COMPUTATION RULES

AND

LOGARITHMS

WITH TABLES OF OTHER USEFUL FUNCTIONS

BY

SILAS W. HOLMAN

PROFESSOR OF PHYSICS AT THE
MASSACHUSETTS INSTITUTE OF TECHNOLOGY

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PREFACE.

It would probably be within safe limits to assert that one-half of the time expended in computations is wasted through the use of an excessive number of places of figures, and through failure to employ logarithms. This waste might be almost wholly avoided by following a few simple computation rules and practising slightly with logarithm tables.

The loss from the use of superfluous figures will be appreciated when it is considered that in direct or logarithmic multiplication and division with four, five, and six places of figures the work is respectively in the ratio of $1:2:3$, or perhaps more nearly $2:3:4$. Thus contrary to the fallacious excuse so commonly given that it is just about as easy to use six- or seven-place tables as smaller ones, the work is doubled or trebled by the use of six places instead of four. Even the employment of six- or seven-place tables, and dropping superfluous places when four or five are desired, causes much loss of time.

The proper employment of logarithms for work of four or more places effects a saving of one-quarter and upward of the time required for direct multiplication or division, with a lessening of fatigue and a gain of accuracy.

The following pages contain simple rules to enable one to answer for himself the question, how many places of figures ought I to use in this computation? — also, an explanation of the use of the notation by powers of ten; certain instructions, more or less novel in form, as to the use of the logarithm and other tables; and a collection of useful tables. This collection is designed to contain all the mathematical tables ordinarily required, and nothing more, in practical work in all branches of the engineering professions, and by students of physics, chemistry, and engineering, for work of any grade not exceeding about one-twentieth of one per cent in accuracy. For

COMPUTATION RULES.

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PROPER NUMBER OF PLACES OF SIGNIFICANT FIGURES.

THE following three pages contain the rules and their underlying principles in a condensed form for ready reference. For readers to whom some of the terms employed are unfamiliar, or who desire fuller proofs and explanations, some additional pages of "Definitions and Explanations" have been appended.

These rules should enable a computer to decide at the outset of his work, or at the successive stages of it, what number of places of significant figures he should retain in order to avoid waste of labor on the one hand or sacrifice of accuracy on the other. They provide for a sufficient number of places to assure that (barring mistakes) the accumulated error arising from the rejection of further places shall be always smaller, usually much smaller, than the supposed uncertainty of the data or result, in computations involving not more than about 20 rejections. The retention of more places is worse than useless. It adds nothing to the accuracy of the result, although increasing materially the labor of computing, and the liability to mistake. The aggregate value of the time thus wasted, — obvious enough to any one who has had occasion to perform extended computations, — may be appreciated from the fact that the use of five places where four would suffice, nearly doubles the labor; using six places instead of four, nearly trebles it; thus wasting 100 and 200 per cent respectively of the necessary amount of work, and probably a greater proportion of time. Moreover, incongruities in the use of places of figures arouse skepticism as to the competence of the worker in other directions.