

Natural Sines to Every Second of Arc, and Eight Places of Decimals. By EMMA GIFFORD. Published by Mrs. Gifford, Oaklands, Chard, Somerset, 1914. vi + 543 pp. Price £ 1.

UNTIL the opening years of the twentieth century it seemed quite unnecessary to undertake the computation of tables of natural functions beyond what had long been in print. The recent development of various types of calculating machines, however, has destroyed the monopoly held by logarithms for the past three hundred years, and has restored to the natural function something of its early prominence, particularly in the work in astronomy. When Georg Joachim, surnamed Rheticus (b. 1514), computed his great table to every 10'' of arc and to ten figures, it was thought that nothing further could well be demanded, and the posthumous publication of these tables by Valentine Otho, under the title of *Opus Palatinum* (1596) was justly felt to mark a great epoch in mathematical progress. The invention of logarithms only a few years later, however, relegated the work of Rheticus to a position of relative insignificance, and there it would have remained had not the rapid progress of calculating machinery in recent years rescued it from this unhappy position.

In 1897 Jordan published his table of natural sines, which was a reprint of Rheticus to every 10'' of arc and to seven figures. This was the first important evidence of the return of the natural function to its former position, but it merely made accessible an important part of the *Opus Palatinum*, so that it represented nothing new in its line.

Mrs. Gifford started out to work *de novo* on a table of natural sines to every second of arc, not having access to the work of Rheticus when she began. By the expenditure of an amount of time and work which seemed out of all proportion to the results secured she computed two hundred and forty sines. She then secured a copy of the *Opus Palatinum* and proceeded to find the sines by interpolation, checking from the results she had already secured and from Callet's centesimal table in which are given a thousand sines to the quadrant, or one to every 324'' of arc. When in doubt as to the eighth decimal place she checked by the equation $\sin^2 x + \cos^2 x = 1$. The work of interpolation was performed by the aid of a Thomas calculating machine, using the figures given by