plexes are thus divided into two groups of three each. The last chapter is devoted largely to polar properties. The orthogonal linear substitutions corresponding to the real polar tetraedra; the properties of tetraedra determined by four generators, two from each system; and the Pascal and Brianchon theorems in space are other topics in this chapter.

This work with its extensive bibliography, and hundreds upon hundreds of references to the literature on the subject, must represent a prodigious amount of labor and pains on the part of the author. As an encyclopaedic reference book it will undoubtedly be useful, although the index does not seem very satisfactory. For example, twenty or more pages are devoted to a discussion and comparison of the Amiot and MacCullagh focal properties, yet neither of these names appears in the index.

D. D. LEIB.

*Festschrift zur Feier des 100 Geburtstages Eduard Kummers mit Briefen an seine Mutter und an Leopold Kronecker.* Herausgegeben vom Vorstande der Berliner Mathematischen Gesellschaft. Leipzig, Teubner, 1910. 103 pp.

IT was very appropriate that the memorial address on Kummer should be delivered by K. Hensel, whose remarkable investigations on algebraic numbers entitle him to speak with authority on Kummer's chief triumph, the creation of ideal numbers. We find here an elementary and entertaining account of Kummer's early interest in Fermat's equation $x^\lambda+y^\lambda+z^\lambda=0$, where $\lambda$ is a prime, which led him to investigate the numbers $a + b\alpha + \cdots + k\alpha^{\lambda-1}$, where $\alpha$ is a complex $\lambda$-th root of unity, and $a, b, \cdots, k$ are integers. It appears on excellent authority that Kummer at an early period supposed that he had a complete proof of the impossibility of Fermat's equation and laid before Dirichlet a manuscript purporting to give such a proof. The latter pointed out to Kummer that, although he had proved that any number $f(\alpha)$ was the product of indecomposable factors, he had assumed that such a factorization was unique, whereas this was not true in general. After years of study, Kummer concluded that this chaotic state of affairs following from the non-uniqueness of factorization was due to the fact that the domain of the numbers $f(\alpha)$ was too small to permit the presence in it of the true prime numbers, and was led to his epoch-making creation of ideal numbers. Without attempting to explain the elaborate machinery of Kummer's method, so delicate that an expert must handle it with the greatest care, and nowadays chiefly of historical interest in view of the simpler and more general theory of Dedekind, Hensel contented himself in his address with a luminous elementary account of the essential features of Kummer's method as developed for a special set of integers. It should be stated that, while it is preferable to take the newer standpoint as regards the foundation of the theory of ideals, this change of viewpoint has not altered the validity of the rich array of fundamental results obtained by Kummer. The brief sketch on page 30 of Kummer's method of proving the impossibility of Fermat's equation, when $\lambda$ is a regular prime, applies directly only to the first of the two cases into which Kummer divided the discussion. However, the same use of the class number is employed in the second case and this point is the one being emphasized by Hensel. All admirers of Kummer will take keen pleasure in reading this masterly Gedächtnisrede.

The 56 pages of letters from Kummer to his favorite and most gifted pupil Kronecker are of historic value. They give a first-hand view of the progress step by step made by Kummer in his construction of his own imperishable monument.

L. E. DICKSON.

*Interpolationsrechnung.* Von T. N. THIELE, Em. Professor der Astronomie an der Kopenhagener Universität, Präsident des Vereins Dänischer Aktuare. Leipzig, Teubner, 1909. xii + 175 pp.

IN this book the theory of interpolation is developed so as to emphasize its role in pure mathematics as well as its place in the calculations of applied mathematics. The book is divided into four chapters. The elementary treatment in the first chapter is based on the general interpolation formula of Newton, written

$$
\begin{aligned}
(1)\qquad X = A + (x-a)[\delta'(a, b) + (x-b)\{\delta''(a, \cdots, c) \\
+ (x-c)\{\delta'''(a, \cdots, d) + (x-d)\delta''''(x, a, \cdots, d)\}\}],
\end{aligned}
$$

where $a, b, c, d, \cdots$ are distinct values of the argument, $A, B, C, D, \cdots$ are corresponding tabulated values, and $\delta'(a, b), \delta''(a, \cdots, c), \cdots$ are "divided differences" defined by

$$
\delta'(a, b) = \frac{A-B}{a-b}, \quad \delta''(a, \cdots, c) = \frac{\delta'(a, b) - \delta'(b, c)}{a-c}, \cdots.
$$