limitations. For instance, the statistical treatment is so condensed that it is difficult to follow the reasoning that connects initial postulates with final equations. However, the author attempts to make the results plausible by comparing them with the quasi-chemical approximation, and this is helpful in such brief discussions.

The space allotted to different topics is often puzzling. For example, 8½ printed pages, including four diagrams and one table, are devoted to a rapid-fire survey that covers the use of adsorption and emission of radiation, excitation energies, photoconductivity, luminescence, thermoluminescence, Hall effect, and thermoelectric power measurements for the determination of electronic energy states. By contrast, 1½ pages are devoted to the description of the Hahn emanation method.

Attention should be directed to a number of original contributions by the author. These include suggestions for further research that might clarify outstanding problems, a statistical treatment of solids exhibiting gross departures from stoichiometric composition, and the incorporation of "solution processes" into the mechanism of catalytic reactions. In addition, the author proposes an adequate symbolism and nomenclature for the various types of defects encountered experimentally. The adoption of this or a similar set of conventions should be seriously considered in order to standardize the widely different conventions prevalent in the literature.

The book seems to be relatively free from typographical and other errors. The symbol κ on page 48 is not defined. Unfortunately, the 1952 and 1953 papers pertaining to the use of the semiconductor model in the interpretation of chemisorption phenomena are not mentioned.

Perhaps this book serves its purpose best as a fairly inclusive summary of ideas pertinent to our present understanding of the defect structure in solids, and thus certainly fulfills one of its principal aims.

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***Thomas Young, Natural Philosopher*: *1773–1829*.** The late Alexander Wood; completed by Frank Oldham. Cambridge Univ. Press, New York, 1954. xx + 355 pp. Illus. + plates. $6.

This work by the late university lecturer in experimental physics at the University of Cambridge is the first full-scale biography of Thomas Young since the classic memoir by Dean Peacock, which appeared in 1855. It is a wholly appropriate memorial for the 125th anniversary of the death of one of the most celebrated natural philosophers who ever wrote in the English language. When we reflect that medicine was his profession and that much of his work in physics was strictly avocational, it is indeed somewhat surprising to note how often and in what varied context his name still occurs in the standard textbooks of today: Young's modulus in elasticity, Young's law of nodes in the vibrating string, Young's interference experiment (wave theory of light), and the Young-Helmholtz theory of color vision. And when we further recall that the same man was a sufficiently competent classical scholar and philologist to provide a considerable part of the key to the Rosetta Stone and to write authoritatively on the origin of languages, we cannot help feeling that this versatile genius should be better known in the 20th century.

Although Wood's book is by no means a distinguished literary venture, it should go far toward restoring Young's true position as one of the founders of modern field physics. The familiar story of the establishment of the wave theory of light is retold here, and indeed rather more perspicuously in terms of modern notation than in the pages of Peacock. It becomes strikingly evident, as the author proceeds, that Young very early grasped the real nature of physical theory—the bold and effective use of hypothesis. To be sure, he was bitterly assailed for this by his critics, notably Brougham, who, although a very brilliant man, possessed an inadequate conception of the nature of physical science. This is not surprising, since physical methodology, or the attempt to assess what physicists really do in describing the world, did not become fashionable until the late 19th century. As a matter of fact, Wood makes it clear that much of the bitterness of Brougham's criticism was very likely the result of a personal animus against Young, who had himself referred in print, with unnecessary severity, to an early mathematical paper by Brougham. The resentment of the Edinburgh reviewer was natural, although one may regret the influence it had in delaying serious consideration of Young's wave theory for many years. It seems clear that Young's scientific personality was not all "sweetness and light." His writings betray a very definite egotistical strain coupled with a blunt impatience with the "errors" of others. He must have impressed many of his contemporaries as being somewhat arrogant.

Not the least interesting feature of Young's life is the paradox it affords of a man who chose medicine as his profession but could not resist the temptation to dabble in fundamental science. Except for the two courses of lectures on natural philosophy that he gave at the Royal Institution in 1802 and 1803, this latter concern must be considered primarily avocational. Yet it was precisely here that he made his principal contribution to thought. It is generally agreed that, although he continued to practice medicine until 1822, he was never very successful as a physician. On the other hand, his lectures on physics were a failure as lectures for the audience to which he addressed them, and yet the book that resulted from these lectures has been referred to by Sir Joseph Larmor as the "greatest and most original of all lecture courses" and by the author of this biography as "a more complete account of the subject than has appeared in English either before or since."

Young's claim to fame as a philologist in connection with his deciphering of a part of the Rosetta Stone has long been somewhat clouded by the celebrated controversy over the relative merits of his contribution and that of the French savant, Champollion. The whole problem is examined once again in dispassionate fashion by Wood, and Young emerges with his stature in this field rather heightened by the evidence presented. Actually it appears that there was ample credit to go around!

It is not generally recognized that Young contributed notably to the success of the early editions of the *Encyclopedia Britannica* by his authoritative articles on such varied subjects as "Cohesion," "Egypt," "Bridge," "Chromatics," "Weights and measures," "Tides," "Lagrange," and "Road making." By a singular irony, the biography of Young himself that appeared in the 11th edition of the *Britannica* (1911) was omitted in the 14th edition (1929). Fortunately it has been restored in the latest reprinting.

Unfortunately Alexander Wood did not live to complete his writing of Young's biography. Frank Oldham, whose interest in Young is attested by his own brief life of the natural philosopher (1933), has done a commendable job of finishing the work. A brief memoir on Wood, whose books on sound are recognized as of great value by all acousticians, prefaces the volume, which will undoubtedly be greatly cherished by all who are interested in the history of physics.

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Energy Transfer in Hot Gases. Proceedings of NBS Symposium held 17–18 Sept., 1951 National Bureau of Standards, (Supt. of Documents), Washington, D. C., 1954. iv + 126 pp. Illus. $1.50.

This book contains 10 papers of a spectroscopic nature, two on reaction mechanisms, two on the flame mechanics, and two on flame temperatures.

Only a few interesting details, taken at random from these reports, can be mentioned here to give an idea of the scope of the symposium. One such detail, reported by Benedict and Plyler, is the discrepancy between temperatures measured in hydrocarbon flames, that is, 2400° to 2800°K obtained from resolved infrared spectra, and values of more than 3000°K obtained from the visible and ultraviolet spectra for the same flame regions. It is attributed to the difference in lifetime in transitions (10^{-3} to 10^{-1} sec and 10^{-8} to 10^{-6} sec, respectively). This means that molecules that radiate vibration-rotation energy will have survived many collisions and, hence, will have a much greater chance of being near to thermodynamic equilibrium than molecules that emit electronic energy.

According to Sen's article on "Astrophysicist's concept of temperature," deviations from thermodynamic equilibrium also play a decisive role in solar and stellar thermometry and have led to the use of "operational cencepts of temperature," such as "effective temperature," "color temperature," "excitation temperature," and "ionization temperature." Only in the relatively seldom occurring case of complete equilibrium are all these temperatures *one and the same,* and one can speak of *the* temperature of the stellar atmosphere. The author mentions that this is not a purely academic question:

> The solar chromosphere and corona, and the highly turbulent atmospheres of giant stars are Nature's gigantic laboratories for the testing of new physical theories of turbulence, shock waves, and departures from thermadynamic equilibrium.

For the time being, Penner, in his study on infrared emissivity of diatomic gases, has developed an equation which he claims is the only available relationship for estimating the equilibrium emissivities of diatomic gases under the conditions existing in rocket combustion chambers, our low-scale imitations of stellar fast-moving furnaces.

Persons not too familiar with the details of spectroscopy will find particular interest in Bernard Lewis' comprehensive paper on the theory of combustion waves in which suitably simplified models of the combustion wave are envisaged and explained, some considering only diffusion, others only the flow of heat, and so forth. Another paper, contributed by Karlovitz, describes in some detail how turbulent flames can generate additional turbulence.

Finally, it may be mentioned that a "Combustion colloquium" was held at Cambridge University, England, 2 years after the National Bureau of Standard's symposium. It comprised 18 contributions, mostly on flame propagation, only two on spectroscopy, which have been edited by W. R. Hawthorne and J. Fabri under the title *Selected Combustion Problems: Fundamental and Aeronautical Applications* (Cambridge Univ. Press, 1953, viii + 534 pp.).

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Essays on the Social History of Science. S. Lilley, Ed. Munksgaard, Copenhagen, 1953. 182 pp. Paper, Kr. 30.

This book has been produced under the auspices of the Commission for the History of the Social Relations of Science, a group that was appointed by the International Union for the History of Science, which is the administrative organ of the International Academy for the History of Science. Financial assistance was provided by UNESCO, and this organization suggested the original idea for the preparation of this book.

We must be grateful to UNESCO, as well as to the editor and the authors, for producing a work of significance for all who are concerned with the social relationships of science, and this means almost everyone—scientist and nonscientist alike.

The essays cover a wide range in time and in subject matter. Several of the titles will indicate the rich content of this thought-provoking volume: "The rise of abstract science among the Greeks" by B. Farring-