

liters) of distilled water previously sterilized and stored in 5-gal carboys, along with sterilized concentrates of the medium ingredients, are aseptically siphoned into the container.

The pH of the medium is initially adjusted and maintained during the growth of the culture by connecting the electrodes to an a-c pH meter and, with constant stirring, by manually adjusting the rate of addition of alkali. The incubation temperature is held to within $\pm 0.1^\circ \text{C}$ with the thermoregulator indicated, without the necessity of interposing a relay system.

Aeration is obtained by forcing compressed air through a filter candle while the exhaust air is aspirated from the container with a water pump at the same time. The rates of the air flow are balanced to maintain a slight negative pressure within the apparatus, obviating any chance of environmental con-

tamination. A relief mercury manometer adjusts for fluctuation in water flow and compressed air pressure, as shown. The addition of an antifoam reagent such as *n*-butyl phosphate prevents undue foaming. At the termination of incubation, the culture may be easily harvested by siphoning it directly into a masked Sharples Supercentrifuge.

With this apparatus, we obtain yields of 55 g, dry weight, of *Shigella sonnei* organisms in $7\frac{1}{2}$ hr, using a simple culture medium containing 1% dextrose as fermentable sugar. About 470 ml of 5 *N* NaOH solution is required to maintain neutrality during the incubation period.

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Book Reviews

Combustion, Flames and Explosions of Gases.

Bernard Lewis and Guenther von Elbe. New York: Academic Press, 1951. 795 pp. \$13.50.

In recent years, the original book entitled *Combustion, Flames and Explosions of Gases*, issued by Cambridge University Press in 1938, achieved ultimate literary distinction by disappearing from library shelves—the copies apparently going into bookcases of prospective purchasers who were unable to obtain them by other means.

The publication of this second book by Lewis and von Elbe has been anticipated with interest by workers in combustion research. The authors, who are associated with the Explosives and Physical Sciences Division, U. S. Bureau of Mines, are eminently qualified by years of work on combustion to write a comprehensive text on the subject.

Although the authors borrowed the title of their first treatise, the tremendous increase in the scope and volume of combustion research in the past decade required that they write essentially a new book. It is intended to provide the investigator, whether he be research scientist, industrial engineer, or student, with the fundamental observations and theories concerning combustion.

This book, like its predecessor, is in four parts. The first discusses the chemistry and kinetics of combustion reactions. New material on reactions of oxygen with hydrogen, carbon monoxide, and hydrocarbons is given. The second part, covering flame propagation, shows the greatest expansion of knowledge. Chapters on flame photography and pressure recording, combustion in nonturbulent and turbulent gases, fuel jets, burners, detonation waves, and flames in electric fields are included.

Part III concerns experimental and theoretical in-

vestigations of adiabatic explosions for several systems. It is essentially unchanged from the corresponding section in the first book. Part IV covers technical combustion processes. New material on gas turbines and turbojets is included. The appendices list selected thermodynamic data, limits of inflammability, and flame temperatures.

The presence of this book on the desk of the combustion investigator is justified alone by its extensive reference list of more than 800 authors, its abundant descriptions of experimental techniques, and its compilations of data. In addition the authors give detailed expositions of many current theories.

The only adverse criticism this reviewer is disposed to make is that the research of several workers has been omitted. Some of the omitted work may have been published after the literature survey was completed. This criticism, then, only indicates the fate of a book in an ever-expanding field. Undoubtedly 13 years hence we shall look to the authors for a third volume in their series.

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Igneous and Metamorphic Petrology. Francis J. Turner and Jean Verhoogen. New York: McGraw-Hill, 1951. 602 pp. \$9.00.

Seldom has there been a book published that can be recommended so highly as this impressive volume. Although it is intended for the use of advanced students, research workers, and teachers in the field of geology, it is essential collateral reading for serious students in all branches of the natural and physical sciences who have an interest in the earth and in the physical and chemical principles that underlie rock genesis. It provides factual information on the classi-