tion in this country at least. "— Ich darf wohl auf Zustimmung hoffen, wenn ich die Meinung äussere, dass zu einer tiefer gehenden Verständniss der Mechanik sowohl in ihren Grundproblemen als in ihren Einzelausführungen verschiedene mathematische Disciplinen erforderlich sind, die zur Zeit leider eine regelmässige Pflege an den technischen Hochschulen nicht finden. * * * In Amerika und England sehen wir vielfach ein Unterrichtssystem in Kraft, bei welchem mit relativ geringfügigen mathematischen Hilfsmitteln höchst ausgedehnte Gebiete der Anwendungen berührt werden. Der richtige Weg liegt auch hier gewiss in der Mitte. Um ihn mit Erfolg zu betreten, wird die Mathematik mit den technischen Wissenschaften unter gegenseitiger bereitwilliger Förderung Hand in Hand gehen müssen."

HENRY S. WHITE.

Ebene Geometrie der Lage. Von PROFESSOR DR. R. BÖGER. Leipzig, G. J. Göschen'sche Verlagsbuchhandlung, 1900. (Sammlung Schubert, VII.) 8vo. Pp. x + 289. Price 5 marks.

A NEW text book on the geometry of position is prepared by Dr. Böger, who is Professor at the Real-gymnasium in Hamburg. The book has some novelties, and distinctive merits. In the first place it is well arranged for reference. Section title and number and paragraph number stand at the head of alternate pages. Paragraph numbers appear black in the text, and are set also in smaller type in the outer margin. Definition, theorem, and corollary are distinctly marked as such. Thus the frequent references back and ahead are consulted with the least possible labor, a rapid review is easy, and the student is never left in doubt as to purpose or connection of a sentence. The table of contents is full and well divided, but there is no index. This lack however will not greatly hinder the student, for at every critical point a line of back references is struck which leads to every desired explanation.

As its title indicates, the work is confined to the plane. Beginning with the perspective relation, it concludes with the construction of a polar relation out of any five real or imaginary elementary data (pairs of conjugate points). Steiner and Cremona defined projective ranges to be any two members of a sequence, each member of which is in perspective with the next preceding and the next succeeding. This definition Böger adopts, and so proves as a theorem the invariance of harmonic sets under projective transformation. Von Staudt and Reye chose the reverse order, but I think it probable that most teachers will agree with Böger as to the easier order for students. From two projective pencils or ranges a conic is generated; then follow the simpler properties; afterward the theory of involutions on a range or pencil, then upon a conic; and so are reached the relation of pole and polar and the usual metric properties of diameters and foci.

Here the second part of the work begins, wherein not the conic itself, but the polarity which it mediates, is the principal object. Whatever determines the one determines the other, and these determining elements may just as well be pairs of conjugate points as exclusively self-conjugate points. The problems of construction thus generalized are here solved by the aid of concepts that will be new to many readers: adjoint, conjoint, component, and resultant involutions. On a conic two involutions are *resultant*, for example, when their centers are conjugate with respect to the conic; and if two involutions are considered, both are *component* to their common resultant. The terms seem worthy of general adoption. A brief treatment of sheaves of polarities and of cubic involutions is added, breaking off where the next topic would be polarities of the third order.

Most striking is perhaps the absence of the word imaginary. From the preface we extract the author's reason for the omission. "Von Staudt's theory of imaginary elements, founded upon a normal Wurf, I have replaced by a theory based upon a perfectly arbitrary Wurf. This theory renders it needless to distinguish between real cases and imaginary, because it employs only such proofs as are valid for all cases alike. If we retain the involution that is determined by a Wurf, and base our proofs always on this involution, never on the presence or absence of its two coincidence points, then there will never be need to introduce imaginary elements. Further, the word imaginary is not only needless, it is positively a detriment; for since it has no corresponding image (Vorstellung), its effect can be nothing but confusion. Therefore the word imaginary ought to be outlawed from the geometry of position." This reasoning and a similar plea in the closing paragraph may not convince the reader, but they are well worth study to any one who is prone to mix algebraic short cuts with geometric reasonings.

HENRY S. WHITE.