reader will find as much of the obscure and undemonstrated in this attempt as has characterized other similar trials in recent years.

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Linear Groups with an Exposition of the Galois Field Theory. By L. E. DICKSON, Assistant Professor of Mathematics in the University of Chicago. Leipzig, Teubner's Sammlung von Lehrbuchern auf dem Gebiete der mathematischen Wissenschaften. 1901. Vol. VI. Pp. x+312.

In 1898 the well-known firm of B. G. Teubner, Leipzig, Germany, began the publication of the 'Encyklopädie der mathematischen Wissenschaften mit Einschluss ihrer Anwendungen,' which is intended to give in seven large volumes a general outline of the known parts of mathematics, together with applications. As a comparatively small amount of space could be devoted to each subject, the same firm decided to publish a large series of advanced text-books in connection with this encyclopedia. This series was planned especially to enable the authors of articles for the encyclopedia to develop their subjects more fully, and thus make their articles more useful. Other writers are, however, invited to make the series as complete as possible.

More than fifty different volumes of this series have already been announced by almost as many different authors. The list of authors includes a number of prominent writers of various countries. The great majority of these are Germans, as might have been inferred from the fact that the work is due to German influence and is published by a German firm. Outside of Germany the Italians seem to have been the most active collaborators, but most of the other European countries, together with America, have promised contributions.

This series of text-books, together with the encyclopedia, will doubtless act as a very strong stimulus for greater mathematical activity, and it will tend to increase in a marked degree the German influence in higher mathematics. Never before has there been such extensive collaboration to make the recent progress in the various fields of mathematical research accessible to the student. It is hoped that this series will do much towards enabling many additional teachers of mathematics, who have sufficient leisure, to join the ranks of the investigators and to assist in developing the rich mines which have been opened in many quarters during the past few decades.

The present work is the sixth volume of the series and is devoted to a subject which has been developed principally on French and American soil. The fundamental ideas are due to the marvelous genius of Galois, who developed them in a memoir entitled 'Sur la théorie des nombres,' published in the *Bulletin des Sciences* de M. Férussac in 1830, when their author was only eighteen years old. This memoir contains the elements of a new kind of imaginaries which have since been known as the Galois imaginaries. They occupy practically the same position in the theory of congruences as the ordinary complex numbers occupy in the theory of equations.

The Galois imaginaries are generally studied by means of congruences with respect to a double modulus, composed of a prime number p and an irreducible function of a single variable $\phi(x)$. It has been known for a long time that the p^n different residue with respect to such a modulus constitute a *domain of rationality, Körper,* or *field.* That is, if these residues are combined with respect to addition, subtraction, multiplication or division (with the exception of division by zero) the result, when reduced with respect to the double modulus, is one of these p^n residues.

About ten years ago Professor Moore proved that every finite field may be represented as a field of this kind and he applied to it the present name *Galois field.* This important theorem exhibits the great generality of investigations with respect to the Galois field. In fact, with ordinary operational laws of algebra the generality is complete. Imbued with the beauty and interest which are attached to such general investigations, the author of the present volume has generalized all the systems of linear groups studied by Jordan with respect to the field of integers taken modulo p. He

has also studied new systems of linear groups in which the Galois field has been employed *ab initio*.

The aim of the present volume seems to be to give a systematic presentation of these results, together with the necessary theorems from the known parts of mathematics. Comparatively little knowledge is presupposed on the part of the reader, but the generality of the methods calls for considerable maturity and training. It is to an unusual extent the work of the author, and is a credit not only to him, but also to all the mathematicians of our country. We predict for it a place among the few American works on mathematics which are known and respected by the leading mathematicians of the world.

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SCIENTIFIC JOURNALS AND ARTICLES.

The Botanical Gazette for June contains the following papers: Mr. A. Rimbach has recorded a series of physiological observations on the subterranean organs of ten Californian species of Liliaceæ. Although they are geophilous herbs of similar organization, they show very different modes of self-burial. The plants studied are grouped on the basis of these methods. Mr. Ralph E. Smith has studied 'The Parasitism of *Botrytis cinerea*,' and has come to the conclusion that too much importance has been ascribed to a cellulose-dissolving enzyme. The two stages in the process are a poisoning and a killing of the cells, and their disintegration and utilization as food by the fungus. The first effect seems to be produced by a substance, probably oxalic acid, formed by the fungus as a by-product of its metabolism. Following this a number of different enzymes are secreted that digest the various constituents of the tissues. Mr. Charles H. Shaw has published a study of 'The Development of Vegetation in the Morainal Depression in the Vicinity of Wood's Hole.' In open pools anchored plants with floating leaves are often confined to a zone somewhat separated from the shore, their approach to the shore line being prevented by the sweeping in of silt. The vegetation of the large open morainal pools, though undrained, may be purely hydrophilous, but about the time of the formation of the floating mat the conditions appear to become xerophytic. The marginal ditch which surrounds pond islands and atolls is formed only in the woods, where a dense felt of humus vegetation protects the ground from erosion. Fallen leaves and other organic materials swept from the forest tend to smother the vegetation which might grow there. In this way there is produced a belt of open water surrounding an island, or ring of vegetation. Mr. G. E. Webb has published a 'Morphological Study of the Flower and Embryo of *Spiræa*.' Some of the conclusions are as follows: The order of floral development is sepals, inner stamens, carpels, outer stamens, petals; no archesporial cell or plate of archesporial cells is differentiated in the microsporangium; the tapetum is cut off from the outside of the archesporial mass; several archesporial cells are differentiated in the megasporangium. Mr. David G. Fairchild describes a precocious poplar branch observed in Patras, Greece, and suggests the possibility of using such precocity in the production of earlier developing varieties of shade or fruit trees. Mr. E. Mead Wilcox records observations on the numerical variation of the ray flowers of *Helianthus annuus*.

DISCUSSION AND CORRESPONDENCE.

A METHOD OF FIXING THE TYPE IN CERTAIN GENERA.

IN view of certain recent discussions* as to the proper means of fixing the types of genera of early authors, when no type was specified, we believe the differences of opinion arising under existing codes of nomenclature will be materially lessened by the adoption of the following rule:

* See *Cambridge, Ann. & Mag. Nat. Hist.*, 7th Ser., VIII., pp. 403–414, November, 1901; ibid., 7th Ser., IX., pp. 5–20, January, 1902; Jordan, SCIENCE, N. S., XIII., pp. 498–501, March 29, 1901; Allen, *Bull. Am. Mus. Nat. Hist.*, XIV., pp. 325–334, November 12, 1901; Howell, *Proc. Biol. Soc. Wash.*, XV., pp. 1–9, February 18, 1902; Allen, *Proc. Biol. Soc. Wash.*, XV., pp. 59–66, March 22, 1902; Cook, SCIENCE, N. S., XV., pp. 647–649.