

**REMARKS ON THE CAMBRIDGE
MATHEMATICAL STUDIES
AND THEIR RELATION TO
MODERN PHYSICAL SCIENCE**

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Remarks on the Cambridge Mathematical Studies and Their Relation to Modern Physical
Science by James Challis

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JAMES CHALLIS

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CAMBRIDGE MATHEMATICAL STUDIES,
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PHYSICAL SCIENCE.

BY THE

REV. JAMES CHALLIS, M.A., F.R.S., F.R.A.S.
FLUMIAN PROFESSOR OF ASTRONOMY AND EXPERIMENTAL PHILOSOPHY IN THE
UNIVERSITY OF CAMBRIDGE, AND FELLOW OF TRINITY COLLEGE.



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PREFACE.

WITHIN the last forty years several works on the Cambridge Mathematical Studies have been produced by members of the University who had taken an active part in improving and extending them either by teaching or writing, and were in other ways well qualified to form a correct opinion respecting their character and tendency. These works were specially called for in consequence of various changes which it had been thought desirable to make in the system of University instruction, in respect both to the modes of teaching and examining, and the subjects taught. In the year 1837 a work was published by Whewell entitled "On the principles of English University Education," and in 1845 another of like character was produced by the same author, the full title of which is, "Of a Liberal Education in general, with particular reference to the leading studies of the University of Cambridge." As might be expected from the titles, so much of these works as is devoted to mathematical studies treats

of them mainly as *educational* means ; and accordingly very much is said about the superiority in this respect of reasoning by geometry above reasoning by analytical symbols, and no account is taken of analytics as an instrument of physical research. In 1833 Professor Sedgwick published "A Discourse on the Studies of the University," which in 1850 was re-published with Additions consisting of a very long Preface and Appendices, which, in fact, constitute by far the greatest part of the volume. The occasional remarks, contained in the latter publication, relative to mathematical studies, I consider to be peculiarly apposite, especially as regards what the author calls "The Newtonian System of Philosophy," and its relation to results obtained solely by experiment or observation. These views, however, refer only to Physical Astronomy. At a date somewhat later a pamphlet entitled "Remarks on the Mathematical Teaching of the University of Cambridge" was produced by Hopkins, who, by his experience both as a private tutor and as a cultivator of applied mathematics, was eminently qualified to speak on the subjects he took in hand. The pamphlet bears no date, but as it is stated on the Title-page that the author was at the time President of the British Association, it must have been circulated in 1853 or 1854. The matters it treats of are almost exclusively restricted to the *means* of teaching mathematics by private tuition, and by the Lectures of College Tutors

and University Professors, and on these points valuable suggestions are thrown out, which were afterwards to a considerable extent carried into effect. The suggestions had special reference to the Report of the Cambridge University Commission issued in 1852.

Since the last-mentioned date various changes have been made in the Scheme of Examination of Candidates for Mathematical Honours, the most important of which are those which were confirmed by Grace of the Senate on June 2, 1868, the principal effect of which was to sanction the introduction into the Examination of a wider range of questions in experimental and theoretical physics. Taking this circumstance into account, together with the limited character, as shewn by the foregoing statements, of the discussions which the Cambridge Mathematical Studies have hitherto undergone, I thought the time was come when they might with advantage be brought again under review, both as regards the principles and the reasoning adopted in the treatment of the several subjects, and as to their relation to modern advances in physical science. I may claim, I think, to have some pretensions for entering upon this undertaking, from having had to do with the study of mathematics as pupil, lecturer, examiner, or professor, during more than half a century, and having spent much time and thought on independent mathematical and physical researches.

Accordingly the contents of this publication consist

for the most part of arguments relating to the *principles* and *processes of reasoning* that are legitimate and necessary both in applied mathematics and physics, with prospective reference to the fundamental hypotheses of the Newtonian System of Philosophy, and to the methods of deducing from them by mathematical reasoning results that might be compared with modern experiments and observation. The questions considered are generally such as involve points of difficulty which, as having respect to principle, require to be cleared up before farther advances can be securely made, and the arguments employed to meet the difficulties are exhibited in as much detail as was practicable in a publication like the present; but generally the reader is referred for the details of arguments to my work on *The Principles of Mathematics and Physics* published in 1869, and to the supplementary *Essay on the Mathematical Principles of Physics*, published in 1873. I have had occasion also to cite for the same purpose communications in the *Philosophical Magazine*, especially some written after the publication of the former work. It will be proper to mention here that the first of the two above-mentioned works is uniformly cited in the Remarks, for the sake of brevity, as 'Principles' with numbers added indicating pages, and the other as 'Essay' with indications of articles.

In publishing the present work I have also had a motive of a personal kind, which I beg leave to take

this opportunity for stating. In February of next year I shall have completed the fortieth year of my tenure of the Plumian Professorship. In the ordinary course of nature I can expect to be able to continue but a short time longer the discharge of its duties, and I really think that the time is come when in respect to lecturing and examining, which are more suited to younger men, I may ask to be allowed to take the place of Professor Emeritus. I make this suggestion with the less hesitation because I feel that I am still able to devote my time to writing and publishing, and may hope thereby to contribute something both to the advancement of Natural Philosophy, and to giving a proper direction to the Mathematical Studies of this University. My plea is (1) that at the present time Natural Philosophy stands in no greater need, whether as regards the teaching of it, or its advancement, than that of being placed on the basis of the principles insisted upon by Newton in the Third Book of the *Principia*; and (2) that hitherto no one besides myself has undertaken to supply this need. (See what I have urged in pp. 86 and 87.) It is hoped that this brief publication may suffice to give the Authorities of the University and Members of the Senate the means of forming an opinion on these two points, and may induce them to determine, if it should be in their power, whether my being engaged in the way I propose in advancing *Experimental Philosophy* as distinct