ELEMENTS OF QUATERNIONS

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BY

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PREFACE.

THE object of the following treatise is to exhibit the elementary principles and notation of the Quaternion Calculus, so as to meet the wants of beginners in the class-room. The *Elements* and *Lectures* of Sir William Rowan Hamilton, while they may be said to contain the suggestion of all that will be done in the way of Quaternion research and application, are not, for this reason, as also on account of their diffuseness of style, suitable for the purposes of elementary instruction. Tait's work on Quaternions is also, in its originality and conciseness, beyond the time and needs of the beginner. In addition to the above, the following works have been consulted:

Calcolo dei Quaternione. Bellavitis; Modena, 1858.

Exposition de la Méthode des Équipollences. Traduit de l'Italien de Giusto Bellavitis, par C.-A. Laisant; Paris, 1874. (Original memoir in the *Memoirs of the Italian Society.* 1854.)

Théorie Élémentaire des Quantités Complexes. J. Hoüel; Paris, 1874.

Essai sur une Manière de Representer les Quantités Imaginaires dans les Construction Géométriques. Par R. Argand; Paris, 1806. Second edition, with preface by J. Hoüel; Paris, 1874. Translated, with notes, from the French, by A. S. Hardy. Van Nostrand's Science Series, No. 52; 1881.

Kurze Anleitung zum Rechnen mit den (Hamilton'schen) Quaternionen. J. Odstrčil; Halle, 1879.

Applications Mécaniques du Calcul des Quaternions. Laisant; Paris, 1877.

Introduction to Quaternions. Kelland and Tait; London, 1873.

A free use has been made of the examples and exercises of the last work; and, in Article 87, is given, by permission, the substance of a paper from Volume I., page 379, *American Journal of Mathematics*, illustrating admirably the simplicity and brevity of the Quaternion method.

If this presentation of the principles shall afford the undergraduate student a glimpse of this elegant and powerful instrument of analytical research, or lead him to follow their more extended application in the works above cited, the aim of this treatise will have been accomplished.

The author expresses his obligation to Mr. T. W. D. Worthen for valuable assistance in the preparation of this work, and to Mr. J. S. Cushing for whatever of typographical excellence it possesses.

A. S. HARDY.

HANOVER, N.H., June 21, 1881.

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