyroxin and bios the reduction of carbonyl- and other compounds by means of fermenting yeast (Lintner, Lüers, Neuberg, Nord and others) could be explained by an intermittent interaction between bios and this compound. In the meantime the former formula of thyroxin and according to a private communication from Dr. Edward C. Kendall the analysis of bios were found to be in disagreement with the facts.