The design of this work will be understood by reference to the following extracts from a Grace of the Senate, passed in May, 1846, which will regulate the examination of Candidates for Mathematical Honours in January, 1848, and succeeding years.

It was determined by the Grace referred to,

1. That Questions and Problems being proposed to the Questionists on eight days, instead of six days as at present, the first three days be assigned to the more elementary, and the last five to the higher parts of Mathematics: that after the first three days, there shall be an interval of eight days; and that on the seventh of these days the Moderators and Examiners shall declare, what persons have so acquitted themselves as to deserve Mathematical Honours.

2. That those who are declared to have so acquitted themselves, and no others, be admitted to the Examination in the higher parts of Mathematics: and that after that Examination, the Moderators and Examiners, taking into account the Examination of all the eight days, shall arrange all the Candidates who have been declared to deserve Mathematical Honours into the three classes of Wranglers, Senior Optimes, and Junior Optimes, as has been hitherto usual; and that these classes be published in the Senate-House at nine o'clock on the Friday morning preceding the general B.A. Admission.

3. That the subjects of the Examination on the first three days shall be those contained in the following Schedule:—

Euclid. Book I. to VI. Book XI, Props. i. to xxl. Book XII, Props. i, ii.

* Arithmetic and the elementary parts of Algebra; namely, the Rules for the fundamental Operations upon Algebraical Symbols, with their
simple and quadratic Equations; Arithmetical
Progression, Permutations and Combinations, the Bin-
omial theorem, and the principles of Logarithms.

The elementary parts of Plane Trigonometry, so far as to include
the solution of triangles.

The elementary parts of Conic Sections, treated Geometrically,
together with the values of the Radius of Curvature, and of the Chords
of Curvature passing through the Focus and Centre.

The elementary parts of Statics, treated without the Differential
Calculus; namely, the Composition and Resolution of Forces acting
in one plane on a point, the Mechanical Powers, and the properties of the
Centre of Gravity.

The elementary parts of Dynamics, treated without the Differential
Calculus; namely, the Doctrine of Uniform and Uniformly Accelerated
Motion, of Falling Bodies, Projectiles, Collision, and Cycloidal Oscill-
ations.

The 1st, 2nd, and 3rd Sections of Newton's Principia; the Pro-
positions to be proved in Newton's manner.

The elementary parts of Hydrostatics, treated without the Diffe-
rential Calculus; namely, the pressure of non-elastic Fluids, specific
Gravities, floating Bodies, the pressure of the Air, and the construction
and use of the more simple Instruments and Machines.

The elementary parts of Optics: namely, the laws of Reflexion and
Refraction of Rays at plane and spherical surfaces, not including Aberr-
rations; the Eye; Telescopes.

The elementary parts of Astronomy; so far as they are necessary for
the explanation of the more simple phenomena, without calculations.

4. That in all these subjects, Examples, and Questions arising
directly out of the Propositions, shall be introduced into the Examina-
tion, in addition to the propositions themselves.

5. (This article refers merely to the days and hours of Examination,
and is therefore omitted.)

* The words "treated geometrically," which were originally inserted in this place,
are now omitted by Grace of the Senate.
6. That the Moderators and Examiners shall be required to declare Candidates, though they have not deserved Mathematical Honour, to have deserved to pass for an Ordinary Degree, as far as the Mathematical part of the Examination for such degree is concerned; and such persons shall accordingly be excused the Mathematical part of the Examination for an Ordinary Degree, and shall only be required to pass in the other subjects, namely, in the parts of the Examination assigned in the Schedule to the last two days; but such excuse shall be available to such persons only for the Examination then in progress.

When the preceding regulations had passed into law, it struck me very forcibly that, in order to carry out the expressed wishes of the University, it would be desirable, if not necessary, that a short course of Mathematics should be compiled, of which the Schedule agreed upon by the Senate should be, as it were, the table of contents. It appeared to me that, with regard to several of the subjects, there were no books in use, which would put before the student the portions to which it would be necessary for him to devote his attention, without an accumulation of other matter which would be likely to confuse and perplex. I mentioned the necessity of such a book several times in the course of conversation, and found that others agreed as to the want, but did not hear of any one who seemed disposed to undertake the labour requisite for its supply. Under these circumstances I determined to attempt the task myself, trusting that the intention would be appreciated, however much the execution of the design might fall short of my own hopes, or the requirements of the case.

For indeed it is a task of no ordinary degree of difficulty, to write an elementary work upon an abstruse subject; points, which appear to the writer plain and intelligible without explanation, sometimes assume a very different aspect to the beginner, and difficulties of which the author is scarcely aware, may be of huge dimensions to a mind not already
familiarised with the mode of thinking which belongs to each particular subject. Hence it has come to pass that so few elementary works have long retained their ground; and hence also, an author may conclude the expediency of endeavouring, so far as he may, to follow in the steps of those few who have shewn an aptitude for this kind of writing. Time has, I think, proved that, of all works which Cambridge has produced, that which the most nearly fulfils the conditions of a perfect elementary treatise, is Wood's Algebra, a work which it is impossible too much to admire for its simplicity and admirable perspicuity. In writing on Algebra, therefore, I have endeavoured, as far as possible, to take Dr Wood's treatise as a model: and, indeed, in all other parts of my work, where the nature of the case allowed, I have endeavoured, though I fear not always successfully, to keep the same example in view.

I may remark also, in general, that it appeared to me that the worst fault into which I could fall, in such a work as the present, would be an affectation of originality. Originality belongs to the progression of science, but not to the exposition of those portions which may be regarded as permanent. I have, therefore, endeavoured to deviate as little as possible from the methods pursued in those books which appeared to me, on the whole, to be the best and the most generally acknowledged.

In each treatise I have introduced all propositions which, according to my judgment, can fairly be included in the intention of the Grace of the Senate, omitting however some which are usually given, but which are only applications of, or deductions from, the fundamental propositions. To take an example, in the treatise on Statics I have not given the investigations for pullies, when their own weight is taken into account, nor when the strings of the pullies are not parallel, because these are only deductions from the simplest
case; and it would seem to be unadvisable to load a treatise, intended to be of the simplest description, with deductions and applications which may be indefinitely multiplied. Nevertheless my judgment may have led me into error; and, indeed, the only authorized comment on the meaning of the Grace will be the Examination Papers of 1848 and the few succeeding years: the character of those papers may perhaps render it necessary to modify some portions of my work in a succeeding edition, should that be called for.

I will, however, be bold to give my opinion, that the success of the new scheme of examination depends, to a considerable extent, upon the Grace of the Senate being interpreted in the narrowest manner possible. The great number of the subjects of which a knowledge is required, renders it impossible for students of no great ability, or whose attention is principally devoted to other academical pursuits, to obtain a very extended knowledge of each; a very real and useful knowledge may doubtless be acquired, but it can scarcely be expected to be adequate to the task of answering questions proposed, unless those questions be almost confined to that small number of propositions which may be considered to be classical in each subject.

A few remarks may be made respecting certain of the following treatises, and the plan upon which they have been written.

The treatise on Algebra has, as I have before observed, been formed as much as possible, on the model of that by the late Dr Wood. I have given Euler's proof of the Binomial Theorem for fractional and negative indices, as being at once the most elegant and the most useful as a mental exercise.

In the treatise on the Conic Sections, I have principally followed the demonstrations given by Mr Hustler, partly because they appeared to me as elegant as could be desired;
and partly because that work having been long published, and being usually counted the text-book in this subject, I thought it well to deviate as little as possible from the beaten track. I have, however, abbreviated to some extent by omission, making it in general a necessary condition of the admission of any proposition that it should be necessary to the understanding of the first three sections of Newton’s Principia; by this and other means, I have endeavoured to render as little formidable as might be a subject confessedly difficult and unpalatable.

In the subject of Mechanics, it is more difficult than in either of the preceding to determine precisely the limits to which questions may, according to the Grace of the Senate, extend. On principles to which I have before referred, I have made the treatises on both Statics and Dynamics as brief as possible.

In giving an English version of the first three sections of the Principia, I have endeavoured to adhere, as nearly as circumstances would allow, to the original, only giving the demonstrations a form more convenient for the purposes of the student; and any interpolations of my own have been enclosed in brackets. In one instance (Lemma VI.) I have, after the example of a version much used in the University, substituted a different mode of demonstration for the very short method given by Newton; but the mode of demonstration adopted may be now, I think, considered classical, as having been given in the notes to the Jesuits’ edition of the Principia.

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The most difficult subject to treat in a clear and elementary manner is, I think, the last, Astronomy; yet is there none upon which a treatise adapted to the new scheme of examination was more required. For hitherto
Astronomy has only been studied for the purposes of the Senate-house examinations by a few, and those the more advanced of the candidates for Honours; and consequently no book has been called forth containing those elementary portions of the subject, which will henceforth be required, in a form adapted to the needs of the majority of students. With regard to the manner in which I have treated the subject, I may remark, that I have not construed the words of the Grace, "without calculations," so as to exclude the introduction of mathematical symbols when by that means distinctness of explanation could be most easily attained; and also I may say, that to no subject more than this does the remark apply which I have already made, namely, that it is difficult to determine what is and what is not intended to be included in the schedule of subjects, and that the difficulty will only disappear under the light of the Examination Papers of 1848 and a few succeeding years.

In conclusion, I will only add that the following pages have been written under a pressure of other engagements, and at a consequent degree of personal inconvenience, which would only have been submitted to under the conviction of the necessity of such a work in the present state of the University. I am well aware of the imperfection which must necessarily attach to the performance of my task, but which yet, I trust, will not be such as to affect to a material extent the utility of my book to those for whom it has been principally written.

H. GOODWIN.

December, 1846.
PREFACE TO THE THIRD EDITION.

In presenting this Third Edition of my Elementary Course I have only a few remarks to make.

I have reprinted the Preface to the first Edition, with a few omissions, although some portions of it may be now unnecessary, because it seems to explain, as well as I could wish, the intention of the work, and the principles which guided me in composing it.

The scheme for the Examination, which was sanctioned by Grace of the Senate in May, 1846, has been slightly modified by a recent Grace, in accordance with a recommendation made by the Board of Mathematical Studies. The words, "treated geometrically," which were originally appended to the "Elementary parts of Optics," are now omitted. On this account I have not reprinted the remarks made in the Preface to the first Edition, on the mode of treating this subject adopted in this work. The propositions which were introduced into the second Edition, with a view to carry out more exactly the intentions of the original Grace, have been retained. I have, however, inclosed them in brackets, to mark the fact that they are not necessary to the completeness of the treatise.

Some portions of Newton's Three Sections, which I ventured, partly with a view to simplicity, and partly from the example of a version much used in this University, to omit in the former editions, I have inserted in the present. The principal addition is the Scholium appended by Newton to his First Section. I trust that the three Sections, as I have now given them, may be deemed complete; at the
same time several good results will, I believe, be found to arise, if the Student will accustom himself to consult the original Latin.

Various additions have been made throughout the work, which need not be specified. But by careful arrangement of the matter, notwithstanding that this edition is printed in a bolder type than the preceding, the bulk of the volume has not been increased.

It is my intention to publish, as soon as my engagements will permit, a small Volume supplementary to the present, containing such notes and illustrations as could hardly be introduced into the work itself, but which yet would form a most desirable and, if I mistake not, a pleasing addition to the Mathematical Course. On this account I have suppressed an Appendix, containing a view of the Solar System, compiled from Humboldt's Cosmos, believing that it will find a more appropriate place in the projected Volume.

The sheets of this Edition having been carefully inspected by a friend, I send the volume out with greater confidence in its freedom from errors than on former occasions.

H. G.

Cambridge,
October, 1849.