

**LESSONS ON HIGHER
ALGEBRA: WITH AN
APPENDIX ON THE NATURE OF
MATHEMATICAL REASONING**

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Lessons on Higher Algebra: With an Appendix on the Nature of Mathematical Reasoning by
Ellen Hayes

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ELLEN HAYES

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▷ LESSONS

ON

HIGHER ALGEBRA

WITH AN APPENDIX ON
THE NATURE OF MATHEMATICAL REASONING


BY

ELLEN HAYES

PROFESSOR OF MATHEMATICS IN WELLESLEY COLLEGE

REVISED EDITION

Notwood Press
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1894



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1964

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MATHEMATICS will ever remain the most perfect type of the Deductive Method in general; and the applications of mathematics to the deductive branches of physica furnish the only school in which philosophers can effectually learn the most difficult and important portion of their art, the employment of the laws of simpler phenomena for explaining and predicting those of the more complex. These grounds are quite sufficient for deeming mathematical training an indispensable basis of real scientific education, and regarding (according to the *dictum* which an old but unauthentic tradition ascribes to Plato) one who is *ἀγεωμέτρητος*, as wanting in one of the most essential qualifications for the successful cultivation of the higher branches of philosophy. — JOHN STUART MILL: *System of Logic*.

Je me plaisais surtout aux mathématiques, à cause de la certitude et de l'évidence de leurs raisons; mais je ne remarquais point encore leur vrai usage, et, pensant qu'elles ne servaient qu'aux arts mécaniques, je m'étonnais de ce que, leur fondements étant si fermes et si solides, on n'avait rien bâti dessus de plus relevé. — DESCARTES: *Discours sur la Méthode*, 1637.

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PREFACE TO THE FIRST EDITION.

THE following Lessons have been prepared for use in a brief course in Algebra offered in the first part of the second semester, freshman year, at Wellesley College. An effort has been made to give unity to the work by proposing one general problem,—the discovery of the roots of Higher Numerical Equations. Everything has been omitted which does not bear directly on the solution of this problem. It hardly need be added that in so brief a presentation of the subject only the more important theorems could be included. The essentials of the Theory of Logarithms have been presented, preliminary to the study of Trigonometry.

The works chiefly consulted in writing the Lessons, and to which special indebtedness should be acknowledged, are the treatises of Todhunter, Hall and Knight, Chrystal, Burnside and Panton, Serret, and Bertrand.

E. H.

1. The first part of the document discusses the importance of maintaining accurate records of all transactions. It emphasizes that every entry should be supported by a valid receipt or invoice.

2. The second part outlines the procedures for handling discrepancies between the recorded amounts and the actual cash received. It suggests a systematic approach to identify the source of the error.

3. The third part details the requirements for the physical handling of cash, including the use of secure containers and the presence of authorized personnel during the process.

4. The fourth part addresses the periodic reconciliation of the cash book with the bank statements to ensure that the records are up-to-date and accurate.

5. The fifth part discusses the role of the auditor in verifying the integrity of the cash records and ensuring compliance with the relevant financial regulations.

6. The sixth part provides a summary of the key points and reiterates the importance of strict adherence to the established procedures.

7. The seventh part concludes the document with a statement of approval and the date of implementation.

PREFACE TO THE REVISED EDITION.

IN revising the *Lessons on Higher Algebra* various minor changes have been made in the articles of the first edition, and a number of articles added. A section on Determinants has also been introduced. In explanation of the brevity of these Lessons, it ought to be said, that the mathematical course for which they were written includes further work for more advanced students, in which the text-book used is Burnside and Panton's *Theory of Equations*.

The presence, in an algebra book, of so unusual a feature as a section on the nature of mathematical reasoning, calls for more than a passing word.

It cannot have escaped the notice of those who are acquainted with the prevailing methods of instruction in mathematics and logic that, on the one hand, the average teacher of mathematics gives little or no attention to the nature of the processes according to which mathematical reasoning is conducted; while, on the other hand, the teacher of logic almost ignores mathematics as a source of illustrations of the principles with which he is dealing. A preface is not the place to discuss the causes or effects of this divorce of two subjects which might go hand in hand; but I must express my conviction that when we discover those methods of instruction which are essential to sound education, they will be found to include logic