pages). Chapter XI (45 pages) is devoted to the discussion of several plane curves of lesser importance. An exposition of the properties of a number of space curves is given in Chapters XII and XIII (72 pages). These chapters are not, however, up to the standard of the rest of the book. Chapter XIV (13 pages) is devoted to polhodes and herpolhodes.

The treatment is, throughout, quite elementary, and can be followed by anyone with a knowledge of analytics and calculus. The book is not, however, suitable for a student seeking a systematic treatment of the theory of the higher curves, as its aim is the consideration of noteworthy curves and not the systematic exposition of curves in general. It is a treatise, not on curve theory, but on particular curves.

The method of exposition, whenever practicable, is as follows: the rectangular and polar equations of the curve are given, the form of the curve is derived from the equations and a figure of the curve is shown. The most interesting geometric properties of the curves are then deduced, the parametric equations — when the curve is unicursal — derived and the integrals for the length of arc and the area of the curve obtained.

The book is metrical both in viewpoint and in method. Trilinear coordinates are, however, used a few times and line coordinates several times but not in such a manner as to necessitate a previous knowledge of those subjects. It is to be regretted that the author does not enter into the projective theory at least enough to show the projective interrelations, and occasionally the projective identity, of some of the curves considered.

The content and method of the book are such as to make it especially valuable for engineers and others not specialists in geometry, but geometers also will find in it a valuable collection of information on particular curves. The Spanish text presents little difficulty to one who can read any Romance language with facility. C. H. SISAM.

The Scientific Papers of J. WILLARD GIBBS. Volume 1, *Thermodynamics*, xxviii + 434 pp., with portrait; volume 2, *Dynamics, vector analysis and multiple algebra, electromagnetic theory of light, etc.*, ix + 284 pp. London, Longmans, Green, and Co., 1906. Large 8vo.

SHORTLY before the death of Professor J. Willard Gibbs he had decided to yield to requests from various sources and to

reprint his principal papers on thermodynamics with some additional chapters, upon which he was then at work. After his sudden death had cut short his plans, his family resolved to fulfil his intention, as far as might be, by printing, under the editorial direction of Professor Bumstead and Dr. Van Name, a complete edition of his published papers * with such additions as could be made out from his brief and meager notes.

The first volume of the Scientific Papers contains the collection of articles on thermodynamics with seventeen supplementary pages of unpublished fragments which represent a first draft of a part of the material that Professor Gibbs was preparing. Among the subjects which he was intending to treat were:

I. On the values of potentials in liquids for small components.
II. On the fundamental equations of molecules with latent differences.
III. On the fundamental equations for vanishing components.
IV. On the equations of electric motion.
V. On the liquid state, $p = 0$.
VI. On entropy as mixed-up-ness.
VII. Geometric illustrations.
VIII. On similarity in thermodynamics.
IX. Cryohydrates.

Of these, his notes contained but the partial treatment of I and IV, although VI may be regarded as somewhat discussed in chapters XII to XV of the Statistical Mechanics. One term which attracts the attention of the reader as probably something of great importance is *latent differences*. Unfortunately the notes left by Professor Gibbs do not permit of any definite conclusions as to what he meant. This must be a cause of deep regret to the scientific world — a feeling which may be somewhat ameliorated by the fact that at last the complete works of Willard Gibbs are easily available for reading and reference.

The second volume contains all the other papers, among which may especially be noted the original pamphlet on Vector Analysis, privately printed in 1881–4; an unpublished letter

* With the exception of his two books in the Yale Bicentennial Series: Vector Analysis (1901), edited by E. B. Wilson, and Statistical Mechanics (1902), Charles Scribner's Sons, New York City.

on the use of vector methods in the determination of orbits, written to Hugo Buchholz; and a short abstract, bearing the date 1884, of a communication to the American association for the advancement of science on the subject of statistical mechanics, which shows that even at that early date the author was tolerably far advanced on the investigations which he published only in 1902. It is regrettable that some account of the later researches on multiple algebra were not available for publication, in particular the matter concerning double products which constitutes an important advance in the general theory. Professor Gibbs seems to have kept this, like many other ideas certainly in an advanced state of development, in his mind rather than on paper. For this reason his published work which has now appeared contains practically all that the world can ever hope to know of his investigations.

E. B. WILSON.

Leibnizens Nachgelassene Schriften physikalischen, mechanischen und technischen Inhalts. Herausgegeben von DR. ERNST GERLAND. Leipzig, Teubner, 1906, vi + 256 pp.

THE volume contains hitherto unpublished papers of Leibniz on physics and mechanics, mostly written during the interval 1670 to 1686, or between the 24th and 40th year of his life. They are partly in Latin, partly in German and partly in French. The editor has supplied historical and explanatory notes. These articles are of interest, not only as showing that Leibniz sometimes touched upon questions which have since become of fundamental importance, such as the conservation of energy, but also as showing the progress of his ideas and his method of work.

FLORIAN CAJORI.