face, the most interesting chapter of the volume, is a graceful memorial to his predecessor at the Sorbonne; it discusses the methods of Laplace, Gauss and Olbers, together with other possibilities in the determination of orbits, and concludes with a concise *résumé* of the method followed in Tisserand's exposition.

In the first chapter Tisserand presents the method of Olbers for the determination of parabolic orbits. By this method the calculations fall into two parts: 1°. No hypothesis is made as to the nature of the orbit, and the six equations are combined in such a manner as to yield a unique equation; this combination can be made in an infinite number of ways and thus yield an infinite number of equations; Olbers effected it in such a happy manner that the unique equation assumes a remarkably simple form whose simplicity is conserved in the second approximation if the observations are equidistant. 2°. In the second part the condition for a parabolic orbit is introduced, thus reducing the number of unknowns to five: to the four equations given by the two extreme observations is joined the unique equation obtained in the first part. Four equations in four unknowns are to be solved; resort must be had to successive approximation. The chief advantage of Olber's method is that the only equations which present difficulties of computation contain only two unknowns; tables of single entry give one of these as functions of the other.

The second chapter presents the well-known method of Gauss for the determination of the orbit of a planet from three observations elaborated in his *Theoria motus*.

M. Perchot has increased the usefulness and convenience of the book by appending general *résumés* of the formulæ in definitive form for computing together with the numerical calculation of the orbit of the asteroid, 1897, DJ., in which no detail has been omitted; this model computation and reproductions of Oppolzer's tables VIII. and IX. conclude the work.

E. O. LOVETT.

Lexikon der Kohlenstoff-Verbindungen. Von M. M. RICHTER. Zweite Auflage der "Tabellen der Kohlenstoff-Verbindungen nach deren empirischer Zusammensetzung geordnet." Hamburg und Leipzig, Verlag von Leopold Voss. 1869.

The work bearing the above title is another product of the indefatigable energy and painstaking care of a German chemist. In 1883 Dr. Richter gave out his 'Tabellen der Kohlenstoff-Verbindungen' arranged in accordance with empirical formulas. While that edition contained 16,000 compounds, and the third edition of Beilstein now reaching completion has some 57,000 compounds described within its spacious pages, this dictionary says something about 67,000.

The work is conveniently divided into the following parts: Introduction, System and Nomenclature; List of about 67,000 compounds and their percentage composition; Register of Proper Names; Table of Numbers for finding the Percentage Composition.

The dictionary is to be issued in about thirty-five numbers, the first eleven of which are at present in hand. Each number contains sixty-five pages and is of the same size, style and print as the *Lieferungen* of Beilstein's 'Organische Chemie,' 3 Auflage.

In the Preface, which, with the Introduction to the system and nomenclature, is given in four languages (German, English, French and Italian), Dr. Richter states that the work was begun ten years ago. Three causes are ascribed for the length of time required to complete the work: viz., changes of nomenclature at the Geneva Convention, the immense number of new facts made known in the time and his own business engagements. Professor Beilstein's desire to exhibit the percentage composition of additional types CHO, CHN, and CHON, thereby adding some 20,000 formulas, has been complied with.

The alphabet of the system shown in the succession of the elements combined with carbon, as determined by the frequency of their occurrence is as follows:

(1) H, O, N; Cl, Br, I, F; S, P.

(2) All the other elements are placed in alphabetical order: A–Z.

The elements follow each other in horizontal and vertical rows according to the number of atoms.

C H O N Cl Br I F S P Al As . . . Zr.
O
N
Cl
Br
I
F
S
P
Al
As
.
.
.
Zr.

The arrangement is really automatic, but there are some explanations given in the Introduction by which an empirical formula may be deduced from the Index of names which accompanies the tables. The lexicon is a collective index to Beilstein for all the compounds therein treated, reference to volume and page being given. Some 8,000 more are also given. These compounds will probably be treated in supplements to Beilstein. Polymeric compounds with fixed molecular weights are registered under their own formulas; $(CHON)_3$, cyanuric acid is found under $C_3H_3O_3N_3$. Reference to purely theoretical papers are omitted, as well as those dealing with analytical, physical, mathematical, crystallographic and medico-physiological data. Papers which describe methods of preparation and properties of the substances and the immediate changes they undergo only are referred to. The immense amount of material has, of course, necessarily been much condensed, authors' names being omitted and abbreviations of journals used. Further, words of frequent occurrence have been abbreviated by using the German abbreviations. This is all explained, however, by a table giving the meanings of the abridgments in the four languages named above.

The author not only recommends that writers in future give the empirical formulas, but also adopt the arrangement of formulas as given in his book. This attempt at uniformity in the writing of formulas has already been inaugurated by the German Chemical Society in the *Berichte* beginning with 1898. An illustrative example may be given; we usually write $C_6H_5NO_2$ (nitro-benzene); by following the order given above this should be $C_6H_5O_2N$. For the sake of classification this is a great convenience and should be insisted upon in the American and English journals, for the immense amount of new material annually added to our already gross number of organic compounds must have systematic arrangement for many obvious reasons. It is by no means desirable, however, that this take the place of the rational formulas, but be given in addition. To economize space, structural formulas are omitted from the volume, but some ten pages are given to the graphic illustration and naming of the ring-systems containing O, S, Se, N, P.

In order to secure a satisfactory nomenclature the 'principle of substitution' was adopted. For example:

"(1) Every compound with fixed constitution is referred to the group-substance from which it is derived, namely, to the hydrocarbon or to the corresponding cyclic system which contains the smallest number of hydrogen atoms, as benzene, naphthalene, pyrrol, etc.

"(2) This group-substance remains intact in naming the derivatives and must always figure as such in the names of the derivatives, no alterations taking place, as pyrazole into pyrazoline, etc.

"(3) Hydrogenized group-substances are named di-, tetra-, etc., hydroderivatives, as dihydropyrazole for pyrazoline.

"(4) Group-substances are named, (*a*) hydrocarbons of aliphatic series in accordance with the resolutions of the Geneva convention; (*b*) for Aromatic hydrocarbons present used terms as benzene, indene, naphthalene, anthracene; (*c*) Ring systems containing O, S, Se, N, P as named in the ten pages adverted.

"(5) As the formation of the derivatives of group-substances may be regarded as taking place by the substitution of hydrogen by other atoms or groups, so are the names derived from the group-substances.

Exception, and wisely, is taken to the Geneva nomenclature convention in indicating the position of the substituent in the open-chain series by letters from the Greek alphabet. In ring-compounds, as is usual, the location is indicated by numbers. The matter is up-to-date.

The entire work is a most valuable contribution to the reference books on Organic Chemistry and no laboratory can well afford to be without a copy. CHAS. BASKERVILLE.

UNIVERSITY OF NORTH CAROLINA,
September 30, 1899.

The Rise and Development of the Liquefaction of Gases. By WILLETT L. HARDIN, PH.D. Macmillans, 1899. 8vo. 250 pp.

Written from a historical point of view and with an ample command of the subject, this book of Dr. Hardin's is really a very satisfactory compilation. It is prepared with evident care and industry, and is finely illustrated. Why a 'popular-science style,' in which it professes to be written, should differ at times from good English, is not plain to the reviewer: but this is the severest criticism that need be made.

The author limits himself to a record of the statements of others, and he is therefore responsible chiefly for the selection and arrangement of his material. Here we might wish that the researches upon the more readily condensable gases, preceding the achievements of Cailletet and Pictet, had been treated more concisely, in order that more room had been found, toward the end of the book, for the discussion of the utilization of liquid air, etc., as at present proposed. The treatment of the latter topic is very scanty, in view of the fact that probably four out of five of the prospective purchasers of the book are interested in the uses of liquefied gases, rather than in the methods of their production. Two chapters, involving thermodynamics, would seem forbidding to the non-technical reader, while they bring no new information to the chemist or physicist. If they could be made the basis of a new chapter, discussing the economic value of gas-liquefaction, for commercial refrigeration and for the intensification of the potential energy of engines, they would serve a most useful purpose.

MORRIS LOEB.

BOOKS RECEIVED.

The Compendious Manual of Qualitative Chemical Analysis. C. W. ELIOT and F. H. STORER. Newly revised by W. B. LINDSAY and F. H. STORER. New York, D. Van Nostrand Company. 1899. Pp. vii + 202. $1.25.

The Evolution of General Ideas. TH. RIBOT. Translated by FRANCES A. WELBY. Chicago, Open Court Publishing Company. 1899. Pp. xi + 231. $1.25.

Wabeno, the Magician. MABEL OSGOOD WRIGHT. New York and London, The Macmillan Company. 1899. Pp. xi + 346. $1.50.

SOCIETIES AND ACADEMIES.

THE ACADEMY OF SCIENCE OF ST. LOUIS.

AT the meeting of the Academy of Science at St. Louis, held on the evening of October 16th, a paper by Dr. T. J. J. See, on the temperature of the sun and the relative ages of the stars and nebulæ, was presented in abstract by Professor Nipher.

The author reviews the work of Helmholtz on the condensation of a homogeneous sun and finds that the heat developed in gravitational condensation from an infinite volume to its present size would be sufficient to heat an equal mass of water about 27 million degrees. In condensing to a mass whose radius was equal to the radius of Neptune's orbit, only about 1 / 6600 part was produced as has been produced since. Nearly all of the heat has been developed since the primitive nebula has reached the dimensions of the solar system. The heat developed before the nebula came within the orbit of Mercury, is only about 1 / 85 part of the total heat produced up to the present time. If the sun should contract 1 / 10000 part of its present radius, 69,700 M., assuming it to be homogeneous, the heat would raise the temperature of an equal mass of water 2,725 degrees. The effect of the various planets is considered, and is shown to be insignificant. An annual shrinkage of 35 meters a year would account for the present heat and would effect the radius less than 1 / 10″ in 1,000 years. The fact that ancient and modern eclipses are sensibly of the same duration, in connection with the substantial constancy of the moon's mean distance, shows that no considerable alteration of the sun's diameter has occurred in historical time. The essential constancy of solar radiation during the last 2,000 years is well established by the agreement of plant distribution now with that described by Pliny and Theophrastus.

Dr. See then takes up the case of a hetero-