the sulfuric acid remained perfectly transparent over a period of 7 months. If rosin consists of abietic anhydride, hydration to abietic acid would certainly be expected to take place more rapidly in the sulfuric acid than in pure water.

The loss in weight obtained by Knecht and Hibbert in heating abietic acid to 180° in a current of carbon dioxide, while corresponding with the theoretical loss on conversion to abietic anhydride, has not been shown to consist entirely of water. Cases where 2 molecules of a monocarboxylic acid combine, in the absence of a dehydrating agent, to form an anhydride are rare in the chemical literature, and still rarer, are those giving a theoretical yield.

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NEW BOOKS

The Origin and Development of the Quantum Theory. By MAX PLANCK. Translated by H. T. CLARKE AND L. SILBERSTEIN. The Nobel Prize Address delivered before the Royal Swedish Academy of Sciences, Stockholm, June 2, 1920. Oxford University Press, American Branch, 29–35 West 32nd Street, New York City, 1922. 23 pp. 16.5 × 24.5 cm. Price $1.20.

Planck's Nobel Prize Address, which is primarily an explanation of how he was led to introduce the quantum of action into physics, is not only of interest as a valuable summary, free from technicalities, of progress in one of the most important branches of modern physics, but is also an inspiring autobiographical account of the effort and *modus operandi* by which a fundamental scientific discovery was achieved.

An insight into the quantum theory may be gained either by examining the distribution of energy in the continuous spectrum emitted by a black body or by considering the phenomena of line spectra and photo-electricity. These two modes of approach are exemplified by the investigations of Planck and Bohr, respectively, both of whom have been awarded the Nobel Prize for their researches in the quantum theory. Although Planck's method of investigation based on thermal radiation is probably the more complex of the two because of the necessity of considering a large aggregate of molecules rather than a single atom, this type of research nevertheless furnished the means by which the fundamental unit of action was first introduced into physics and is, therefore, the aspect of the quantum theory particularly emphasized in the author's address.

Planck first sought to explain the distribution of energy in the spectrum of a black body by employing the classical electrodynamics and statistical mechanics. This investigation yielded a formula which agreed with experimental data only at long wave lengths; at high frequencies an equation

devised by Wien was much more accurate. However, a certain function (the reciprocal of the second derivative of the entropy with respect to the energy) proved to be proportional to the square of the energy in the classical theory and to the first power of this quantity in the Wien formula. By ingeniously constructing a hybrid equation in which both first and second powers of the energy were included, Planck was able to derive empirically his celebrated radiation law, which combines the successful parts of the Wien and classical theory formulas. In endeavoring to provide a sound theoretical basis for this law, so that it would not be "only an interpolation formula found by happy guesswork," he was finally led to the revolutionary concepts of the element of action and the absolute value of the entropy.

After a description of how the quantum of action was thus evolved, the address includes a brief survey of the success achieved by the quantum theory in the fields of specific heats, photo-electricity, and especially spectroscopy. Allusion is made to the difficulties associated with the introduction of the quantum of light energy into optics. Particularly interesting and significant is the author's conclusion that the quantum theory is to-day probably no further advanced than was the electromagnetic theory of light when the velocity of light was first discovered by Römer in 1675.

J. H. VAN VLECK

Die Alchemie des Geber (The Alchemy of Geber). Translated into German and interpreted by Dr. ERNST DARMSTAEDTER. Julius Springer, Berlin, 1922. viii + 202 pp. 10 figs. 26 × 17 cm. Price $2.40 unbound; $2.65 bound.

There are several treatises on alchemy, such for instance as those of Gmelin, of Kopp and of Berthelot, and there is in particular the recent, monumental "Origin and Spread of Alchemy" by Edmund von Lippmann; these all furnish valuable information about, and excellent surveys of alchemy. Nevertheless, to acquire a genuine understanding and appreciation of medieval alchemical thought one must study the works of the old master alchemists themselves. These are usually written in Latin and consequently are beyond the reach of the ordinary chemist of to-day.

We should, therefore, be grateful to Dr. Darmstaedter for this evidently careful translation of the five chief works of Geber: "Summa Perfectionis Magisterii," "De Investigatione Perfectionis," "De Inventione Veritatis," "Liber Fornacum" and "Testamentum Geberi," books which from the middle ages have been considered veritable classics of alchemical literature.

Geber's knowledge in particular of the metals, their properties and the methods by which they may be purified was surprisingly great. His descriptions of the various important types of chemical operations, such as distillation, sublimation, solution, calcination, crystallization, smelting, etc., impress one with the considerable development of chemical technique

and technology which had already taken place, and with which he was familiar.

His opinions and conclusions, too, were by no means so illogical or absurd when one considers on the one hand that he started with the then current opinion that pure metals consisted wholly of mercury and sulfur in varying proportions, and on the other hand that his processes of "ennobling" did indeed, as a result of the formation of alloys, or of sulfides or of arsenides, give products which appeared to be genuine transmutations.

It is evident, too, that Geber is not interested solely in making gold. It is the "art" of gold making which appeals to him, and there is also evident a genuine scientific curiosity, and a longing to fathom the secrets of Nature.

One is impressed with the technical difficulties, many of them due to ignorance about gases, which confronted the experimenter of that period. There were also great difficulties in securing raw material needed for making many of even the simplest substances. Geber's description of the preparation of ammonium chloride and its purification by sublimation is particularly interesting from this point of view. He directs one to start with 1 part of salt, 5 parts of urine, $^1/_2$ part of soot and 1 part of *sweat.*

The author promises a later volume dealing with further investigations as to the personality of "Geber" and the origin of his writings.

The book is excellently printed.

ARTHUR B. LAMB

Carotinoids and Related Pigments. The Chromolipoids. By LEROY S. PALMER, Ph.D., Professor of Agricultural Biochemistry, University of Minnesota. American Chemical Society Monograph Series. The Chemical Catalog Company, Inc., 19 East 24th Street, New York City, 1922. 316 pp. 6 figs. 23.5 × 15.5 cm. Price $4.50.

The first five chapters deal with the occurrence of carotinoids in the phanerogams, the cryptogams, the vertebrates and the invertebrates. It is surprising to see how widely distributed these pigments are; it would seem almost that everything had a yellow streak in it.

These are followed by chapters on the chemical and biological relations, the methods of isolation, properties, identification and quantitative determination of these substances; the closing chapter deals with their function in plants and animals. Thus the subject is most carefully and thoroughly covered. An idea of the painstaking care which has been expended can be formed from the Bibliography given, covering some 500 titles.

Professor Palmer has rendered the fraternity a real service in writing this eminently satisfactory treatise which is worthy of a place beside Willstätter's "Chlorophyll" and Tschirch's "Härze."

A. H. GILL