

**A TREATISE ON COMPUTATION.
AN ACCOUNT OF THE CHIEF
METHODS FOR CONTRACTING
AND ABBREVIATING
ARITHMETICAL CALCULATIONS**

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A Treatise on Computation. An Account of the Chief Methods for Contracting and Abbreviating Arithmetical Calculations by Edward M. Langley

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EDWARD M. LANGLEY

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COMPUTATION

THE HARPUR EUCLID. With upwards of 900 Exercises and numerous Appendices on Modern Developments of Geometry. By E. M. LANGLEY, M.A., Senior Mathematical Master, the Modern School, Bedford, and W. S. PHILLIPS, M.A., Senior Mathematical Master at Bedford Grammar School. Crown 8vo.

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603-24

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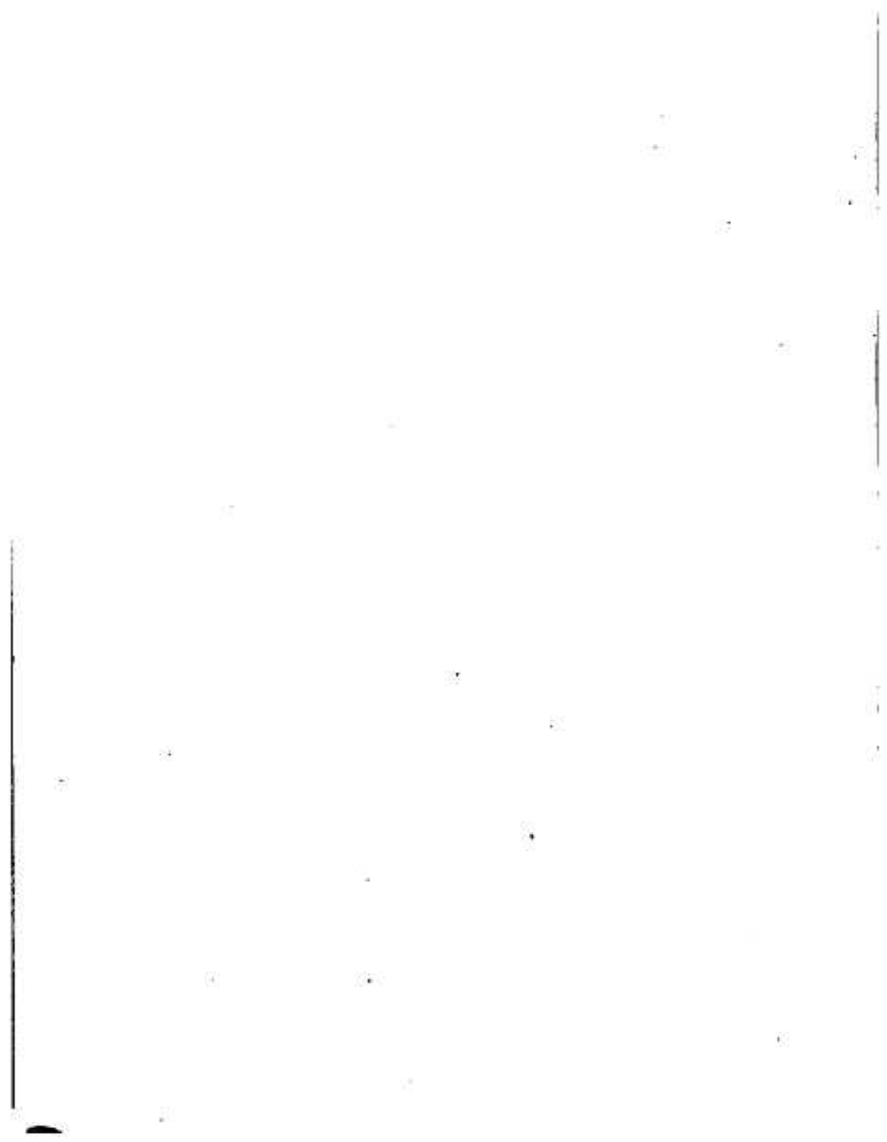
"He who can easily, rapidly, and accurately, add, subtract, multiply
and divide, is a computer."—DE MORGAN

"Superfluitas impedit multum . . . et reddit opus abominabile."—
ROGER BACON

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Yale Cat 0 9-20-23 E. M. H.

P R E F A C E.

IN the following little treatise I have aimed at giving an account of the chief general methods for arriving at rapidity of numerical calculation. I have in nearly all cases tried to show the nature of general methods by actual examples worked, rather than by sets of verbal rules, believing strongly in the Newtonian maxim, "*Exempla magis prosunt quam precepta*".

If due attention were paid in schools to arithmetic as an art of computation, a considerable part of what is here put down might have been omitted; but the majority of teachers seem to be contented to go on inculcating cumbrous and antiquated methods of work which must be discarded by any one who has to perform rapidly and accurately such calculations as are necessary in many branches of applied science; and I have had to point out that fundamental changes must be made in the methods of performing even the most elementary operations.

Section I. is therefore devoted to explaining generally what methods are to be chosen for effecting various arithmetical operations without raising the question of *abbreviation* or *approximation*.

Section II. shows how to abbreviate the processes employed, to obtain approximate results, and to estimate the amount of error to which these are liable. Attention is drawn to the *essentially approximate nature* of physical calculations, and to the consideration, sometimes neglected, that to whatever degree of accuracy the *arithmetical operations* are carried out, there cannot be a higher degree of accuracy in the *results obtained* than in the *numerical data on which those calculations are founded*.

Section III. deals with logarithms. Specimens of various trigonometrical tables are given, and their uses explained. In particular, I have insisted on the use of cologarithms, and on the omission of the tabulated 10 from the logarithms of trigonometrical ratios.

Section IV. illustrates the principles previously explained by applying these to such calculations as actually occur in the office or the laboratory. I have to thank Professor Ayrton for the free use he has allowed me to make of the examples in his *Practical Electricity*.

In a work involving such a large number of figures there is only too good reason to suspect some undiscussed errors in the printing. I shall be grateful to any one who, on detecting any such error, will inform me of it.

In addition to these, I cannot help suspecting others, both of omission and commission, for which I am alone responsible. For all these I ask the indulgence of my readers, and venture to hope that they will help me in the task I have undertaken by pointing out possible improvements. My obligations to previous writers are many, especially to De Morgan; at the same time, I am not aware of the existence of any work which occupies quite the same ground.

In conclusion, I return my sincere thanks to the many friends who have helped me with their sympathy and advice; and in particular to Professor A. Lodge, and Mr. G. J. Gibbs. To Mr. T. Wilson (Rothamstead Laboratory, Harpenden), Mr. A. E. Field (Grammar School, Bedford), and Mr. F. Taylor (Modern School, Bedford), who have undertaken the arduous task of working through the proof sheets, I owe more than I can express.

EDWARD M. LANGLEY.

Modern School, Bedford.

ON COMPUTATION.

I. QUICKNESS IN PERFORMING AND VERIFYING ELEMENTARY WORK.

ADDITION.

1. 5 IN adding up a column of digits, such as the one
9 given on the left of this page, it is customary to
6 do it either mentally or with actual vocal accom-
8 paniment as follows :—
1 Two and four, six ; and one, seven ; and eight,
4 fifteen ; and six, twenty-one ; and nine, thirty ; and
2 five, thirty-five. For rapidity it is not necessary to
— abandon the vocal statement of the result (though
35 for other reasons it may be well to learn gradually
to do without it) ; but supposing, for the present,
that it is retained, the work should be accomplished with a
*complete suppression of the "and," and also of the mention of
the digits which have to be added.* Thus the student should
simply say :—

Six, seven, fifteen, twenty-one, thirty, thirty-five,
laying emphasis on *thirty* and writing down 5 just as he says
the word "*five*".

4937685

43299

376

8142488

976251

4397164

5732

18502995

Thus, in effecting the summation here given,
the only numbers mentioned should be as
follows :—