

elementary in the sense that no excessive demands are made on the reader's knowledge at the outset. Here is introduced the canonical form of equations which is destined to play a predominant part in the sequel, and earlier is a sketch of the theory of linear differential equations with periodic coefficients as developed by Hermite, Floquet and Poincaré.

In the second section, the partial differential equation of Jacobi is discussed and Stäckel's important theorem on the possibility of solving it by separating the variables is given. This leads to the consideration of motions determined by one degree of freedom, and in particular of forms of motion termed "Libration" and "Limitation," the latter being of the nature of Poincaré's asymptotic solutions. An account follows of conditionally periodic motions, based on the researches of Staude.

The third section treats of the motion of a particle attracted by two fixed Newtonian centres of force. This problem provides illustrations of the theory of the previous section. Otherwise it is a little inconsistent with the practical aim of the author, for its astronomical interest, as was frankly admitted by Lagrange, is very slight. A reference might here have been made to Prof. Greenhill's paper on the stability of such forms of motion (*Proc. Lond. Math. Soc.*, vol. xxii.).

The problem of two bodies is treated in some detail in the fourth section, the Hamilton-Jacobi equation being made the basis of the discussion. The case of a repulsive force is also discussed, and this leads to a digression on the dynamical theory of the tails of comets.

The most important results in the general problem of three bodies are investigated in the fifth section. The general integrals and the different forms which they assume when expressed in different systems of co-ordinates are discussed. The method of variation of parameters is explained in conjunction with Jacobi's canonical elements and also in connection with relative coordinates. The chief results of Jacobi's classical memoir on the elimination of the nodes and of Laplace's theory of stability are given here. Finally, the equations of the problem are reduced to the form expressing four degrees of freedom.

The rest of the book is devoted to the theory of perturbations. In the sixth section, Poincaré's system of canonical elements is introduced, the form of the development of the disturbing function is described and a very brief sketch of Laplace's coefficients is given. The final section contains the theory of secular perturbations of a planetary system, which is treated in some detail. At the end of the volume will be found some useful numerical tables.

The second volume is promised for next year. It will contain the theory of periodic orbits in the problem of three bodies and researches on the convergence of series.

H. C. P.

OUR BOOK SHELF.

Lexikon der Kohlenstoff-Verbindungen. By M. M. Richter. Pp. 2482. (Hamburg: Leopold Voss, 1899.) Price, 39 parts, 1.80 marks each.

NOTHING could illustrate more forcibly the rapid growth of organic chemistry than the increased dimensions of the new edition of Richter's "Tabellen der Kohlenstoff-

Verbindungen," published in 1884, which now appears for the first time under the title of "Lexicon."

The first edition, the publisher tells us, accounted for 16,000 compounds; in the present volume, which is brought down to the first quarter of 1899, 67,000 compounds are described, so that in fifteen years organic chemistry may be said to have multiplied more than fourfold. It is not surprising to learn that the stupendous labour of collecting and arranging this enormous mass of material has taken ten years to complete.

The lexicon contains all the known carbon compounds, arranged in order of their molecular formulæ on an ingenious system, which is fully set forth in the introduction. The name and a few physical constants are given, but the chief information is contained in the very full references to the original literature and to Beilstein's well-known "Handbuch." Since the first edition of the book appeared, the nomenclature of the Geneva Commission has been introduced, and in many cases the new and the old names appear side by side.

There is also an index of the names of the different compounds at the end of the volume.

Where organic research is being pursued with the almost feverish rapidity which is in vogue, more especially in the German laboratories, involving in the process the production of many compounds, both old and new, it is easy to understand the time and trouble which might be expended in fixing the identity of these compounds. One object of the lexicon is to lighten the labours of the investigator in this direction.

This becomes more imperative where the number of isomerides is large, for it is not uncommon to meet with 50, 60, or even 100 substances with the same molecular formula. For example, an experimenter who happened in the course of his research to obtain a compound of the formula $C_7H_{10}O_4$ would be confronted with a choice of 59 substances among compounds already known. By reference to the lexicon, he would see from the physical properties whether the compound had already been prepared, or, failing this, he could at once refer to the literature on the subject.

Richter's "Tabellen" is sufficiently well known among chemists and its utility long enough proved to ensure an excellent reception for the new edition and to render superfluous any further description of its use or its merits.

The author complains (and who does not) of the present system, or lack of system, of chemical nomenclature.

Organic chemistry has, in fact, outgrown its mother-tongue. It can no longer express itself clearly in the language of its childhood. An attempt was made by the Geneva Commission of 1892 to introduce reforms, and some excellent proposals were made, and have since been to some extent adopted on the continent. The author adds, "it is and remains deplorable, the fact that the resolutions arrived at at Geneva have no prospect of being generally adopted." It is to be hoped that before many more thousands have been added to the still growing number of organic compounds, the confusion which is rapidly impending through the want of a universally recognised system of nomenclature will be averted by a complete and thorough revision, more especially of the names of ring compounds.

J. B. C.

Ueber Harmonie und Complication. By Dr. Victor Goldschmidt. Pp. 136; with 28 figures. (Berlin: Julius Springer, 1901.) Price 4 marks.

MANY attempts have been made to associate the forms occurring in music with forms which manifest themselves to senses other than that of hearing. If the term "harmony" is used to include all such groupings and arrangements as give us pleasure, then we have harmonies