Thus, in a motion in which r of the n bodies collide at $t=0$, one would expect the motion of the r colliding bodies to be relatively only slightly affected for numerically small values of t by the $n-r$ bodies which do not partake in the collision. Thus, for example, the theory of binary collisions is closely dominated by the theory of straight line motion of only two bodies, and Sundman's famous regularization of a binary collision is almost obvious. Even when the rigorous proofs are complicated (involving such things as Tauberian conditions), the theory is usually well motivated. A fundamental and deep result in this connection is to the effect that when all n bodies collide, the configuration ultimately becomes very close to a "central configuration." Hence a necessary preliminary for further progress (of certain kinds) in the n body problem is a detailed study of the central configurations and the closely related homographic solutions. Such a study is here given.

Also given in this chapter is a new explicit reduction of the problem of three bodies to a system of order 8, using the integrals of linear and angular momentum; or to a system of order 6, with use of the energy integral and elimination of the time. The coordinates used in the system of order 8 are, roughly speaking, the three mutual distances and the angle between the invariable plane and the plane of the three bodies. If there is no invariable plane, the motion takes place in a plane anyway, and it is this plane which is used instead of the invariable plane.

The last chapter is devoted to the restricted problem of three bodies with special reference to the limiting case considered by Hill in connection with the motion of the moon. Hill was able to compute numerically to a high degree of accuracy the coordinates of a one parameter family of periodic motions as functions of the time and period. The exact solution of this problem involves the solution of an infinite system of nonlinear equations, the appropriate existence theorems of which were first proved by Wintner some fifty years after the completion of Hill's calculations. This is probably the most important original contribution of the author, which is now published in a general treatise for the first time together with an account of Hill's original computations.

Other topics discussed in chapter VI are: regularization, the location and character of the critical points of the potential functions $\frac{1}{2}(x^2+y^2)+(1-\mu)[(x-\mu)^2+y^2]^{-\frac{1}{2}}+[(x-\mu+1)^2+y^2]^{-\frac{1}{2}}$ and $\frac{3}{2}x^2+(x^2+y^2)^{-\frac{1}{2}}$, and the non-planar restricted problem of three bodies. The book closes with a few general remarks about the divergent series of dynamics.

DANIEL C. LEWIS, JR.
UNIVERSITY OF NEW HAMPSHIRE

PHYSICS

Physics. By W. F. G. SWANN, D.Sc., director of the Bartol Research Foundation, the Franklin Institute of Pennsylvania; with the assistance of Ira M. Freeman, Ph.D., associate professor of physics, Central College, Chicago. New York: John Wiley and Sons, Inc.

THIS book is one of a series under the general title of THE SCIENCES, which in the words of the general editor, Professor Gerald Wendt, Ph.D., provides "a brief but significant survey of the fundamental sciences, an elementary but sound foundation for the further study, but above all a key to the understanding of our environment and of the possibilities inherent in science." The editor's choice of an author of the book on physics was a very happy one. Dr. Swann is eminently qualified for the task. His occupation as a director of research has freed him from the habit-forming routine of the classroom, and he has been able to write a book which is easy to read, full of information and devoid of pedantry. He ventures "to utter the heresy that the *ideas* are more important than the *facts*," and in his presentation of the subject he emphasizes the ideas. He gives no irrelevant facts and avoids mathematical formulas and argument.

After a brief introduction on the scope and purpose of physics, the book takes up the subject of Dynamics, treated by "a general discussion in which the methods of thought employed in this science are established," in which besides the conventional subjects of force and mechanical energy, we find a section on vibrations, an account of the relations of heat and energy and a sketch of the kinetic theory of matter and of thermodynamics. Then follow chapters on the main divisions of physics, presenting mechanics and heat again and going on in the usual order to the end. It may be noted as unusual in such presentations that we find an account of the development of the tempered scale of the piano, and a long—in proportion—description of lens optics. The story closes abruptly with electromagnetic induction. The concepts of the electron and the proton are used in the discussion of electrostatics and of electrodynamics as well, and it is hard to see why such important parts of physics as the electric discharge in rarefied gases and radioactivity have been omitted. I hope that the author is holding them back to serve as the introduction to another book in which he will present the new philosophy of physics which has grown up in recent years, in which "the revolutionary nature of the ideas involved is so great that our grandfathers would have required a lifetime to become accustomed to the implications of even a part of them." Dr. Swann would do this work admir-

ably and when the book comes out he could appropriately name it "Metaphysics."

W. F. MAGIE

PRINCETON, N. J.

ANHYDROUS ALUMINUM CHLORIDE

Anhydrous Aluminum Chloride in Organic Chemistry. By CHARLES ALLEN THOMAS. In collaboration with Mary Baluk Moshier, Herbert E. Morris and Ross W. Moshier. American Chemical Society Monograph Series, No. 87. xiii + 972 pp. New York: Reinhold Publishing Corporation. 1941. $15.00.

AT last there is available a real encyclopedia of the manifold uses of anhydrous aluminum chloride in organic chemistry. Excellent monographs and review articles by Calloway, Groggins, Kränzlein, Montagne, Nenitzescu and others, have appeared within recent years, and have been most helpful, but nothing which has attempted to cover the field with the comprehensiveness and thoroughness of the present volume. Its author and his collaborators have rendered to all organic chemists a service which is sure to receive their grateful appreciation and sincere commendation. As the most complete and up-to-date handbook of the subject, it should be in the chemical library of every educational and research institution concerned with the field of organic chemistry, as well as of those corporations whose industries depend in any way upon the use of anhydrous aluminum chloride.

When "anhydrous aluminum chloride" is mentioned to an organic chemist, there rise instinctively and immediately before him the well-known and ubiquitous "Friedel-Crafts Reactions," and 378 pages of the volume are devoted to syntheses based upon such reactions. It is entirely fitting, therefore, that a portrait of Charles Friedel appears as the frontispiece, and one of James Mason Crafts upon page 76, and that a brief historical sketch (7 pp.) of these two distinguished chemists follows an excellent summarized and generalized introduction.

In addition to the pages occupied as noted above, separate chapters are devoted to the Physical Properties of aluminum chloride (45 pp.); the Mechanism of the Reactions Catalyzed by it (20 pp.); Addition Reactions (140 pp.); Aldehyde Syntheses; Aromatic Halogenation; Dehydrating Condensations (32 pp.); Dehydrogenation Condensations and Reduction Phenomena (20 pp.); Miscellaneous Condensations (20 pp.); Aromatic Rearrangements and Migrations (24 pp.); Effect of Aluminum Chloride on Aromatic Compounds (22 pp.); Aluminium Chloride in Aliphatic Chemistry (60 pp.); Polymerization (26 pp.); Aluminum Chloride in the Petroleum Industry (23 pp.); Preparation, Manufacture and Purification of Aluminum Chloride (24 pp.); and Notes on the Application of Aluminum Chloride (storage, transportation, particle size, etc.). In addition to complete author and subject indexes, there is an index of some 1,400 U. S. and foreign patents. References to the original literature appear throughout the text, the total number of such citations amounting to several thousand.

Paper, binding and presswork are up to the usual high standards of the publishers.

The two main purposes of the American Chemical Society Monograph Series are stated to be: (1) to present the knowledge available upon the chosen topic in a form intelligible to those whose activities may be along a wholly different line, to the end that other chemists may realize how closely their own investigations may be connected with other work which on the surface appears far afield; and (2) to promote research in the branch of science covered, by furnishing a well-digested survey of the progress already made, and by pointing out directions in which investigation needs to be extended. Both of these purposes are well served in this latest addition to the series.

MARSTON T. BOGERT

COLUMBIA UNIVERSITY

SCIENCE TWENTY-FIVE YEARS AGO

BOTANY AS A NATIONAL ASSET[1]

IN connection with the organization of the National Research Council, I feel that American botany is offered a great opportunity of which we should take advantage. As a member of the council I wish to acquaint you with its purpose, so far as botany is concerned. Since the organization of the council was stimulated by the desire to develop a program of national preparedness, the natural first impression would be that, so far as botany is concerned, it is merely the problem of more efficient food production and distribution. This would stamp the enterprise at once as a problem of practical agriculture, in connection with which botanical investigators who are dealing with the fundamental problems of plants would have little or no part. Nothing is further from the intention of the council. The chairman has recently outlined the work of the council briefly as follows:

[1] Concluding part of the presidential address before the Botanical Society of America, given in New York in December, 1916, and printed in the issue of SCIENCE for March 9, 1917.