

reason why a different term should be needed when coefficients are replaced by cogredient coefficients. The reason why the operation is invariant is the same in both cases. As illustrating the degree of elegance attained by M. Andoyer may be cited from § 3, Chapter I, the proof (susceptible of improvement, though not of simplification in form) that absolute invariants exist; and the entire § 2 of chapter III, which sets forth the relation of a homography to a binary bilinear form.

In a text prepared especially to emphasize geometrical applications, the purely algebraic side of any problem is naturally of only secondary importance. Here the student learns to think of invariance as based on reasons rather than on specific normal forms; it is not important for the beginner to reduce the canonizant, for example, to typical form, and it is important to see clearly that every eliminant of a set of equations must be an invariant, regardless of the notation used to express it. This principle leads to a preponderance of reasoning over reckoning, and the postponement of purely algebraic problems. While complete form systems are given for each special stem form, Gordan's theorem is simply stated without proof. Nor is there any mention of Hilbert's theorems (though on p. 101 it is stated that "Le théorème de Gordan subsiste dans le domaine ternaire,") nor of the enumeration problems solved by Sylvester and Deruyts. This marks the elementary character of the work, and leaves much to be looked for from the larger compend which, the preface tells us, the author has had in preparation already for some years.

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*Sur les lois de réciprocité.* Par X. STOUFF, professeur à la Faculté des Sciences de Besançon. Paris, Hermann, 1898. 8vo, 31 pp.

THE laws of reciprocity have been the object of numerous mathematical researches, the chief of which are the memoirs of Jacobi, Eisenstein, and Kummer in *Crelle's Journal*. Stouff proposes to apply  $n$ -dimensional geometry to the subject following the examples of Minkowski's geometry of numbers.\* At bottom the question of the laws of reciprocity appears to have a natural and close connection with the fuchsian polygons of Poincaré generalized for space of any number of dimensions. The intervention of these polygons appears implicitly in Gauss's memoir on biquad-

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\* Minkowski, *Geometrie der Zahlen*, Leipzig, Teubner, 1896.