

Lehrbuch der Algebra, verfasst mit Benutzung von Heinrich Webers gleichnamigem Buche. Erster Band: Allgemeine Theorie der algebraischen Gleichungen. By Robert Fricke. Braunschweig, F. Vieweg und Sohn, 1924. viii + 468 pp.

When the last edition of the *Lehrbuch der Algebra* by the late H. Weber became out of print, the publishers invited Professor Fricke to write a treatise on algebra in three volumes to replace that by Weber. The subject matter of the present volume 1 is essentially the same as Weber's volume 1 and the earlier chapters on abstract groups in Weber's volume 2. Fricke states that his second and third volumes will differ more essentially from those by Weber. Volume 2 will treat those algebraic equations which are not solvable by radicals and possess groups representable by binary and ternary substitutions; in particular, Klein's theory of the icosahedron and equations of the fifth degree will be presented from the geometrical standpoint of Klein (in contrast to Weber's algebraic treatment). Volume 3 will develop the theory of algebraic numbers and the class equation of complex multiplication of elliptic functions.

Professor Fricke is an experienced writer of unusual clearness. In addition to his recent book on elliptic functions, he was joint author with Klein of extended treatises on elliptic modular functions and automorphic functions. These earlier books show that the author has long been familiar with the field covered by the new algebra. The latter will be somewhat simpler to read than Weber's algebra. General determinants are given a better notation, and their rank is employed systematically, thus avoiding the circumlocution of Weber. Certain proofs are replaced by simpler or more natural ones; for example, the product of two determinants, and the determination of the number of positive signs in the canonical form $\sum \pm x_i^2$ of a quadratic form.

There are brief treatments of the following topics omitted by Weber: k -fold bordered determinants, linear dependence, rank of symmetric matrices, besides the additions on pages 6-7, 10-13, 67.

Certain topics in Weber are omitted by Fricke: elimination of two unknowns from three equations; domains defined by an imaginary cube root or fourth root of unity; most of Weber's chapter 11 on continued fractions (perhaps those domains and the theory of the equivalence of quadratic numbers will be treated in volume 3).

Although the general theory of transformations of Tschirnhaus is developed at length, there is no mention of the chief application to the reduction of the general equation of the fifth degree to a normal form involving a single parameter, whether the Bring-Jerrard form $y^5 + y + c = 0$ or the still more important Brioschi form. Doubtless these normal forms will be given in volume 2. But it is far preferable that the reader should meet them as the culmination of the elaborate theory of transformations of Tschirnhaus (Weber I, 2d ed., p. 205, p. 263)