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 ± 0.1° 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 contamination. 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 7½ 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 investigations 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-

fication, composition, and origin of the igneous rocks and on their subsequent modification in response to changing thermodynamic environment in the earth's surface to a depth of 15 or 20 km.

In this rigorous advanced treatise, the underlying principles of phase equilibrium, the physicochemical behavior of rock-forming minerals as determined by laboratory experiment and as deduced from thermodynamic theory, and the data on the igneous and metamorphic rocks from geological field evidence are presented, correlated, and interpreted in a straightforward, lucid, and convincing manner. The complexities involved in the behavior of multicomponent systems under a wide range of changing physical conditions form the theoretical and quantitative background for the discussion of both igneous and metamorphic phenomena which, in a most unusual approach, are treated and interpreted against the same common principles.

The general plan of the book is sixfold: (1) An introduction that presents the principles of chemical equilibrium and thermodynamics, briefly discusses rock classification with the details reduced to a minimum, then presents igneous rock associations and the concept of petrographic provinces, followed by a presentation of factual information derived from laboratory studies of silicate melts. (2) A discussion and interpretation of the igneous rocks that include the crystallization of basaltic and granitic magmas, the reaction series, oceanic volcanic associations, nonorogenic continental volcanic regions with alkaline or plateau basalt affinities, volcanic associations of orogenic regions, plutonic rock associations, the calc-alkaline series, alkaline rocks, and those rocks that are high in volatiles. (3) A presentation of the constitution of the earth with a discussion of the environment, origin, and evolution of magmas. (4) An introduction to metamorphism that includes classification and the principles governing the chemical adjustment of solid rocks to metamorphic conditions. (5) A discussion and interpretation of metamorphic rocks, zones, and facies, of chemical changes, and of fabric. (6) A presentation and interpretation of the relations of metamorphism to magma and orogeny, with discussions of both regional and contact metamorphism.

This excellent treatise should be in every scientific library and on the reference shelf of every teacher and advanced student in geology.

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Smithsonian Meteorological Tables. 6th rev. ed. Compiled by Robert J. List. Washington, D. C.: Smithsonian Inst., 1951. 527 pp. $4.00.

This edition of the well-known Smithsonian publication is the first postwar revision; it replaces the fifth edition published in 1939. Although larger (58 new tables and 159 additional pages) than the former edition, it is not merely an expansion. Before noting the changes, it may be well to summarize the contents.

After a brief introduction, the book contains lists of tables under the categories: "Conversion Tables;" "Wind and Dynamical Tables;" "Barometric and Hypsometric Tables;" "Geopotential and Aerological Tables;" "Standard Atmosphere and Altimetry Tables;" "Thermodynamic Tables;" "Hygrometric and Psychometric Tables;" "Tables of Miscellaneous Physical Properties of Air and Air-borne Particles;" "Tables of Miscellaneous Properties of Water Substance and Soils;" "Radiation and Visibility Tables;" and "Geodetic and Astronomical Tables." This listing is evidence of some of the changes that have been made. For example, the new edition does not list meteorological stations (such a list occupied 31 pages of the former edition); nor does it list meteorological codes. Certain other deletions have been made, most of them good. For example, the thermometric table correcting for the temperature of the emergent mercurial column is gone. Such a table is appropriate in physics or chemistry tables but is not needed in meteorology, where the bulb and column of a thermometer will generally be at the same temperature.

The page gain resulting from the deletions and the added pages has been utilized both for the presentation of new tables and for the expansion of old ones. Obvious changes are those resulting from our increased interest and work with the upper air—the addition of standard atmosphere tables and an increased number of radiation tables. Extensions of old tables include the expansion of the range of speed tables to yield directly conversions of speeds up to 400 mph. Other revisions are those that take into account recent definitions adopted by the IMO. For example, the Beaufort scale has been extended beyond force 12. Perhaps a more important example is the use of the new definition of relative humidity (in terms of the ratio of actual to saturation mixing ratios rather than of actual to saturation vapor pressures).

A minor criticism is the failure of the compilers to adopt the meter ton second system. It is not overly important which system of units meteorologists use, but it would be convenient if they all chose the same one. Since the IMO in 1911 adopted the mts system, it might well have been utilized for these tables.

The arrangement of tables and their explanations has been altered and, I believe, improved in balance. In place of the older system in which the explanations of the various tables were concentrated in the first 86 pages, in the new edition the explanations are placed throughout the book, each near to, and often on the same page as, the table to which it refers.

This edition represents a useful updating, in terms of wartime and postwar developments in meteorology, of a standard reference work. The resulting gain in usefulness will be important to any user.

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