

added conditions indicate which boundaries are to form part of the fundamental region [Klein, *Ausgewählte Kapitel der Zahlentheorie* I, p. 216].

A simplification is made by Cahen by employing as roots of a form the reciprocals of the values used by Dirichlet. Then, in Cahen's notation, a substitution which transforms a form into a second transforms the roots of the second into the roots of the first form.

On page 301, sixth line from bottom, and on page 306, first line of §376, the word *impropre* should read *propre*.

The concluding pages (316-400) are devoted to notes and tables, the latter being borrowed from Tchébyscheff. There is a note on prime numbers in which are proved special cases of Dirichlet's theorem on an arithmetical progression. A note on the decomposition of numbers into prime factors shows how the problem can be solved by finding a quadratic form $x^2 + Dy^2$ which represents the given number, using the tables on pages 391-400. In the headlines to pages 397-400, $x^2 + 4y^2$ should read $x^2 - 4y^2$. There is a note on the calculation of primitive roots of prime numbers and tables (pages 375-390) giving the primitive roots and indices for all prime numbers < 200 . The final note gives Gauss's theory of complex integers $a + bi$, their geometrical representation being emphasized.

Cahen's book will prove of special interest to those students who desire numerous illustrative examples and numerical applications of the general theorems. The amount of detail, which has added considerably to the size of the book, can not fail to allure the reader to the fascinations of number theory.

L. E. DICKSON.

Essays on the Theory of Numbers: I. Continuity and Irrational Numbers. II. The Nature and Meaning of Numbers. By RICHARD DEDEKIND. Authorized translation by W. W. Beman. Chicago, The Open Court Publishing Company, 1901. 115 pages.

THE essays of Dedekind, *Stetigkeit und irrationale Zahlen* (Braunschweig, 1872), and *Was sind und was sollen die Zahlen?* (Braunschweig, 1888) have already become classics in the literature of mathematics. In giving a fairly literal translation of them, Professor Beman performs a service for which one must feel grateful, especially as one needs whatever advantage one's own language gives in attempting to master the abstruse second essay.

The word *Abbildung* is translated transformation (page

50). Then one has a transformation of an element s , or system S , into an element $\varphi(s)$, or a system $\varphi(S)$, and also (page 56) a transformation of S in Z . [The latter denotes a transformation of S into $\varphi(S)$, a part of Z .] This use of the word transformation is not easily associated with its ordinary use. The translation "representation" for *Abbildung* has been used by others. By its adoption, the language becomes very smooth. Then, under the representation φ , a system S is represented by $\varphi(S)$. If the latter is a part of a system Z , we have a representation of S in Z .

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L. E. DICKSON.

Annuaire pour l'An 1902, publié par le Bureau des Longitudes.
Paris, Gauthier-Villars.

THE *Annuaire* for the year 1902 does not differ materially from its predecessors. The information on the various subjects which it treats is, as usual, brought up to date; otherwise the body of the volume contains no material changes. The only matters which call for special remark are the notices placed at the end of the volume. The committee which has charge of the *Annuaire* always chooses subjects for these notices which shall be scientific and of general interest. The current *Annuaire* is no exception to the rule.

M. Poincaré writes a luminous article of thirty-four pages, on wireless telegraphy. He gives a simple account of the main principles which underlie this latest development in the applications of electricity. As usual, he carries the reader by easy stages up to the most recent results, including those of Marconi, so far as they are known.

M. Cornu develops, with much detail, the theory and practice of polyphase currents. Some parts of this article will perhaps be a little tedious to the mathematician, as several pages, here and there, are devoted to elementary explanations of harmonic motion, and the composition of harmonic motions of the same phase and different amplitudes; but this is doubtless an advantage for many of the readers whom this volume reaches. Considerable space is devoted to the construction of the most modern forms of dynamos.

In the third appendix M. Guyou makes a plea for the use of the decimal division of the angle. He admits that it is hopeless to ask astronomers to change from the degree to