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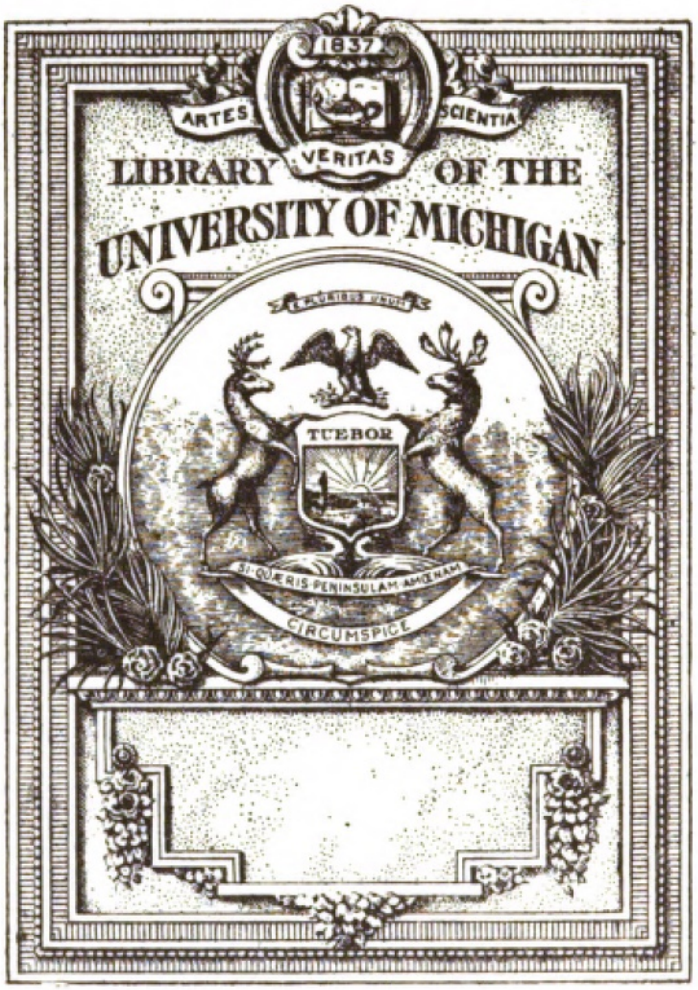


OF

A LIBERAL EDUCATION

IN GENERAL;

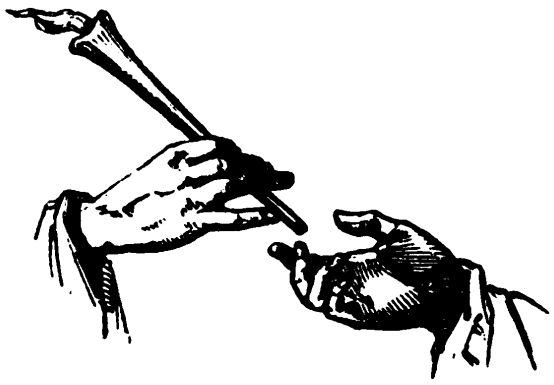
AND WITH

PARTICULAR REFERENCE TO THE LEADING STUDIES OF THE UNIVERSITY OF CAMBRIDGE.

PART I.

PRINCIPLES AND RECENT HISTORY.

BY WILLIAM WHEWELL, D.D.,
MASTER OF TRINITY COLLEGE.



Λαμπάδια ἔχοντες διαδώσουσιν ἀλλήλοις.

SECOND EDITION.

LONDON:
JOHN W. PARKER, WEST STRAND.

M.DCCC.L.

Cambridge:
Printed at the University Press.

TO

GEORGE BIDDELL AIRY, Esquire,

ASTRONOMER ROYAL.

My dear Airy,

It gives me great pleasure to make the present volume the memorial of a long and valued friendship, by dedicating it to you. But even without such a motive, I might fitly have placed your name in the front of my book, on account of its subject; for though it is now several years since you were called from a sphere of academical to one of more direct national influence, we still enjoy the benefit, both in our scientific activity, and in our educational methods, of the paths which you traced for us, and of the spirit which you diffused among us. I know too that you continue to take a lively interest in the proceedings and character of your ancient home. I will further add, as another reason for offering my Reflections to you, that with regard to the kind of Mathematical Studies most suited to the University, and especially with regard to the destructive effect of mere analysis upon the mind, I know that your views agree with my own.

That you may long continue your noble career of scientific distinction and national usefulness, is the hearty wish and prayer of,

My dear Airy,

Yours most truly,

W. WHEWELL.

Trinity Lodge, *Oct.* 10, 1845.

PREFACE TO THE SECOND EDITION.

THIS new Edition of my book *Of a Liberal Education in general, and with particular reference to the leading Studies of the University of Cambridge*, I have now further designated as PART I., and have described its subject as the *Principles and Recent History* of such Education; having at the same time published PART II., of which the subject is *Discussions and Changes* 1840—1850. Having, in this Second Part, an opportunity of carrying on further the discussion of the questions which came before me, I have made only slight and unimportant corrections in the First Part.

I may take this opportunity of remarking that Mr Harvey Goodwin's *Elementary Course of Mathematics*, on which, in Article 354, and the following, I have ventured to offer some criticisms, reached a third edition in October last: and in this edition the part of the work which contains the requisite propositions of Newton is brought so near to Newton's own reasoning, as to be liable to little or none of the objection which I have made to it in Article 358; though I still think it advisable that the student should consult the original text.

As completing the collection of recent University Regulations concerning Examinations which I have given in the Appendix to Part II., I will insert two

Regulations which were established by vote of the Senate, Feb. 20, 1850.

"All students who shall have passed the Examinations and kept the Exercises required for the Degree of Bachelor of Laws, or Bachelor of Physic, or who shall have passed the Examination entitling to admission *ad respondendum quæstioni*, after January 1, 1850, and no others, may be Candidates for Honors in the Moral Sciences Tripos and the Natural Sciences Tripos of 1851.

"No student who has degraded shall be allowed to be a Candidate for Honors in the Moral Sciences Tripos or in the Natural Sciences Tripos, unless he shall previously have obtained special permission for so doing from the Syndicate appointed to examine into the cases of applicants for permission to become Candidates for Mathematical Honors after they have degraded."

TRINITY LODGE,
Feb. 20, 1850.

PREFACE TO THE FIRST EDITION.

HAVING recently been led to consider the connection between the general principles of Education, and several points in the present condition of the University of Cambridge; and also to collect the series of *Graces* by which the Examinations of the University have been modified in late years; I have thought that the result of these occupations might have some interest for others as well as myself. I therefore here publish my reflections and my extracts, as a contribution towards any future deliberation on the questions on which they bear.

I fear I must apologize to the general reader for having treated the subject of Education in a manner much more scanty and partial than the title of my volume, and of several of its sections, might lead him to expect. In explanation of this, I may say that though, in what I have written, I had mainly in view certain questions relative to the present studies and modes of procedure of Cambridge, I had endeavoured to decide these questions by a reference to the general principles which must always and everywhere regulate a Liberal Education, and that this was what my title was intended to imply. I have spoken, at present, principally of Classical and Mathematical Studies: I trust other publications of mine may serve to show

how far I am from thinking that these two subjects comprize all the studies which belong to the developement and discipline of man's mind and character. I do not know if any of my readers will wish to see such views as are offered to him in the present volume followed out into the other departments of a Liberal Education; but if so, I trust he will excuse me for bringing out at present that portion of this train of reflections which bears especially upon questions likely to come soon under discussion in this place.

I express this hope the more particularly, inasmuch as I have already experienced, in several instances, (—Mr Lyell has afforded me a remarkable one noticed in the present volume—) how readily I may be blamed for supposed omissions of important truths, in writing upon this subject of Education.

Among my readers in the University, probably there will be some who will be dissatisfied to find that still further modifications are proposed in the University Examinations; thinking that after so many changes as have been made of late, what we most want, is that steadiness of procedure which requires an abstinence from legislative change. I entirely agree in thinking such a steady procedure a most valuable attribute of an Educational System; but I would beg these readers to observe that, in some respects, the modifications here suggested are provisions intended to remedy the effect of previous innovations, which have placed us in an unsteady position. And I would represent to them that in other matters, my suggestions are mainly of the

nature of those small and quiet alterations which must go on in all Institutions from time to time, in order to avert larger and more violent changes which arise from accumulated incongruities.

There will probably be other persons who will be dissatisfied with my proposed measures, because they think that the condition of the University and the circumstances of the time call for more sweeping changes. To these I would reply, that it is necessary for the proper and salutary influence of Educational Institutions, that alterations in their modes of acting should be made slowly. It is their office to connect one generation with another, not to follow the revolutions of popular tastes, or to run a race with the spirit of the age. Education necessarily implies some constraint; to legislate in the hope of removing all constraint on University Studies, would be to legislate for the annihilation of all efficiency in our system. Education necessarily holds to the past. To act in the hope of introducing into the University course every novelty which attracts admiration in the world, would be to bewilder and intoxicate those whom we ought to direct and discipline.

If the suggestions contained in the following pages are approved of in the University, I hope that other persons will take such steps as may tend to bring corresponding measures formally under the consideration of the University. But I am far from thinking that what I have proposed is necessarily the only right course; and if any other Member of the Senate will,

in an open and candid spirit, either point out the defects and bad consequences of my proposals, or suggest better remedies for our alleged evils, I shall give a respectful attention to what he may urge, and shall be ready to guide myself by any light thus supplied.

I trust however, that such proposals, if any are offered, will be conceived with a view to the general promotion of good Education in the University, and not with a view to any supposed interests of particular sections of the students.

I will only add one remark. If there are any persons who are willing to judge of the character of this University by its acts, I hope the history of its legislation on the subject of Education since 1772, which I have given in the third chapter of this volume, will show them how far the University is from being unwilling or unable to discern defects in her condition, and to apply the remedies which seem most likely to remove existing evils.

TRINITY LODGE,
Oct. 10, 1845.

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OF

A LIBERAL EDUCATION, &c.

PART I.

PRINCIPLES AND RECENT HISTORY.

CHAPTER I.

OF THE SUBJECTS OF EDUCATIONAL STUDY.

SECT. 1. *Of Education in General.*

1 THE Education of the youth of any community in general is one of the most important concerns about which members of the community can have to deliberate; for upon this education depend the preservation, the order, the prosperity of the community, its moral and its intellectual condition. The education of the upper classes of the community is still more especially important; both because the characters of members of those classes have a greater influence upon the conduct and fortunes of the general body, and because the education of the lower classes will in a great measure depend upon that of the upper. The education of the upper classes is termed *Liberal Education*, and *the Higher Education**: the education of the middle classes

* The French distinguish *l'instruction secondaire*, which includes what we term a *liberal education*, from *l'instruction supérieure*, which denotes *professional* education; but I do not think the corresponding English phrases are used with this distinction.

will commonly be, in its highest parts, an imitation of the Higher Education, more or less incomplete; and the education of the people, when they are educated, must generally be an Elementary Education; including little more than the first elements of the Higher Education. A Liberal Education then,—the Higher Education in every community,—is important, both as being the education of those who must direct the course of the community, and as alone exhibiting, in any completeness, the Idea of Education.

2 In proportion to the great importance of our deliberations on the subject, is the difficulty of deciding what the Higher Education ought to be, in our own nation. Such a decision requires a deep insight into the circumstances, character and tendencies of the nation, and a comprehensive and correct knowledge of the past history and future prospects of all branches of Education; that is, of the studies, employments, and influences by which the minds and characters of young men in past times have been, and hereafter may be formed. The consideration of the greatness of this difficulty ought, perhaps, to operate in making men less ready than they often are, to deliver their opinions of the modes in which Education may be improved. Perhaps, also, the same consideration may tend to procure a more favourable reception for remarks on this subject, which do not arise from mere transient, general, speculative views, but which are suggested and directed by a long continued careful attention to the subject, growing out of official position, and applied with a view to practical results.

3 The Remarks now offered to the Reader, however, though based upon the general conditions to which a Liberal Education must necessarily be subject, solicit attention, in the first place, with reference to their practical application to the present state of the University of Cambridge. On this subject the writer

has various grounds for venturing to offer his opinion. He has, during a long course of years, occupied a series of active educational offices in the University, and has been engaged, along with others, in shaping most of the changes which have, during that time, taken place in the Educational System of the University: and he has so far attended to the general principles of Education, as to have repeatedly published upon them*. This latter circumstance makes him hesitate the less to offer himself again to the notice of the University and the Public with such Remarks; inasmuch as, looking back to what he has previously published on this subject, he finds nothing which subsequent thought and experience do not appear to him to have confirmed.

4 It may be a matter of interest to some persons out of our University, to know something of the principles on which we conduct, or attempt to conduct, Education within it. And even within the University, a publication of such principles, by one who has necessarily to take a share in what is done, may not be without its use; since the constitution of the University makes it very important that, in administering the educational system, various classes of persons should co-operate and sympathize; while the habits of the University do not provide any common channel through which a person in one class makes known to persons belonging to other classes, the principles on

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* *Thoughts on the Study of Mathematics as a part of a Liberal Education.* 1835.

On the Principles of English University Education. 1837.

Also several Remarks in the Prefaces to the various Editions of the Author's Treatises *On Mechanics, On Dynamics,* and especially of the Treatises *On the Doctrine of Limits,* and *On the Mechanics of Engineering.*

Also in *The Philosophy of the Inductive Sciences,* Book XIII. Chap. 3. will be found some remarks *on Intellectual Education,* and on the subjects which, in a highly cultivated nation, it ought to include.

which he acts, and the views which he entertains. It may tend to make the continuation of our system more steady, and changes in it, when any have to be made, less abrupt, if those who necessarily must take a part in producing or resisting change, explain to each other their objects and their reasons. I trust, therefore, that the publication of such remarks as I have to make will be found to be a step naturally connected with the official position to which I have already referred.

5 If my leisure allowed me, I should be desirous of discussing the subject of a Liberal English Education in its general aspect;—of examining what is involved in the Idea of such an Education, and in what measure the actual Education of England may be brought nearer to this Idea. But for the present, I must confine myself within much narrower limits. Omitting the consideration of Moral and Religious Education, I shall now treat of Intellectual Education only; and even with regard to that subject, I shall direct my remarks so as to make them applicable in an especial manner to the present condition of the University of Cambridge. On questions connected with this point, I shall perhaps go into details which may appear to a general reader uninteresting or obscure. Such readers can, of course, cease to follow my remarks, when they become too local or technical. But in order that they may excuse me for this mode of treating the subject, they will perhaps recollect, not only that our local questions are important to ourselves; but also, that general doctrines, on this as on other subjects, are saved from the danger of being loose, impracticable, and extravagant, by being treated with a view to their actual practical application in a special instance; and further, that the general doctrines respecting Intellectual Education which are true with regard to one Institution, must be true with re-

gard to others also. If I can succeed in bringing into view solid and comprehensive Principles applicable to Education at Cambridge, such Principles cannot well fail to have some value for those who are concerned in administering other existing Institutions of the Higher Education, or in establishing new Institutions of the same kind.

6 I hope, also, that the special purpose aimed at in the Remarks here made, will be accepted as an excuse for any want of symmetry or comprehensiveness in the course of intellectual culture here recommended. It would not be difficult to draw up a much more complete scheme of Literature and Science, and to require that our plans of a Liberal Education should be based upon this scheme. I do not think it would be found easy, under any circumstances, to carry into effect an Education so planned; but at any rate, it is not likely that the discussion of such a plan would be the best way of pointing out what steps are advisable in the present condition of our University. I state this, hoping that the view here given of the proper elements of our Liberal Education will not be regarded as if it were intended for a complete scheme of human knowledge. I am well aware how much it falls short of the latter idea.

7 In order to indicate the relation between the subject of Liberal Education in general, and that portion of it which I shall at present examine, I may remark, that I have already distinguished Moral and Religious Education, which I here pass by, from Intellectual Education, which I here consider. Further, of this branch of the subject, there is a subdivison which I shall employ in my discussion. The Studies by which the Intellectual Education of young men is carried on, include two kinds; which, with reference to their subjects, we may describe as *Permanent*, and *Progressive* Studies. To the former class belong those

portions of knowledge which have long taken their permanent shape;—ancient languages with their literature, and long-established demonstrated sciences. To the latter class belong the results of the mental activity of our own times; the literature of our own age, and the sciences in which men are making progress from day to day. The former class of subjects connects us with the past; the latter, with the present and the future. By the former class of studies, each rising generation, in its turn, learns how former generations thought, and felt, and reasoned, and expressed their thoughts, and feelings, and reasonings. By the latter class of studies, each generation learns that thought, and feeling, and reasoning are still active, and is prepared to take a share in the continuation and expression of this activity. Both these kinds of studies give man a conscious connection with his race. By the former he becomes conscious of a past, by the latter, of a present, Humanity.

8 Since the Studies which are employed as means of Education thus have it for their office to connect a man's mind with the general mind of the human race; the subjects of these Studies cannot be mere casual and arbitrary trains of thought and feeling, either of past or of present times. It is not merely because some men in former times have had certain thoughts, and have expressed them in certain books, that their books are proper means of education for us. In order to render books fit for such a use, they must contain thoughts and expressions of thought which are sympathized in by men in general, by successive generations, by distant nations, by the human race. And hence it is that we describe the books which discharge this office in education as *permanent* subjects of study. Such books form the educational studies, not of one generation or one country only, but of all generations and all countries, so far as they are educated. Such books have supplied the subject of sympathy among

civilized nations ever since civilization began; at least the civilization with which the European world is concerned. Such books express thoughts which belong to humanity in its general and permanent character; and express them in words on which the human mind delights to dwell. And again, with regard to the progressive studies which are to form a portion of a liberal education; it is not enough that we take for this purpose any expression of the present activity of men's minds. Progressive studies, too, must be a part of the developement of humanity in its general form. They must express an activity which belongs to man as man. They must be, though not permanent in their form, universal in their principles. They must be the results, not of individual caprice, or fancy, but of human Reason. They must aim, not at mere change or novelty, but at Truth. And since the progress of the human mind is from Truth to Truth, the new Truths must be founded upon the old ones; the progressive studies which education embraces must rest upon the permanent studies which it necessarily includes. The former must be its superstructure, the latter, its foundation.

9 The term *Education* especially implies, by its etymology*, that character in the studies of the rising generation which I have attempted to describe: namely, that these studies draw forth and unfold a portion of our common human nature. They *educe* the elements of the Humanity which we have within us. The studies and occupations of the young are not properly called *Education*, merely because they *draw out something*, without considering whether it is an attribute of the race, or an accident of the individual. Young persons may be so employed and so treated, that their caprice,

[* It must however be allowed that the connection of *educare* with *educere* is very obscure.]

their self-will, their individual tastes and propensities, are educed and developed; but this is not Education. It is not the Education of a Man; for what is educed is not that which belongs to man as man, and connects man with man. It is not the Education of a man's Humanity, but the Indulgence of his Individuality.

SECT. 2. *Of Permanent Educational Studies.*

10 Turning our attention first to the Permanent Educational Studies, we may further remark, that they are mainly such as are fitted to educe two principal Faculties of man considered as an intellectual being; namely, Language and Reason.

Language and Reason are attributes of Humanity intimately connected with each other. Without the use of Language, we could not express general propositions, or derive them from each other, in virtue of their forms of expression, in the manner which also we call Reasoning. Without the use of Reason, we could not conceive objects and their connexions in a general and abstract manner, and therefore could not apply to them names, and use Language. The Reason cannot express itself without Language; Language cannot be employed without the Reason. The books in which we read the thoughts of former generations of men, do not exhibit to us, in any part, Language alone, or Reason alone; but necessarily everywhere, Language and Reason combined;—Language expressing Rational Thought, or at least, expressing human feelings modified and moulded by Rational Thought.

11 But though Language and Rational Thought must thus be always combined in books, at least in books which are permanently studied by men, our attention may be especially directed to the one or the other of these two elements. Language may be considered as the outward vesture of Thought; Thought, as a body which is contained within this clothing; and

we may attend especially to the one or to the other; to the body or to the garment. But further; Language includes within its folds, not merely Thought, the result of the Reason operating purely and simply; but, as we have already intimated, Thought excited, unfolded, and swayed by the various Feelings which belong to man. Language is a necessary help of the Mind, when engaged in reasoning; but Language is far more commonly and generally used in expressing the sentiments which arise out of the Desires, Affections, Emotions, and Occupations of men, in their habitual intercourse, than in obtaining and enunciating the propositions which the pure Reason contemplates. It is much more familiar, as an implement in our daily outward life, than as an instrument in our occasional internal ratiocinations. The body of which Language is the clothing, is not the Reason merely, but the whole Nature of Man; and hence, this vesture of our humanity draws to it men's attention far more generally and more strongly, than it could do, if it were merely connected with the most recondite and central portions of man's being, his Reason.

12 Language, then, naturally draws men's attention as the clothing or vehicle of emotion, as well as of thought. But yet Language is so far properly the clothing or the vehicle of thought only, that it can express emotion only so far as it is moulded or *informed* by thought. The expression of mere emotion, unshaped by the operation of thought, is not language; it gives rise to Interjections, which are language only so far as they bear the traces of previous thought, or have meaning given them by accompanying words. And hence, when we turn our attention upon Language, we have to think of our thoughts; we have to turn the mind's operation back upon itself; we have to perform a *reflex* act of thought.

13 Reflex acts of thought imply a clearness and

flexibility of mind, of which, perhaps, all men are in a great degree capable, but for which some nations, in some stages of their progress, appear to have had a peculiar aptitude. The attention to the lines of connexion and shades of difference in the modes of expressing thought and emotion, which arises out of this clearness and flexibility of mind, enabled the nations so gifted to choose expressions which they, and other men since them, have dwelt upon with unfading pleasure and interest. The books of these nations, expressing the thoughts and emotions of Humanity in its general and permanent character, and thus expressing them in forms on which men's minds can dwell with satisfaction and delight, are, according to what we have said, fitted to supply the permanent subjects of educational study for succeeding ages. These books contain the means of the Higher Education of civilized nations, so far as the faculty of Language is the basis of Education.

14 The nations of which I speak, as having thus left us, in their books, expressions of the thoughts of man, in a form fitted for permanent educational study, are, as the reader will already have understood, ancient Greece and Rome. Those nations, at certain periods of their history, produced books which men accepted as fit subjects of permanent attention and abiding admiration; and these books have, in consequence, ever since occupied a prominent place in the education of civilized Europe. They have connected one generation and one nation with another. They have influenced the course of men's thoughts, and the mode in which thoughts have been expressed; they have affected the language of each nation, and have thus operated upon men's minds through all the innumerable channels through which language modifies thought. I need not attempt to enumerate all the modes in which ancient Greece and Rome thus exercise an influence upon

modern England: but I may mention two ways in which this influence familiarly appears; the study of *Classical Authors*, and the study of *Philology*.

15 The Classical Authors of Greece and Rome are, by that very designation, understood to be accepted both as models of literary excellence, and as general and familiar subjects of the study of liberally educated men. By the existence of such familiar models, and by their place in a liberal education, the ideas of literary beauty of thought and expression are embodied and exemplified; and these ideas, thus becoming familiar to men in the course of their education, mould the taste and awaken the discernment of those who, without such direction, would not have assigned to the highest literary excellence its proper place. Moreover classical authors, adopted as subjects of study on the ground of their literary merits, become a bond of mental union among all liberally educated men, by supplying to their memories a common store of thoughts, images, turns of expression, histories, arguments, and modes of treating all subjects of human thought and interest, from the most trivial to the most solemn. These common intellectual possessions of educated men make them feel themselves members of a common human family; not bound together by ties of origin, or territorial abode, or material desires, but by a common mind; a family which has a community of thought and expression, not the result of extraneous accidents, but of the very internal constitution of human nature.

16 Again, besides the effect thus produced upon educated men, by their acquaintance with the matter of the classical writings, there is a further effect, which is produced by the attempts which have been made to analyse the form of literary works. Language, and the Expressions by which thought, feeling, and imagination are conveyed, have been made themselves

the subject of attention, classification, and rule. The discussions connected with these points have been conducted with especial reference to the writings of the classical authors: and the methods and doctrines thus produced have been generally accepted and studied by the students of the classical authors themselves. Thus the Grammar and Rhetoric and Criticism of Greece and Rome, as well as the great original authors of those countries, have always been included in a liberal education. And these common studies of liberally educated men have given them a common phraseology, in which they can discuss questions of Grammar and Rhetoric; and have furnished them with known examples of Criticism, such as call out the powers of literary analysis which belong to the human mind. The Latin and Greek Grammar supply to the educated man a type, or at least a starting point, for Universal Grammar; and the series of labours of Critics and Commentators from the time of the original authors to our own time, exhibit to him the mind of man in a constant habit of self-examination and self-analysis, by means of which the classical forms of language and expression are not merely unconsciously used and admired, but consciously accepted and recognized, as truly exemplifying the genuine utterance of humanity.

17 But while the classical literature of Greece and Rome thus supplies us with studies by means of which the powers and properties belonging to one of our principal human faculties, Language, may be exhibited in their most complete form, and each man's share in them realized by their influence in his education; we have, in other writings, both of ancient and of comparatively modern times, works by the study of which, as a part of education, the other principal human faculty lately mentioned, the Reason, may also be exemplified in its most complete form, and educed in each person's mind. I speak now of Mathematical

works, in which truths respecting measurable quantities are demonstrated by chains of the most rigorous reasoning, proceeding from Principles self-evident, or at least certain. The Geometry which took a distinct form in Greece in the time of Plato, has been commonly used ever since for this purpose, both by the Greeks themselves and by other nations: and such studies derived, from this employment of them, their name of *Mathematics* or Disciplinal Studies. In such works, we have the pure operation of Reason exhibited to our consideration. In them, the external clothing of language is no longer the object of our regard; we fix our attention upon the internal connexion of the ideas thus presented to us. We regard the matter, not the form, of the thought: and here, the matter almost completely determines the form; for the matter depends upon the universal and necessary processes of the human Reason, and is not modified by those differences of individual taste, disposition, and mental habit, from which arise the differences of style in different authors. Accordingly, it has been remarked by critics that, in the Greek Geometers, there is no difference of style; and while an argument of Plato is at once recognized as different in its expression from an argument of Aristotle: in a geometrical demonstration, we cannot distinguish, by internal evidence, whether it be of Euclid, or Apollonius, or Archimedes. This severe necessity of form, arising from the inflexible connexion of the matter, belongs to Geometry eminently, and almost alone. But other portions of Mathematics, though perhaps never yet put in a form so rigorously rational as Geometry assumed in the Elements of Euclid, may still be employed in cultivating and unfolding the Reason in the course of Education. Arithmetic exhibits to us a series of truths and processes leading to truth, of which the demonstrative evidence is not inferior to that of Geometry. Mechanics and

Hydrostatics were reduced by Archimedes to a shape in which they contained propositions deduced by the severest processes of demonstration from manifest fundamental principles; and these studies might have been used, as Geometry was used, as a discipline of the Reason. At first, however, this was not done. The speculative powers of men in general did not take firm hold of these demonstrated truths, when they were first brought to light. After the time of Archimedes, they were again let slip as speculative truths; and were not recovered, and ranged among the results of demonstrated mathematical reasoning, till comparatively modern times. Having, however, now taken this place, they may be used, along with Geometry, as a means of educating the Reason. And besides the direct effect of the study of the mathematical sciences of Mechanics as an intellectual discipline, the introduction of this study into a liberal education, opens the way to the student's possessing a clear and steady comprehension of the greatest of the achievements of man in the domain of material knowledge, the Newtonian system of the universe. At the present day (as I have elsewhere attempted to show*) no education can be called good, which leaves the pupil in ignorance, or with a loose and merely verbal knowledge, of these discoveries. Mechanics then, as teaching the principles, both of machines, and of the mechanism of the heavens, should be one of the Permanent Studies which belongs to our Higher Education.

Other branches of Mathematics have grown up in modern times, which may also be used with advantage as parts of a liberal education; but these, for the most part, have the character of the progressive, rather than the permanent, educational studies.

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* *Philosophy of the Inductive Sciences,* Book XIII. Chap. 3. *Intellectual Education.*

18 But before I proceed to speak of those progressive studies, I may remark, with regard to the mode of educating the Reason, that there has been, in this case, as in the education of the faculty of Language, not only a direct study of the great models of excellence, but an attempt to analyse the means of success. The Greeks employed themselves in discovering, and stating in a technical form, the conditions under which Reasoning is rigorously demonstrative. They had, here also, a *critical* as well as an *exemplary* branch of study; Logic, as well as Mathematics. In the work of reasoning, as in the work of literary composition, the reflex tendencies of their minds came into play. As they laid down rules excluding Solecisms in Grammar, they laid down also rules excluding Fallacies in Logic. And Logic has, from their times, held its place in a Liberal Education, along with Grammar and Rhetoric.

Sect. 3. *Of Progressive Educational Studies.*

19 Besides the permanent results of human thought, which, once brought into being, remain ever after as subjects of human study, there are other works of the intellect which from time to time change their form. There are progressive portions of literature and knowledge;—new sciences, or new methods of science, new forms of criticism and philosophy. And as the permanent subjects of educational study educe in men those human faculties and those ideas by which they are connected with the past condition of humanity, so these progressive subjects of study connect men with the condition of humanity in their own time, and give them their share in the future intellectual prospects of the race. Even among the ancient Greeks, these progressive subjects of study were already cultivated. Astronomy had been brought into being as a mathematical science at the time of Plato; and the subject

made some remarkable advances soon afterwards. Optics and Harmonics were also cultivated as mathematical sciences among the Greeks. And these sciences, especially Astronomy, were employed as portions of the Higher Education. Such sciences derive their fundamental principles from observation of the material world; and deduce results from these principles by mathematical processes. Besides these portions of knowledge, thus obtained in various ways, the Greeks employed themselves in speculating concerning the nature of knowledge in general, and the mode in which man may and must acquire it. Such speculations formed a large portion of their Philosophy; and such Philosophy has occupied every succeeding generation up to the present time; and most, the generations of greatest intellectual activity.

20 In this portion of human knowledge, which has thus been progressive, it naturally follows that the subjects are expanded, transformed, and multiplied by the successive steps of progress. The Science and Philosophy of modern times differ from, or at least extend beyond, those of the ancient world. Even those Sciences which had begun to exist among them, have so changed their aspect and enlarged their boundaries, that the ancient portion is the smallest part of them. Our Mechanics, and our Hydrostatics, are much more extensive and profound than those of the Greeks. Our Astronomy has undergone revolutions which have made it belong eminently to modern times, although the ancient foundations laid by the Greek geometers have not even at this day lost their validity or importance. But in addition to these ancient sciences, others have sprung up, which did not exist at all, or at least in any scientific form, among the Greeks and Romans. Such are the Classificatory Sciences, Botany and Zoology. Such are those Sciences which

I have elsewhere* termed Palætiological, and which explore the past history of the world by studying the causes of change; among which we may especially notice Geology, the History of the Material Earth, and Ethnography, or Glossology, the History of Languages. Such, again, are the Sciences which consider bodies according to the elements of which they are composed: Chemistry, which analyses them, and Mineralogy, which classifies them with a view to their analysis. Such sciences, finally, are those which attend to the structure, the symmetry, and the functions of living beings; Anatomy, Comparative Anatomy, Morphology, Biology. On these subjects, whatever sparks and gleams of intelligence we may discover in ancient authors, the broad light of science was not shed, till the human mind, in the course of its movements, arrived at its modern period of activity. These are the subjects with which a person must acquaint himself, who wishes fully to appreciate the progress which man has made and is making in the pursuit of truth. And though it may not be possible for any one to give his attention to the whole of these; and though it is not necessary, for educational purposes, that a man should attempt to acquaint himself with any large portion of them; yet it is requisite, as a part of a Liberal Education, that a person should so far become acquainted with some portion of this body of accumulated and imperishable knowledge, as to know of what nature it is, what is the evidence of its reality, by what means additions to it are made from time to time, and what are the prospects which it opens to the present generation of mankind. The Progressive Sciences, to this extent, ought to enter into the scheme of a Liberal Education.

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* *History of the Inductive Sciences,* Book XVIII. *Introduction.*

21 The Sciences just mentioned derive their new truths in part from experiment and observation, and are progressive in virtue of new facts, as well as new reasonings, which they incorporate into their texture. But even those sciences which consist altogether of reasonings are progressive, and require to be noticed under this aspect. Mathematics must be studied in the character of a Progressive, as well as of a Permanent Science. For the Mathematics of modern times involves processes unknown to the ancients. Results are now deduced from principles by combinations of symbols of number and quantity, rather than by reasoning upon the relations of space. And thus, in addition to the Elementary Geometry and Conic Sections of the Greeks, and the calculation of numerical questions directly; we have the calculation of such questions by symbols (*Algebra*), and the calculation of the properties of curves by the symbols of their coordinates (*the Algebra of Curves*), and by the symbols of the changes of such quantities (*the Differential Calculus*); and these modes of calculation form additions to the body of mathematics, which may overlay, and almost put out of sight, the original form of mathematical sciences.

22 Again, as the study of the exact reasoning of the ancients pointed to Logic, which defines the methods of strict reasoning; so the sciences which are, as we have said, derived from facts, direct us to the study of those processes which determine the methods of obtaining truth from facts. To obtain consequences from principles is Deduction; to obtain general truths from particular facts is Induction. The Logic of Induction, or at least a Philosophy which includes Induction within its scope, is a necessary accompaniment of the progressive sciences; and such a Philosophy ought also to make a part of our Liberal Education.

23 I have said that a portion of the Sciences

which have come into existence in modern times, and which are still in progress, should be introduced into a Liberal Education, to such an extent as to acquaint the student with their nature and principles. It is an important inquiry, in determining the proper scheme of a Liberal Education, what portion of science is best fitted for this purpose. I have already remarked elsewhere*, that among the sciences, Natural History affords very valuable lessons which may beneficially be made a portion of Education: the more so, inasmuch as this study may serve to correct prejudices and mental habits which have often been cherished by making pure mathematics the main instrument of intellectual education. The study of Natural History teaches the student that there may be an exact use of names, and an accumulated store of indisputable truths, in a subject in which names are not appropriated by definitions, but by the condition that they shall serve for the expression of truth. These sciences show also that there may exist a system of descriptive terms which shall convey a conception of objects almost as distinct as the senses themselves can acquire for us; at least when the senses have been educated to respond to such a terminology†. Botany, in particular, is a beautiful and almost perfect example of these scientific merits: and an acquaintance with the Philosophy of Botany will supply the student with a portion of the Philosophy of the Progressive Sciences, highly important, but for the most part hitherto omitted in the usual plans of a Liberal Education. But the Philosophy of Botany cannot be really understood without an acquaintance with a considerable portion, at least, of

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* *Philosophy of the Inductive Sciences*, Book XIII. Chap. 3. *Intellectual Education.*

† *Philosophy of the Inductive Sciences*, Book XIII. Chap. 2. *The Education of the Senses.*

the details of Systematic Botany. On these grounds, I should much desire to see Botany, or some other branch of Natural History, or Natural History in general, introduced as a common element into our Higher Education, and recommended to the study of those who desire to have any clear view of the nature of the Progressive Sciences; since it is, in fact, the key and ground-work of a large portion of those sciences.

24 I have ventured to give reasons* why the Chemical Sciences (Chemistry, Mineralogy, Electro-Chemistry) are not, at the present time, in a condition which makes them important general elements of a Liberal Education. But there is another class of sciences, the Palætiological Sciences, which, from the largeness of their views and the exactness of the best portions of their reasonings, are well fitted to form part of that philosophical discipline which a Liberal Education ought to include. Of these sciences, I have mentioned two, one depending mainly upon the study of Language, and the other upon the sciences which deal with the material world. These two sciences, Ethnography, or Comparative Philology, and Geology, are among those Progressive Sciences which may be most properly taken into a Liberal Education, as instructive instances of the wide and rich field of facts and rea-

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* *Philosophy of the Inductive Sciences,* Book XIII. Chap. 3. *Intellectual Education.* Of course it is not here intended to imply that Chemistry and the Sciences connected with it are not studies highly philosophical and important, and very suitable and instructive parts of a Liberal Education; but only, that if we select some of the progressive sciences as necessary portions of our educational scheme, there are much stronger reasons in favour of taking Natural History than Chemistry, for this purpose. It is further to be recollected, that a knowledge of Chemistry is quite essential as a part of the professional education in medicine.

sonings with which modern science deals, still retaining, in many of its steps, great rigour of proof; and as an animating display also of the large and grand vistas of time, succession, and causation, which are open to the speculative powers of man. Moreover these sciences have the further recommendation of giving occasion to pointed and striking applications of some of the more limited sciences which we have noticed as fit elements of our Higher Education. Geology uses as her instruments, among others, the sciences of Mechanics and Hydrostatics, and the various branches of Natural History. And Ethnography, or Comparative Philology, though it cannot be pursued at all without a knowledge of several other languages besides Greek and Latin, many very conveniently and naturally begin from those relations between Greek, Latin, and English, which a classical education forces upon our notice, and from that ready perception of the relations of language which a classical education cultivates.

25 Of the two classes of studies above mentioned, the Permanent and the Progressive Studies, the former are the most essential as parts of Education; and must be mastered before the others are entered on, in order to secure such an intellectual culture as we aim at. A full apprehension of the force of Reason and the beauty of Language are necessary, to connect men with the most gifted and most cultivated portions of their species which have hitherto existed. When they have arrived at such an apprehension, but not till then, they may go on to sympathize with the most gifted and cultured minds of their own time, in the activity of their progressive tendencies. But the former step must necessarily precede the latter. An acquaintance with the past must be a portion of Education, in order that there may be an intelligence as to the present. Intellectual progress

cannot be a part of the occupation of life, if intellectual discipline be not included in Education. Attempts at progressive knowledge can have no value or real result, in the minds of those who have not been prepared to understand what is still to do, by understanding what has already been done. It is very possible to introduce a large portion of progressive studies into Education; but they can never properly constitute the whole of it; nor can the education of the youth include the whole intellectual progress of the man, if he is really to share in the progress of his times. A man who really participates in the progress of the sciences, must do so by following their course when the time of education is past. The Progressive Sciences are to be begun towards the end of a Liberal Education. On the other hand, the Permanent Studies, Classical Literature and Solid Reasoning, are fundamental parts of a Liberal Education, and cannot be dispensed with. Modern Science and Philosophy ought to be introduced into education so far as to show their nature and principles; but they do not necessarily make any considerable or definite part of it. The intellectual culture, though it will be incomplete if these are excluded, may still be a culture which connects a man with the past, and prepares him for the present; but an education from which classical literature or mathematical reasoning is omitted, however familiar it may make a man with the terms of modern literature and philosophy, must leave him unprepared to understand the real purport of literature and philosophy, because he has not the intellectual culture which the greatest authors in literature and philosophy have always had.

SECT. 4. *Of English Education.*

26 The above views are drawn from the Idea of a Liberal Education considered in the most general

manner. They have been to a great extent realized in the Education given in this country as the Higher Education, to those who pass through the usual course of English Schools and Universities; at least so far as the Permanent Studies are concerned. Grammar and Arithmetic at the Schools; Classical Authors and Logic, or Classical Authors and Mathematics, at the Universities, have represented the two classes of Permanent Studies by which the two faculties of Language and Reason are to be educed and unfolded, as the completeness of man's intellectual constitution requires them to be educed and unfolded. In the University of Cambridge, the Classical Authors have always formed a leading part of the subjects of study. The other portion of the Higher Education, by which the Reason is especially cultivated, may be considered as having been Logic in former times, while Disputations in set logical forms, both in the Colleges and in the Public Schools of the University, constituted a large part of the business of a university student; and as being Mathematics in recent and present times; the Disputations being now in a great measure done away, and a proficiency in Mathematics forming a large portion of the knowledge required by the University, as the condition of conferring her Degrees and awarding her Honours.

27 In this general scheme of the subjects with which the intellectual Education of the University of Cambridge is concerned, we find nothing but what is right and conformable to the necessary general idea of the Higher Education of youth, as we have attempted to show on general principles. But the same principles, if they are applied to the detail of such a scheme, will point out some more special rules with regard to the subjects thus employed in a Liberal Education, and the mode of employing them; and we may be thus led to make, respecting the present modes of teaching

among us, and respecting possible changes, some remarks which may not be without a more especial bearing and interest.

28 In the first place, I remark that, since the two kinds of studies I have spoken of, Classical and Mathematical, have their value, primarily, as permanent subjects of thought, connecting us with past generations, and fixing in our minds the stable and universal principles of Language and of Reason, these studies must be pursued in such a way as to imply a regard for this, their permanent character. For instance, with respect to the Classical Authors, the reason why we make *them*, especially, the subjects of our educational studies is, that having been selected at first as objects of especial admiration on account of the truth of their thoughts and the felicity of their expressions, they have continued to be studied by the successive generations of well-educated men; and thus they connect all such men with one another, by their common familiarity with these subjects of study. Hence we cannot, consistently with the meaning of a Liberal Education, substitute for the Classical Authors of Greece and Rome any other authors; for instance, eminent modern writers of our own or other countries. Even if the genius and skill shown in modern poems and orations were as great as that which appear in Homer or Virgil, Demosthenes or Cicero, the modern works could not supply the place of the ancient ones in Education. No modern works can, in men's minds, take their station in the place of the familiar models of poetry and eloquence which have been recognized as models for two thousand years; which have, for so many generations, called forth and unfolded the ideas of poetry and eloquence, and furnished standard examples and ready illustrations of human powers of thought and expression. The most remarkable examples of poetry and eloquence in modern times have

been the works of educated men, and have themselves shared in the influence of the ancient models. We cannot rightly admire the greatest modern poets and orators,—we cannot admire them as they sought to be admired,—if we read them in ignorance of the works of their great predecessors in the ancient world. If we attempt to elevate modern authors into *Classics* by deposing the ancient classics, we break the classical tradition of thought which alone gives meaning to the term; and which alone gives classical authors their value in education*.

29 Again: the acquaintance with Classical Authors, which a good education requires, is an acquaintance with the works themselves, and not merely with any speculations to which they may have given rise. The educated man must read and understand the great writers of antiquity in their original languages. He must not merely know, in a general manner, the views which they present, of the progress of history, and philosophy, and art, and knowledge: he must know the sentences and expressions in which these views are conveyed, or from which they are deduced. So far as the Greek and Roman writers form part of a Liberal Education, the study of the *text* of those writers is the permanent element of Education; whatever interest or merit may belong to antiquarian, or critical, or philosophical speculations, of which those writings furnish the materials. Antiquity and ancient history, ancient philology and criticism, ancient philosophy and metaphysics, may be the subjects of progressive sciences among ourselves, at the present day: for new writers may present, on such subjects, views very different from their predecessors; may even assume the character of discoverers; and may, by their sagacity and

* I have already written to the same effect, *English University Education*, p. 32.

gift of generalization, draw to them the admiration of classical scholars. But such Progressive Studies cannot answer the purpose of the Permanent Studies. An acquaintance, however exact, with these new antiquarian, or philological, or philosophical views, cannot supply the want of a familiarity with the classical authors. To be able to translate Homer and Thucydides, Virgil and Livy, is a necessary part of a good Education. Such a power must be acquired in youth. To learn the current theories concerning the Greek and Latin languages, or Greek and Roman early history, however ingenious and plausible the theories be, cannot make an education good, in which such a knowledge of the original authors is wanting. Indeed, such theories are not necessarily any parts at all of a good education. They may be very fitly attended to as the studies of the man, when the education of the youth is completed: and to be able, through life, to follow, with an intelligent interest and sound criticism, contemporary discussion on such theories, is one of the beneficial results of a good education.

30 Thus, to be able to understand and translate the ancient Classical Authors is the primary and indispensable part of the Classical branch of a good education. This acquirement implies, of course, an intimate acquaintance with the system of Greek and Latin grammar; and such a knowledge of the customs and institutions of the Greeks and Romans, as may explain expressions in which these are referred to. Moreover, as I have already said, an acquaintance with Greek and Latin grammar supplies a type of Universal Grammar, and has always answered this purpose in the minds of educated men. It is true, that Grammar also may be dealt with as a Progressive Science; and that, in proportion as philosophical grammarians have had to treat of languages very different in their structure from the Greek and Latin, or as they have included

a larger range of languages in their generalizations, they have moulded their science into forms different from the traditional forms of Greek and Latin Grammar. But still those familiar forms answer as a starting point for the widest generalizations; and have furnished the technical phraseology in which grammatical and philological questions have been discussed among cultivated persons in all ages. And thus, a knowledge of the traditional forms of Greek and Latin Grammar is itself one of the permanent studies of a liberal education. The necessity of such knowledge cannot be superseded by any new modes of learning languages which may, perhaps, be applied to the Greek and the Latin with apparent success. Supposing a boy were to learn one or both these languages by the habit of hearing and speaking, as children learn languages, this knowledge could not stand in the place of that grammatical study which is an essential point in education. Even if a person who had so learned were to read the Classical Authors, he might still know nothing of Greek and Latin grammar. He might read Homer and Virgil as many Englishmen read Shakespeare or Milton, without thinking of the grammar, and without being able to give any account of it. And if it be said that such a person has no need for Greek and Latin grammar, since, without these, he can do that to which they are merely instruments, namely, understand the best authors; we should reply by denying this doctrine. We should say that such a person, if he is to be a well-educated person, *has* a need of Grammar. A knowledge of English Grammar is essential to a good education; a person familiar with the Greek and Latin grammar, even if he be not taught English grammar directly, frames such a grammar for himself by applying to English construction the analysis and analogies of Greek and Latin. And if a person cannot do this, but, though understanding what he reads, is unable to

analyse the construction of an ungrammatical sentence, so as to point out in what the fault consists, we do not look upon him as a well-educated man. He may be a lover and reader of poetry, or of eloquence, and may have a good practical knowledge of the language; but he has not the spirit of analysis and the perception of rule which are among the habits of all well-educated men. Faults in grammar are the most palpable and universally recognized indications of the want of a good education. Solecisms and barbarisms in language are inconsistent with a good education, because the well-educated man is saved from such errors by principle as well as by habit; by a clear insight into the rules and relations of language, as well as by the imitation of other men*. And thus, not only to know and understand the text of Classical Authors, but to understand the grammar of their sentences, is included in the Permanent Studies which belong to a Liberal Education.

31 As in Classical, so also in Mathematical Studies, we must, for the purposes of a good education, attend to the distinction of the Permanent and the Progressive parts of such studies. It will easily be conceived that there are, in Mathematics, progressive as well as permanent portions. The Sciences which are founded upon a knowledge of the phenomena of the world, as Astronomy, Optics, and the like, make repeated steps of progress by new observations of phenomena, or new combinations of old observations. It may be that in such sciences some progress is making in our own time; and if this be so, such progress naturally draws men's notice in an especial manner. And moreover, Mathematical Science has changed its aspect, not only by the observation of new facts, but also by the invention of new methods of

* *University Education*, p. 36.

calculation. As we have already said (21) calculation by means of symbols of number and quantity has, in many instances, taken the place of reasoning by means of the properties of space: and thus, in addition to the ancient Geometry, we have, in modern times, new branches of pure mathematics, Algebra, the Algebra of Curves, and the Differential Calculus. In these branches, new steps and modes of calculation, new advances in generalization and abstraction, new modes of dealing with symbols, such as may each be termed a New Calculus, have been constantly, in modern times, invented and published by mathematical writers. And these novelties, because they are novelties, and often because they render easy what before was difficult, are received with pleasure, and followed with interest by mathematical readers. And it is very fit that this should be so. But still, these Progressive portions of Mathematics cannot take the place of the Permanent portions, in our Higher Education, without destroying the value of our system. Wherever Mathematics has formed a part of a Liberal Education, as a discipline of the Reason, Geometry has been the branch of mathematics principally employed for this purpose. And for this purpose Geometry is especially fitted. For Geometry really consists entirely of manifest examples of perfect reasoning: the reasoning being expressed in words which convince the mind, in virtue of the special forms and relations to which they directly refer. But in Algebra, on the contrary, and in all the branches of Mathematics which have been derived from Algebra, we have, not so much examples of Reasoning, as of Applications of Rules; for the rules being at first proved by reasoning, once for all, the application of them no longer comes before us as an example of reasoning. And in the reasoning itself, quantities, and their relations, are not expressed in words and brought before the mind as objects of intuition, but are denoted

by symbols and rules of symbolic combination. This mode of denoting the relations of space and number, and of obtaining their results, is in the highest degree ingenious and beautiful; but it can be an intellectual discipline to those only who fully master the higher steps of generalization and abstraction by a firm and connected mental progress from the lower of such steps upward; and this requires rather a professional mathematical education, than such a study of mathematics as must properly form part of a liberal education. Moreover, supposing these higher forms of Algebra to be thus completely mastered, the intellectual discipline which they afford is not a discipline in reasoning, but in the generalization of symbolical expression: and this appears to be a mental process of which a very small exercise is all that a liberal education requires. For instance, the general student may, especially if his mind has an aptitude for such studies, derive intellectual profit, from learning how the forms and properties of given curves are determined by symbolical expressions of co-ordinates, and of the relative rate of change of these co-ordinates, as in the Differential Calculus: but it can hardly be worth the while of such a student to bestow much time in ascending to that higher generalization in which these changes of the co-ordinate of a given curve are mixed with other changes, by which any one curve may be transformed into any other, as in the Calculus of Variations. Such steps of wide symbolical abstraction, however beautiful as subjects of contemplation to persons of congenial minds, are out of the range of any general system of Liberal Education.

32 All these branches of Algebra of which we have spoken may, as I have intimated, be considered rather as Progressive than as Permanent Studies; and therefore, not necessarily parts even of a Higher Education; since in order to the full cultivation of the

Reason they need not be possessed at all. They are fit matters of the study of the professed mathematician, when his general education is terminated. But of Geometry, on the other hand, it is not too much to say that it is a necessary part of a good education. There is no other study by which the Reason can be so exactly and rigorously exercised. In learning Geometry, as I have on a former occasion said*, the student is rendered familiar with the most perfect examples of strict inference; he is compelled habitually to fix his attention on those conditions on which the cogency of the demonstration depends; and in the mistakes and imperfect attempts at demonstration made by himself and others, he is presented with examples of the more natural fallacies, which he sees exposed and corrected. He is accustomed to a chain of deduction in which each link hangs from the preceding, yet without any insecurity in the whole; to an ascent, beginning from solid ground, in which each step, as soon as it is made, is a foundation for a further ascent, no less solid than the first self-evident truths. Hence he learns continuity of attention, coherency of thought, and confidence in the power of human Reason to arrive at the truth. These great advantages, resulting from the study of Geometry, have justly made it a part of every good system of Liberal Education, from the time of the Greeks to our own.

33 Arithmetic has usually been a portion of Education on somewhat different grounds; namely, not so much on account of its being an example of reasoning, as on account of its practical use in the business of life. To know and to be able familiarly to apply the rules of Arithmetic, is requisite on innumerable occasions of private and public business; and since this

* *University Education*, p. 139: *Thoughts on the Study of Mathematics.*

ability can never be so easily or completely acquired as in early youth, it ought to be a part of the business of the boy at school. For the like reasons, Mensuration ought to be learnt at an early period; that is, the Rules for determining the magnitude, in numbers, of lines, spaces, and solids, under given conditions; a branch of knowledge which differs from Geometry, as the practical from the speculative; and which, like other practical habits, may be most easily learnt in boyhood, leaving the theoretical aspect of the subject for the business of the Higher Education which comes at a later period. There is another reason for making Arithmetic a part of the school-learning of all who are to have a Liberal Education: namely, that without a very complete familiarity with actual arithmetical processes, none of the branches of Algebra can be at all understood. Algebra was, at first, a generalization and abstraction of Arithmetic; and whatever other shape it may take by successive steps in the minds of mathematicians, it will never be really understood by those students who do not go through this step. And, as we have already said, there is, in a general education, little or nothing gained by going beyond this. The successive generalizations of one or another New Calculus, may form subjects of progressive study for those whose Education is completed, but cannot enter into a general Education, without destroying the proportion of its parts.

34 I have spoken of Geometry as a necessary part of a Liberal Education. It may be asked, how far this Geometry extends? the Elements of Euclid, especially the first Six Books, are generally accepted as the essential portion of Geometry for this purpose. This portion of Mathematics is, however, insufficient fully to exercise the activity of the Reason, and to balance the influence of classical studies. If we consider what portions of mathematics may most properly

be added to Elementary Geometry, the parts that offer themselves are Solid Geometry, Conic Sections, Mechanics, Hydrostatics, Optics and Astronomy. Of Solid Geometry, we have an Elementary portion in the Eleventh and Twelfth Books of Euclid, and which has often, and very suitably been used for purposes of Education. Conic Sections are a very beautiful extension of Elementary Geometry; and would probably have been made a part of a general Education more commonly than it has been, if we had inherited from the Greeks any Treatise on the subject, as perfect as the Elements of Euclid are on their subjects. The properties of the Conic Sections are not merely so many propositions added to those of Elementary Geometry: there are introduced, in this branch of Geometry, new geometrical conceptions; for instance, that of the Curvature of a curve at any point. The proofs of the properties of Conic Sections, discovered by the Greek geometers, have come down to us only in a fragmentary manner; and although there have appeared several modern treatises which are very good examples of geometry, no one of them has acquired a permanent and general place, as a part of a Liberal Education. This has arisen in part, at least in England, from the prevalence of a disposition among mathematical students in modern times to adopt the algebraical mode of treating these as well as other curves. But we may observe that the subject of Conic Sections, so treated, is of small comparative value as a portion of Education. If we make the Conic Sections merely examples of the application of Algebra to curves, they are of no more importance than Cissoids, Conchoids, or any other curves; and have little claim to be considered as a distinct part of our Educational Studies: while a geometrical system of Conic Sections is both a striking example of geometrical reasoning; a distinct member of an enlarged system of Geometry;

and a necessary introduction to other mathematical studies, which may very fitly be brought before the student when he has mastered these.

35 Mechanics and Hydrostatics are subjects in some respects in the same condition as Conic Sections. The Greeks, especially Archimedes, established, with full evidence, some of the fundamental propositions of these mathematical Sciences; but they did not transmit the Sciences to us in a form in which they have retained a place in Educational Study; and no particular modern treatises have permanently and generally acquired such a place. Yet these Sciences, as a mathematical portion of our Higher Education, are eminently fitted to promote the developement of the reason; since they not only offer examples of reasoning as solid and evident as that of Geometry, but also show to the student that such reasoning is not confined, in its power, to Space and Number only, but may be extended to the ideas of Force and Motion. And there is another reason why Mechanics and Hydrostatics are valuable educational studies. The truths which they teach are perpetually exemplified in the external world, and serve to explain the practical properties of machines, structures, and fluids. If the Sciences of Mechanics and Hydrostatics be introduced into Education in a proper form, the habits thence acquired, of coherent and conclusive thought on such subjects, will be continually confirmed and extended, by the consideration of the mechanical problems which come before men in a practical form.

36 There is a further reason, as we have already (17) remarked, why Mechanics and Hydrostatics are studies which may be introduced into a Liberal Education. These sciences are the key to the understanding of all the great discoveries of modern times with regard to the constitution of the universe, and especially the discoveries of Newton. By these discoveries,

the motions of the earth, planets, moons, and other cosmical bodies, are explained upon mechanical principles, and their apparent irregularities deduced from their mutual forces by mathematical reasoning. These discoveries also offer the best example which the world has yet seen of *Induction*, the inference of a true theory from phenomena by philosophical sagacity; as well as of the *Deduction* of consequences from hypotheses by direct reasoning. These discoveries of Newton are still so recent, and have been followed by so continuous a train of similar discoveries with regard to other parts of the system of the universe, that they may be considered as belonging to the Progressive Sciences;—as exemplifying a mental activity which is still going on, and as a portion of the subjects of intellectual research and promise which at present interest men. But yet Newton's exposition of his system has been so long before the world, is so complete in its reasonings, and is so familiar to all who have shared in the intellectual culture of recent times, that it may now be very properly used also as a portion of our Permanent Educational Studies;—a specimen of what such reasoning ought to be; and a ground-work on which all must build in doing more than is there done. The Propositions contained in the *Principia* of Newton are beautiful examples of mathematical combination and invention, following the course of the ancient geometry; and for the purpose of general education, a portion might be selected from this work without difficulty, which should be not too long or complex for the student, and which should come in a natural order after Conic Sections and Mechanics.

37 Astronomy is a subject in which the Greeks made some of the steps which form the foundation of the Mathematical Science; especially the Doctrine of the Sphere and the Doctrine of the relative motions of the Sun, Moon, and Planets. These portions of know-

ledge, ever since they were brought to light, have been taught as a necessary part of the instruction of well-educated men. The geocentric theory of the solar system, held by the ancients, has, in modern times, been superseded by the heliocentric or Copernican theory; and Astronomy in this form is, for additional reasons, a necessary part of a Liberal Education; namely, not only as a beautiful example of the mode in which common phenomena are made the subject of mathematical demonstration and calculation; but also as a most conspicuous instance of the progress of science, and the full establishment of Truths which at first sight seem opposed to the evidence of the senses. It is highly desirable that Astronomy should form a part of a Liberal Education to the extent just stated, the Doctrine of the Sphere, and the Doctrine of the Solar System; to which may be added Dialling, as an application of the Doctrine of the Sphere in a special and familiar case.

38 In Optics, as a Mathematical Science, the Greeks made little progress, though even in this they made a beginning. The Science had its rise for the most part, in the sixteenth century. Its main problems, the determination of the foci and images which spherical surfaces produce by reflection and refraction, deserve to be introduced into a Liberal Education on the ground already assigned in the case of Astronomy;—namely, their being beautiful and simple examples of common phenomena, made the subject of Mathematical demonstration; and a portion of knowledge, commonly diffused among educated men. Perspective, which may be considered as a branch of Optics, may be made part of Education on more general grounds. It was cultivated by the ancients as well as the moderns; and a knowledge of it is necessarily assumed in judging of paintings; a subject in which all educated persons feel a lively interest.

39 I have now completed the enumeration of the branches of Mathematics which belong to a Liberal Education in general. The mathematical part of such an education may, of course, be carried further, if the mathematical aptitude of the student make such an exercise of it easy and satisfactory to his teachers and to him. The *Principia* of Newton, indeed, is so extensive a work that the student may find an abundant store of employment in the extension of his studies from one part of that book to another; and he will everywhere find in it what is admirable in its mathematical character, philosophically important, and historically interesting. He may also pursue the Differential Calculus, and the other portions of Algebra, to an unlimited extent; and especially the solutions which more modern analysts, by means of that calculus, have given of problems such as those which Newton solved by his geometrical method. These solutions must not be allowed to supersede those of Newton as permanent studies; for they have neither the mathematical instructiveness, nor the permanent interest of the Newtonian propositions. They are mere examples of a method of symbolical calculation. But they are proper and necessary objects of attention to a person who wishes to share in the progressive mathematical studies of his time: and the speculations which belong to this kind of mathematics are so beautiful an exercise of abstraction, generalization, and ingenuity, that we cannot wonder at their being pursued with an exclusive enthusiasm by many of those who attend to mathematical science for its own sake. With us, who have here to regard mathematical science only as an instrument of education, the case is, of course, different. We take parts of the geometry of Newton as a standard portion of our educational course; but we cannot consider, as containing anything essential to our object, the beautiful symbolical reasonings of the *Mécanique*

Analytique of Lagrange, or the *Mécanique Céleste* of Laplace; nor can we accept, as substitutes for our simpler forms of the science of Mechanics, any of the Elementary Treatises in which the like symbolic generalizations are presented in a more elementary manner. As we have already said, the main purpose of mathematical studies, in a liberal education, is, not to familiarize the student with symbolical abstraction and generalization, but with rigorous demonstrations, which exercise the reason, and which have long been accepted and referred to by educated men, as examples of solid reasoning.

SECT. 5. *Of Analytical Mathematics as an Educational Study.*

40 The question of the kind of Mathematics which is to be used in the course of Education, has not been exempt from difference of opinion in modern times. According to what we have said, the mathematical studies which belong generally to a Liberal Education must be portions of Mathematics which are established among mathematicians in a permanent form, and in which the reasoning is intelligible without learning a new mathematical language. But the beauty of the symbolical reasonings of modern times, and the interest which belongs to them as a part of the progressive science of our own day, have, as we have intimated, excited an enthusiasm in many persons; and these persons have often been disposed to substitute such symbolical forms of mathematics in the place of the geometrical modes of treating the subject, which we have represented as essential to the object of our Higher Education. Thus, proofs of the properties of Conic Sections, by means of symbolical combinations of co-ordinates, have been proposed as substitutes for the geometrical demonstrations of the like properties; and the relations between the curves described

by moving bodies and the forces which act upon them, have been investigated by applying the differential calculus to the co-ordinates of the curves; instead of establishing those relations in the way in which Newton did. Such branches of mathematical science are often called *Analytical*, and *Analysis* is often opposed to Geometry. This opposition is not very exact; for Geometry has also its Analysis. We demonstrate a Theorem, or solve a Problem, by means of *Geometrical Analysis*, when we suppose the Theorem proved, or the Problem solved, and trace the consequences of this supposition into a known theorem, or a problem obviously soluble. In solving a question by means of Algebra we, in like manner, express the given supposition in algebraical language, using symbols of unknown, as well as of known quantities, and by tracing the consequences of this expression, we can often find the value of the unknown quantities. And this analytical process is so much more common in Algebra than in Geometry, that processes conducted by means of algebraical symbols are commonly called *Analytical*. I will adopt this phraseology, though, as I have said, it is not very exact, while I make a few remarks on the use of Analytical Mathematics as an instrument of Education*. I have already spoken on this subject, in my *Thoughts on the Study of Mathematics as a part of a Liberal Education*, published in 1835; and all subsequent experience appears to have confirmed the truth of the views there expressed.

* The reader may observe that the reasons here given for adopting geometrical rather than analytical modes of reasoning in our elementary university course of mathematics, apply rather against analytical generalities and special calculus, than against the introduction of simple algebraical processes. For example, these reasons would not exclude from Mechanics the method of finding the space fallen through in a given time, by means of assuming an arithmetical series and taking its limit: and the like processes.

41 The recommendation of the geometrical branches of mathematics, as parts of education, is, as we have seen, that they are an effectual discipline of the reason, and have always been familiar as such among educated men. On the other hand, the recommendations of analytical forms of mathematics are such as these;—their supplying easier solutions of the problems with which the mathematician has to deal;—the symmetry and generality of their processes;—and their having, in consequence of these qualities, superseded geometrical methods in the mathematical literature of modern times. These merits of analytical processes have been shown, in a most striking manner, in the works of many great mathematicians of modern times; who have given to such processes great completeness and beauty, and have solved, by means of them, problems which had foiled the attempts of previous calculators. And these great works have been accompanied by many elementary works, which expound the like methods in a more limited form, accessible to common students, and applicable to simpler problems. We have to consider the advantages and disadvantages of employing in our Higher Education such Analytical Elementary Treatises, to the exclusion of geometrical modes of treating the same subjects.

42 The first reason which we have mentioned, why Mathematics, in the shape of Geometry, holds its place as an element of great and incomparable value among the permanent studies of a Liberal Education, is this: that it offers to us examples of solid and certain reasoning, by which the reasoning powers, and the apprehension of demonstrative proof, may be exercised, unfolded, and confirmed. This is eminently true of the Geometrical Forms of Elementary Geometry, Trigonometry, Conic Sections, Statics, and Dynamics. It is not true to the same extent, and hardly at all, of the Analytical Methods of treating

the same subjects. For, in the Geometrical Form of these sciences, we reason concerning subjects in virtue of the manner in which the subjects are conceived in the mind. In the Analytical Methods, on the other hand, we reason by means of symbols, by which symbols, quantities, and the relations of quantity, are represented; and by means of the general rules of combining and operating upon such symbols; without thinking of anything but these rules. When the supposed fundamental conditions are once translated into the language of Analysis, we dismiss from our minds altogether the conceptions of the things which the symbols represent; whether lines, angles, velocities, forces, or whatever else they may be. The mode of proceeding is the same, whichever of these be the matters in question; and the steps of the process are not acts of thought, in any other way than as the application of an assumed general rule to a particular case is an act of thought. We arrive at our conclusion, not by a necessary progress, in which we see the necessity at every step, but by a compulsory process, in which we accept the conclusion as necessary in virtue of the necessary truth of our rules of procedure, previously proved or supposed to be proved. In the one case, that of geometrical reasoning, we tread the ground ourselves, at every step feeling ourselves firm, and directing our steps to the end aimed at. In the other case, that of analytical calculation, we are carried along as in a rail-road carriage, entering it at one station, and coming out of it at another, without having any choice in our progress in the intermediate space.

43 It is plain that the latter is not a mode of exercising our own locomotive powers; and in the same manner analytical processes are not a mode of exercising our reasoning powers. It may be said that much thought and skill are required in the analyst, in

order that he may choose the best scheme of symbols, the best mode of combining them, the best analytical artifices for arriving at his result, and shortening the way to it. And in like manner, in travelling by a rail-road, thought and skill are requisite in order to select the line and the train, or the combination of lines and trains, which will lead us to the intended place. We must know the stations and times of the system, in order to use it. But still, this is not any exercise or discipline of the bodily frame. It may be the best way for men of business to travel, but it cannot fitly be made a part of the gymnastics of education. And just as little is mere analysis a discipline of the intellectual frame. It may be the best way for the professed mathematician to deal with the problems which he has to solve, but it cannot answer the purpose of that gymnastic of the reason, without which a liberal education cannot subsist.

44 Thus mere Analysis is not a suitable discipline of the reasoning powers, because analytical processes do not exhibit reasoning, in the common sense of the term, and in a form which resembles the common reasonings with which men are concerned: whereas geometry does exhibit reasoning in a form which resembles such common reasonings, except in so far as geometrical reasoning is more perfect and certain than most such reasonings. Geometry sets out from certain First Principles; namely, Axioms and Definitions; and at every step uses formulæ which, if they are really applicable, lead necessarily to the next step, by an evidence which the like forms of language express and convey, on all subjects, as well as Geometry. Its *Because* and *Whereas*, its *But* and *For*, its *Wherefore* and *Therefore*, are its connecting links, in the same sense in which they are the connecting links of all reasoning. If in other subjects we have First Principles equally certain, and Definitions equally precise,

we can reason in the same manner as in Geometry; and to reason conclusively, we must do so. All geometrical reasoning may be resolved into a series of syllogisms; and in its proper form, consists of a chain of enthymems, or implied syllogisms; and in like manner, all other sound reasoning on all subjects consists of a like chain of enthymems. In geometrical reasoning, each proposition, when once established, is used in establishing ulterior propositions, with as much confidence and promptitude as if it were itself a self-evident axiom. And in like manner, in all sound connected reasoning, a proposition, once established, is to be used with confidence and promptitude, in establishing ulterior propositions. And the habit of thus advancing, with clear conviction and active thought, from step to step of certain truth, is an intellectual habit of the greatest value; which a good education ought to form and render familiar; and which nothing but geometrical study can impart. In analytical reasoning, we have no such chains of syllogisms present to the mind. It may be said, indeed, that every step in analysis is a syllogism, in which the major is the Axiom, *Things which are equal to the same are equal to one another;* and the minor is a proposition that *two certain forms of symbols* have been proved to be *equal to the same.* But to this we shall reply, that the perpetual repetition of this elementary kind of syllogism, even if the process were so conceived, is no sufficient discipline in reasoning: and further, that the algebraical equality of two symbols does not exemplify a member of a syllogism, in any way which can make such reasoning an intellectual exercise. I repeat, therefore, that mere analytical processes are no proper discipline of the reason, on account of the difference of form between such reasoning and the reasoning with which men are mainly and commonly concerned.

45 But again: Analytical reasoning is no sufficient discipline of the reason, on account of the way in which it puts out of sight the subject matter of the reasoning. In geometrical reasoning, we reason concerning things as they are; in the first place, in virtue of certain Axioms concerning them, which are self-evident from our conceptions of the things; and then, in virtue of Propositions deduced from those Axioms, which Propositions are considered as properties of the things. We reason concerning Straight Lines, Angles, Spaces, Curves, Forces, Inert Masses, conceiving them as Straight Lines, Angles, Spaces, Curves, Forces, Inert Masses. We are thus led to see that such reasoning as we employ in one case, is not applicable to such case only, but also to other classes of cases, in which the things reasoned of are of altogether a different kind. We pass from Geometry to Mechanics, not by identifying Forces with Lines, but by taking Axioms concerning Force, evident by its nature as Force, and by applying these Axioms, one after another; bearing in mind, at every step, the peculiar nature of Force. In this way, we are prepared to pass on, and to apply reasoning of the like rigour to other subjects, as different from these, as Force is from Space. In this way, Geometry, and Geometrical Mechanics, are a discipline for every kind of sound reasoning. We are prepared to bring the mental power to act by its syllogistic chain, upon all classes of conceptions. In Analysis, the contrary is the case. The Analyst does not retain in his mind, in virtue of his peculiar processes, any apprehension of the differences of the things about which he is supposed to be reasoning. All things alike, Lines, Angles, Forces, Masses, are represented by the letters of the alphabet. All curves, Conic Sections, Transcendental Curves, Curve Surfaces, are alike represented by the relations of co-ordinates; and for the sake of uniformity,

Straight Lines are represented in the same manner. All relations of Motion and Force are, in like manner, represented by the equations of co-ordinates of the points moving and acted on. When he has once placed before him these equations of co-ordinates, he no longer thinks at all about the special nature of the things originally spoken of. His reasonings are operations upon symbols; his results are equations. His final equation may give him an angle, or a radius of curvature, or an angular velocity, or a central force; but he has no separate processes of thought for these different cases. He obtains his result equally well, if he has forgotten, or does not know, which of these things his x represents. I am quite willing to allow that this peculiarity arises from the perfection of analysis; from the entire generality of its symbols and its rules. What I am here saying is, that this is a kind of perfection which makes analysis of little value as a discipline of the reason for general purposes. For in reasoning for general purposes, it is quite necessary to bear in mind, at every step, the peculiar nature and attributes of things about which we reason. We cannot, in any subject, except analytical mathematics, express things by symbols once for all, and then go on with our reasoning, forgetting all their peculiarities. Any attempt to do this, (for such attempts have not been wanting,) leads to the most extravagant and inapplicable conclusions. Anything in common reasoning resembling such an attempt; as when men start with the definition of certain Technical Terms, and build systems by the combinations and supposed consequences of these,—belongs to a class of intellectual habits which it is the business of a good education to counteract, correct, and eradicate, not to confirm, aggravate, and extend. And therefore I say, that mere analytical reasoning is a bad discipline of the intellect, on account of the way in which it puts out of

sight the subject matter of the reasoning; on the right apprehension of which, with its peculiar character and attributes, all good reasoning, on all other subjects, must depend.

46 It is easy to show by examples, taken from the branches of mathematics which I have mentioned, that analytical modes of treating those subjects have, in fact, put out of sight the peculiarities of the conceptions which belong to each subject, and have merged all their special trains of reasoning in undistinguishing symbolical generalizations.

In the Elements of Geometry, *Ratio* and *Proportion* are among the peculiar conceptions which belong to the subject; and of which the properties, as treated by Euclid, rest upon an especial Axiom, (Book v. Axiom v.) The mode in which, by means of this Axiom, the case of incommensurable quantities is reasoned upon, without any introduction of arbitrary assumptions or ungeometrical notions, has always been admired, by the cultivators of Geometry, as a beautiful and instructive example of mathematical subtilty and exactness of thought. In the analytical mode of treating the subject, a Ratio is identified with an Algebraical Fraction: and the reasonings about Ratios become operations upon Algebraical Fractions; in which operations, everything dependent upon the peculiar character of the conception disappears; and all the propositions of Geometry, in which Proportion is involved, are, on this scheme, made to depend upon Algebra.

47 Trigonometry was a science invented for the purpose of measuring Angles by means of Lines drawn in a certain manner, in a circle whose center is the angular point; and of using these measures for the solution of triangles. This subject has recently been modified so that Angles are measured by certain Algebraical Fractions, the original conception of the Circle being rejected. And in this manner, all the proposi-

tions of Trigonometry have been superseded by certain analytical formulæ involving those Algebraical Fractions.

48 Conic Sections were, till lately, treated as a geometrical subject; the Curves being defined, in some treatises, by the sections of a cone by a plane; in others, by certain simple relations of lines drawn in their own plane. But in either method, various conceptions were introduced, extensions of those of Elementary Geometry; as the conceptions of *Tangents* to such curves; of Properties *analogous* to those of the Circle; of properties of *Conjugate Diameters;* of properties of the *Circle of Curvature;* and the like. These properties were proved by Geometrical reasonings, built upon some simple fundamental properties, exhibiting at every step the evidence of the relation of the properties of the Conic Sections to those of the Circle; and supplying a transition to the properties of Curves in general. Of late, Conic Sections has been treated as a mere branch of analysis; the definitions of Tangents and Circles of Curvature have become Algebraical or Differential Formulæ; the analogies with the circle have also appeared only as interpretations of Algebraical Formulæ; and the subject of Conic Sections has ceased to be of any meaning, as an introduction to the subject of curves in general; because the Conic Sections are treated only as curves in general; and any other class of curves might with equal propriety be made a separate branch; or rather, there is no propriety in so treating any class of curves; for all their mathematical interest, so treated, consists in their being examples of general methods.

49 Statics, the Mechanics of Equilibrium, depends upon certain fundamental truths, which were established by Archimedes, among the ancients, and by Stevinus, Galileo, and others, among the moderns. From these fundamental truths, by keeping steadily in view the conception of Statical Force, all ordinary pro-

blems may be solved by geometrical methods. But in modern times, the subject has been differently treated. The fundamental proposition, the Composition of Forces, or some equivalent one, has been proved (sometimes, even this, by analytical reasoning from assumed Axioms;) and then, all problems alike have been made to depend upon the equations which apply the fundamental properties, in the most general form, to every possible system of matter. In this manner, the conception of Force has been dismissed from the mind, as soon as the first steps of the science had been made.

50 The Doctrine of Bodies in Motion acted upon by Forces, was created by Galileo and his successors, and was applied by Newton to the System of the Universe, in such a manner as to draw to this doctrine the universal attention of the educated portion of mankind. Independently of the immense importance in the history of Inductive Astronomy which belongs to the Propositions of Newton's *Principia*, the work is a very beautiful series of examples of the application of the principles of Mechanics, combined with the properties of the Conic Sections, and other known geometrical propositions. In virtue of its combined merit and interest, this work is eminently fitted to be a part of the permanent mathematical studies of a Liberal Education, and specially of a Liberal English Education. But this subject also has been treated analytically. The forces by which bodies describe Conic Sections or any other orbits, the orbits which bodies will describe under the influence of any forces, the attraction of masses of attractive particles, and the like problems, have been investigated symbolically by means of the Differential Calculus, and other analytical processes; and hence the peculiar mechanical conceptions with which the speculators of Newton's time had to struggle, and which he followed out till they led to his remarkable discoveries, have been obliterated from the minds of most of our modern analytical mathematicians.

51 Even in Astronomy, though so much a science of observed phenomena, explanations of observed phenomena, and reasonings from them; mathematicians of analytical propensities have had a tendency to pass as briefly as possible over such observations, explanations, and reasonings; and to dwell mainly upon parts of the subject where principles, once established, gave a hold for their analytical instrument, the Calculus. They have thus assimilated this to other parts of their body of Mathematics: and though Astronomy is an Inductive Science, explaining phenomena by its Theories, they have omitted out of it all that is Inductive, Explanatory, or especially Astronomical.

Remarks of the same kind might be made respecting other branches of Mathematics, but the subject has been pursued far enough, I trust, to justify the general opinion which I have delivered.

52 I assert, therefore, that these branches of Mathematics, thus analytically treated, do not possess that value as instruments of an exact and extensive discipline of the reason, which the geometrical branches of Mathematics do possess. Indeed it must appear, I think, from what has been said, not only that mere Analytical Mathematics does not possess so much value as Geometrical Mathematics for such purposes, but that, in truth, it possesses none at all, or at least very little. Analytical operations in Mathematics do not discipline the reason; they do not familiarize the student with a chain of syllogisms connected by a manifest necessity at every link: they do not show that many kinds of subjects may be held by such chains: and at the same time, that the possibility of so reasoning on any subject must depend upon our conceiving the subject so distinctly as to be able to lay down axiomatic principles as the basis of our reasoning.

52 With reference to analytical mathematics, the argument in favour of the use of Mathematics as a

permanent educational study, loses all its force. If we can only have analytical mathematics in our system of education, we have little reason to wish to have in it any mathematics at all. Our education will be very imperfect without Mathematics, or some substitute for that element; but mere analytical mathematics does not remedy the imperfection. If we can only have analytical mathematics, it is well worth considering whether we may not find a much better educational study to supply its place in Logic, or Jurisprudence. The general belief, for undoubtedly it is a general belief, that Mathematics is a valuable element in education, has arisen through the use of Geometrical Mathematics. If Mathematics had only been presented to men in an analytical form, such a belief could not have arisen. If, in any place of education, Mathematics is studied only in an analytical form, such a belief must soon fade away.

53 I must request the Reader to observe that the consequences which I have spoken of, are spoken of as resulting from the use of *mere* Analysis, as the mathematical element of Education. If the geometrical modes of treating Mechanics, Conic Sections, and the Dynamics of the Universe, are carefully preserved and steadily employed, as Permanent Educational Studies, such analytical methods as I have mentioned may be brought before the Student with advantage, as further illustrations of the standard mathematical truths to which he is introduced; as examples of the various modes of arriving at mathematical truth; and as manifestations of the extent to which the solutions of problems may be simplified and extended. But this pursuit of simplicity and generality must not be allowed to interfere with the attention which is to be given to the standard modes of establishing such truths. Such a pursuit of mathematical variety, simplicity, and generality, if it take the place of the study of standard

reasonings, can only end in destroying all the benefit of a mathematical training of the mind. When the student has before him a standard proof of a proposition, he has to make it his business completely to understand this proof: and if there be in it any difficulties or obscurities, to understand completely the solutions of such difficulties and the explanations of such obscurities. This struggle is the very condition and essential point of intellectual discipline. And since all the standard proofs are (in a right scheme) really demonstrations, the student's not fully seeing their evidence can arise only from the imperfection of his intellectual culture, which imperfection ought to be remedied, not acquiesced in. If the proof be long and complex, the discipline is none the worse on that account; and the standard course being well selected, the proofs will have a connexion and coherence, which is a beauty of a higher kind than mere brevity and facility. But if, instead of adhering to such a standard train of mathematical demonstrations, the student be allowed or encouraged to substitute, for its steps, brief and easy methods of arriving at each result, there is, for him, no exercise of intellectual vigour and power. Instead of overcoming difficulties, he tries to evade them, or is unaware of their existence. He has no conception of the relation of the subject, in that point of view in which alone it is worthy of being selected as a subject of educational study. He does not give his attention to understand any one proof, but employs all his mental activity in casting about for short and easy proofs, of which he does not see the meaning or connexion, and which he very likely accepts as proofs on the credit of teachers who admire and recommend such a line of mathematical acquirement. Mathematics, so studied, tends to fill the mind, not with chains of reasoning, of which the evidence is seen and felt, but with detached conventional operations upon symbols, which

are supposed to supply the place of such evidence, and with a craving curiosity as to where such proofs are to be found. Such a course of study tends to unsettle and dissipate the mind, and to busy it with the recollection of ill understood symbols, just as much as a true mathematical culture tends to give to the intellect stability, concentration, and clear insight.

54 It may be said, that if we have a series of Standard Demonstrations, with which the student is required to acquaint himself, he may acquire these by rote, through the mere exercise of memory, without any really intellectual process going on in his mind. But, this objection is as valid against any one set of proofs as another;—as valid against the new analytical processes as the old geometrical demonstrations. If we accept the novelty of a proof as evidence of the student who produces it really understanding it, we are quite as liable to be deceived, as if we accept the accuracy with which he gives an old proof, as evidence of his understanding *that*;—indeed, much more so; for it is more likely that men will understanding what they have long had the opportunity and the motive to study carefully and thoroughly. Besides which, by such a preference of novelty, we drive the active student to seek, not for a way of showing that he understands a proof, but for a new proof, or a new form of an old one.

55 But in truth, with moderate care on the part of the teacher, there is no danger of the student being undetected, when he gives a proof by memory alone, without understanding it. The smallest question, proposed to him with regard to any part of the proof, will show whether his understanding has gone along with the steps of the demonstration. Every one must know this who has examined a student in the propositions of Euclid's Elements: and exactly the same is the case with every other geometrical subject.

56 But further: it is easy to annex to the examination of the student in the standard propositions, Applications and Examples of them, or easy Problems founded upon them; and the student who understands the propositions will be able to solve such Examples and Problems; and he who has learnt by rote will not be able to do this. Such Examples and Problems ought to form part of all examinations of students in a standard course: and if this is done, there is no danger of the study of such a course degenerating into a mere act of memory.

57 A standard course of geometrical demonstrations being retained and upheld, analytical processes which run parallel to these proofs may be usefully taught to the student, as a preparation for progressive mathematical studies; for these must mainly consist of analytical methods. I will add further, that if the study of Analysis is not thus begun in connexion with Geometry and Arithmetic, in which the evidence of the truth is simple and evident, Analysis itself will never be rightly understood by the student. Algebra was originally a generalization of Arithmetic, and by common students, is never understood, except when it is so taught; although accomplished mathematicians may delight the lovers of symbolical generality by presenting it as an independent science. The analytical Doctrine of Curves must be built upon geometrical foundations; and common students will never understand its language, or be able to use it with intelligence, except they are, for a considerable period of their progress, practised in translating its conclusions, when obtained, into the language of Geometry. Analytical Mechanics, in like manner, must begin from mechanical truths expressed in words, not in symbols; and the student will never understand mechanical truths, expressed in symbols, except he has been well disciplined in the study of them expressed in their own proper

form. Hence, for the sake of having Analysis itself understood by our students, we must retain our geometrical studies, (along with Arithmetic,) as standard and fundamental elements of our education. If we do not do this, our students may indeed learn to write down the symbols which Analysis uses, and the combinations of them which are contained in books, even the most general and complex of such combinations. But they will do so without any intelligence of the truths which such combinations express, or of the real import of the language. It is very possible for a student to write down the proof of the formula for drawing a tangent to a curve of double curvature in terms of its three co-ordinates, and yet not be able to find where the tangent to the parabola cuts the axis;—to give the investigation for finding the path of a body acted on by any forces in space, and yet not to be able to find where a projectile acted upon by gravity hits a given plane, the velocity and direction being given. Such consequences flow very naturally, and with regard to the greater part of students, inevitably, from a study of analysis which has not been begun, and supported, by geometrical reasonings and exemplifications. But such consequences, when they occur, are evidences of a very worthless system of mathematical education.

58 And there is a further evil in such a system, in its effect upon the dispositions of the students towards mathematical studies. Clear demonstrative proofs, and chains of such proofs, have a great charm for all well-constituted intellects. The human mind loves light and coherence: it delights to see a few evident principles solidly built up into a large system of unexpected, but undeniable truth. Geometry, rightly studied, is admired and dwelt upon with complacency by most students. The same is the case with other geometrical studies, more or less, according to the capacity of the student. But Analysis, pursued without a proper geo-

metrical and arithmetical foundation, has in it no clearness or light. The student who is led on in such a course, is immersed in a mist of symbols, in which he only here and there sees a dim twilight of meaning. When this is presented to him as an exercise of his intellect, he is naturally perplexed, repelled, and disgusted. He cannot fail to perceive that this is, for him, no intellectual exercise. He finds, in such a course, no advantage or satisfaction, and gives to it a reluctant and unsympathetic labour. He considers it as an arbitrary and useless imposition: tries to evade the task; and casts it from his thoughts as soon as his purpose is answered.

59 Or if he have a taste for the symmetry and generality of expressions at which analysts aim, he attends only to those fundamental relations of symbols on which the processes of analysis depend. He is curious to see how far these conventions, without any other principles being added, may be made to lead to analytical operations and results. He dwells upon the new forms that can be given to the fundamental conventions of analytical language; the subtle distinctions which such new forms bring into view; the further generalization of that which seemed most general; the characters of analytical language by which it is most removed from common language. So far as his mind is occupied in such speculations, it may have some of its powers exercised and unfolded, but these are not the powers which it is the object of a Liberal Education to unfold. The qualities thus educated are rather the subtilty and technicality of the schoolmen of the middle ages, than the clear apprehension of demonstrated truth in which the intellectual culture of man has consisted during all the progressive periods of man's intellectual history.

60 On all these accounts, then, I venture to assert, that while we hold Mathematics to be of inestimable

value as the Permanent Study by which the reason of man is to be educated, we must hold also that the Geometrical Forms of Mathematics must be especially preserved and maintained, as essentially requisite for this office: that Analytical Mathematics can in no way answer this purpose: and if the attempt be made so to employ it, will not only be worthless, but highly prejudicial to men's minds.

61 But besides the value of Mathematical Studies in Education, as a perfect example and complete exercise of demonstrative reasoning; Mathematical Truths have this additional recommendation, that they have always been referred to, by each successive generation of thoughtful and cultivated men, as examples of truth and of demonstration; and have thus become standard points of reference, among cultivated men, whenever they speak of truth, knowledge, or proof. Thus Mathematics has not only a disciplinal but an historical interest. This is peculiarly the case with those portions of mathematics which we have mentioned. We find geometrical proof adduced in illustration of the nature of reasoning, in the earliest speculations on this subject, the Dialogues of Plato; we find geometrical proof one of the main subjects of discussion in some of the most recent of such speculations, those of Dugald Stewart and his contemporaries. The recollection of the truths of Elementary Geometry has, in all ages, given a meaning and a reality to the best attempts to explain man's power of arriving at truth. Other branches of Mathematics have, in like manner, become recognized examples, among educated men, of man's powers of attaining truth. Thus when Trigonometry was invented, mathematicians had the means of calculating in numbers the lines of diagrams, by means of a *Canon*, or *Table*, of *Sines*, *Cosines*, *Tangents*, *Secants*, and the like, already calculated to a given *Radius*. Here was a striking example, and one which has ever

since produced an effect to men's views of intellectual labour, how calculation might be abridged by the accumulated results of previous calculation. This was still more completely exemplified by the additional invention of *Logarithms*. No one can use *Trigonometrical* and *Logarithmic Tables* without seeing that they give man a new power of numerical calculation. Conic Sections, again, containing a remarkable extension of Geometry beyond its Elementary Limits, introduced also a number of new Geometrical notions and terms, as *Parabola*, *Ellipse*, *Hyperbola*, *Directrix*, *Focus*, *Normals*, *Diameters*, *Conjugate* and *Transverse Diameters*, *Circles of Curvature*, *Asymptotes*, *Infinite Branches*. These terms, and the like, when they become familiar, offer many means of referring to the properties and analogies brought into view in this Higher Geometry; and enable the man who is instructed in such studies to follow many of the applications of Mathematics to matters of general interest. Mechanics, again, is another branch of Mathematics, quite distinct, but possessing an interest of the same kind. The properties of the *Center of Gravity*, and of the *Mechanical Powers*, *The Lever*, *Wheel and Axle*, *Pulley*, *Inclined Plane*, *Wedge and Screw*, have been long familiar to the minds of mathematicians, and may be made to serve as images of all statical action, and as modes of conceiving and solving all statical problems. These, and a few other terms, form a mechanical language, by means of which all men of education understand each other in discussing mechanical questions. In the Mechanics of Motion, we find no truths permanently established till we come to modern times; but the propositions proved by Galileo concerning *Falling Bodies* and *Projectiles* have ever since been standard portions of mathematical knowledge. And the truths mathematically demonstrated by Newton, respecting the forces by which the universe is regulated, have

been regarded with admiration as the triumphs of man's reasoning powers. By the attention bestowed by men in general upon these investigations, many terms referring to mechanical action have become generally current; as *Attractive* and *Repulsive Forces*, *Centers of Attraction*, *Centripetal* and *Centrifugal Forces*; *Inertia*; and the like. These terms may often be loosely and improperly applied by half-educated persons. It is the business of a good education to enable the student to understand and apply them rightly and clearly. To these subjects, belonging to the Mechanics of the Universe, we may add, as also familiar among men of mathematical culture, the *Cycloidal Pendulum*, as simplified by Newton's pupil, Cotes; and the *Center of Oscillation*, investigated by several mathematicians of that period. The doctrines of Astronomy have been familiar among educated men from the earliest period: and the terms and theories of that Science must be known by any one who would share in the historical influence of intellectual culture.

62 Now these branches of mathematics, in order to be possessed as a portion of the intellectual culture which has been historically transmitted from one generation to another, must be studied in that geometrical form in which they were originally produced and have generally been exhibited; not in some new analytical form, which supersedes the old; however elegant or compendious the new form may be. These mathematical studies connect successive generations of educated men by an intellectual sympathy, not merely in virtue of their subjects, but of the mode of treating them. If we have a science concerning Lines and Angles, analytically or however otherwise treated, quite different from the Geometry of Euclid, such a science cannot supersede Euclid as an element of Education. It cannot make the philosophical speculations of ancient and modern times intelligible to us, as a knowledge of the

ancient Geometry does. And the same is the case with regard to the other subjects. If our Trigonometry differs entirely from the Trigonometry which appears in the History of Mathematics; if our Conic Sections is a different science from the Conic Sections with which all ancient and most modern mathematicians are familiar; our new Mathematics cannot connect us with the ancient thinkers, as educational mathematics ought to do. If our Mechanics is a new Science, reducing all special cases, as the Mechanical Powers, to one universal case of equilibrium, and obliterating their peculiar characters, it cannot enable us to understand the familiar discussions of those whose Mechanics is of a more historical complexion. If our knowledge of the Mechanics of the Universe, though it implicitly includes the Newtonian truths, do not explicitly exhibit the Newtonian proofs and methods, it will not enable us to share in the interest with which those who know the history of science dwell upon the philosophical events and revolutions of the great Newtonian epoch. And even with regard to smaller problems, such as the Motion of Projectiles or the Oscillations of Pendulums, a person, in order to understand the principles which have been applied to their solution, must have them brought before him in the distinct and elementary form in which they were at first treated; and not merely as cases included in wide symbolical expressions of mechanical principles.

63 Thus the geometrical form of the mathematical subjects which have been mentioned are valuable parts of a Liberal Education, not only as being the best examples of rigorous reasoning, but as having been always regarded as the standard achievements of human reason; and thus possessing an historical as well as a disciplinal character. This historical character of the branches of Mathematics may be much obscured, and the consequent value of a mathematical education much

impaired, by treating the subjects in a merely analytical manner. Analysis presents each subject under its symbolical general forms, obtained by symbolical operations from fundamental principles; and thus puts out of sight, entirely or nearly, all the peculiar conceptions and terms which the original mathematical explorers of these subjects, proceeding in the geometrical way, had employed. A person may possess great knowledge of the analytical forms of Geometry, Trigonometry, Conic Sections, Mechanics, Dynamics, and yet know nothing at all of their history, or even of the principal terms in which their history is told. A person may be well acquainted with the formulæ of Analytical Trigonometry, and even able to combine them with skill; and may yet be ignorant of the meaning which the words Sine, Cosine, Tangent, Secant, Versed Sine, have had in all mathematical books till within these few years. With the same knowledge, he may be unable to solve a triangle in numbers, or to use a Table of Logarithms. A person may be well taught in Analytical Conic Sections, and may not know a single proposition of those which constituted the study of Conic Sections from the time of Apollonius to that of Newton, and which alone gave it its interest. A person who is thus ignorant of the propositions which belonged to Conic Sections in Newton's time, and of their demonstrations, will necessarily be unable to understand Newton's reasonings in the *Principia*; for these reasonings assume the ancient propositions, and follow a like mode of proof. And he may be entirely ignorant of every line of the *Principia*, and of every step of Newton's train of discovery and demonstration, and even unable to follow Newton's reasoning as presented by himself, though he is intimately acquainted with the modes in which the Mechanics of the Universe has been analytically treated.

64 Now if the analytical modes of treating the

various branches of Mathematics produce this effect, they destroy one of the main reasons why mathematical studies are accepted as parts of Education. For undoubtedly it has always been supposed, by those who have approved of such education, that the Mathematics so taught was to make men acquainted with those mental triumphs of past generations which have always occupied a conspicuous place in man's intellectual history. If our educational Mathematics does not do this, men in general, when they learn that the case is so, will be far less ready to assent to the value which we set upon the study. If our educational Mathematics give us no acquaintance with the works of Euclid and Archimedes, Galileo and Newton, men in general will look upon our Mathematical Education as illusory and worthless. If any one moderately acquainted with the general literature of the country knows more than our best mathematical students do, of the history of mathematical and physical discoveries, a praiser of our system will find, in general, averse and incredulous auditors. To know accurately those events in scientific history which other men know vaguely, is a most proper and characteristic superiority of a well-educated man; but to know certain general symbolical results, which are supposed to render all scientific history superfluous, is an accomplishment which can only be of little value in education: for a good education must connect us with the past, as well as with the future; even if such mere generalities did supply the best mode of dealing with all future problems; which, in fact, they are very far from doing.

65 For (to add one more to the points of advantage of geometrical over analytical forms of Mathematics for common educational purposes), it will generally be found that a person who has studied the branches of Mathematics in the more special and detached forms in which they were treated geometrically, before ana-

lytical generalities became so common, will be able to apply his knowledge to the calculation of practical results and the solution of problems, better than a person who has acquired his mathematical learning under general analytical forms. The geometrical student has a firmer hold of his principles than the analytical student has. The former holds his fundamental truths by means of his conceptions; the latter, by means of his symbols. In applying doctrines to particular cases, or in solving new problems, the former sees his way at every step, and shapes his course accordingly; the latter must commit himself to his equations; which, except he be a consummate analyst, he will not readily understand and interpret in their particular application. I have no doubt that in any application of geometrical, mechanical, or hydrostatical principles to a problem of moderate difficulty, supposing the problem new to both of two students; one, a geometer of the English school of forty or fifty years back, the other, a modern analyst, instructed in equal degrees; the former would much more accurately and certainly obtain a definite and correct solution. In the application of Mathematics to problems of engineering and the like, the generalities in which the analyst delights are a source of embarrassment and confusion, rather than of convenience and advantage. When particular problems are solved by particular considerations or particular artifices, the ingenuity thus exercised is a talent really more generally available than a knowledge of the general methods which express all problems alike, but actually solve none.

66 From the considerations which have thus been stated, I am led to the conclusion, that the geometrical modes of treating the various branches of Mathematics are those which are to be employed as Educational Studies. The geometrical forms of Trigonometry, Conic Sections, Statics, and Dynamics, and not any

analytical substitutes for them, must be parts of a Liberal Education. This must be so, because thus alone can Mathematics be an intellectual discipline, strengthening the reasoning powers for other non-mathematical occupations; thus alone can the mathematical sciences be known in that historical shape with which a liberally educated person ought to be acquainted; and thus best is a person of moderate mathematical attainments able to apply to practical cases the knowledge which he possesses.

I have hitherto spoken of that part of Education which consists of Permanent Mathematical Studies. But Progressive Mathematics may also advantageously enter into our Higher Education; and I proceed to speak of this portion of Educational Studies.

Sect. 6. *Of Progressive Mathematics as an Educational Study.*

67 As I have already said, a liberal Education ought to include both Permanent Studies which connect men with the culture of past generations, and Progressive Studies which make them feel their community with the present generation, its businesses, interests and prospects. The Permanent Studies must necessarily precede, in order to form a foundation for the Progressive; for the present Progress has grown out of the past activity of men's minds; and cannot be intelligible, except to the student of past literature and established opinions. But the Progressive Studies must be added to the Permanent; for without this step, the meaning and tendencies of the past activity of men cannot be seen, nor our own business understood. And though Progressive Studies may form the business of life, as well as of the specially educational period of it, they may with advantage be begun in that period, before each man's course of study is, as in

after life it generally is, disturbed and perplexed by the constant necessity of action.

68 This necessity of Progressive, as well as Permanent Studies, may be applied to Mathematical Studies in particular. For Mathematics, for the last three centuries, has been, and still is, a science in which a rapid progress is taking place. Old problems have been solved by new and simpler methods: new problems, formerly insoluble, have been successfully attacked; and the methods by which these successes have been attained have excited a strong admiration in men, on account of their ingenuity, generality, and symmetry. On these accounts, it is to be expected that those persons who cultivate mathematics will be drawn to give some of their attention to these modern and progressive portions of mathematics; and those who have to teach Mathematics as a part of Education, may naturally be led to introduce into their teaching a large share of this kind of Mathematics.

69 Almost all these modern portions of Mathematics are of the analytical kind. It may be useful to mention some of the most conspicuous of these newer mathematical trophies. The expression of the form and properties of Curves by means of their *Co-ordinates* was introduced by Descartes; and the like methods have since been extended to *Curve Surfaces*, giving rise to an extensive subject, the *Application of Algebra to Geometry*. The rates of change of variable quantities related in a given manner became the subject of the *Differential Calculus*, invented by Newton, (under the form of *Fluxions*) and by Leibnitz. The inverse process connected with this is the *Integral Calculus;* (the *Method of Quadratures* of the Newtonians.) Then come, as additional branches, *Differential Equations*, *Finite Differences* (originally termed the *Method of Increments*); *Definite Integrals*, and finally, the *Calculus of Variations*, which treats of the

change in the forms of relation of related variable quantities. Moreover we have the application of all these modes of calculation to *Mechanics* (including *Hydrostatics*) and to the *Mechanics of the Universe*, cultivated to a wide extent by Euler, and carried to the highest pitch of generality and symmetry by Lagrange. To this may be added the application of analytical methods to other subjects, as *Optics*. All these portions of Mathematics lie open to us as parts of Progressive Science; and it is our business to select from them such a portion as may suit the purposes of a Liberal Education.

70 I have argued against the exclusive, or even the copious use of Analytical Mathematics among Permanent Educational Studies. It may be asked, whether the same objections apply to the study of such subjects as I have recommended, most of which are analytical in their form. To this we may reply, that the objections by no means apply in this case. When, by the pursuit of Permanent Mathematical Studies, the reasoning faculties have been educed and confirmed, the Student's powers of symbolical calculation, and his pleasure in symbolical symmetry and generality, need no longer be repressed or limited. He may go on following the reasonings and processes of the beautiful portions of mathematics above mentioned, as far as his taste and talents prompt him, or as the demands of other studies will allow. When the Student is once well disciplined in geometrical mathematics, he may pursue analysis safely and surely to any extent.

71 But though modern mathematics may thus be very fitly studied as a sequel to the older forms of mathematical science which must enter into a Liberal Education; these modern methods cannot supply the place of the ancient subjects as the Permanent Studies in our Educational course. This is sufficiently shown already, by what we have said of the unfitness of mere

analysis either to exercise the reasoning powers, or to render intelligible the history of human knowledge. Yet perhaps it may sometimes appear, both to teachers and to students, that it is a waste of time and a perverseness of judgment to adhere to the ancient kinds of mathematics, when we have, in the modern analysis, an instrument of greater power and range for the solution of problems, giving us the old results by more compendious methods; an instrument, too, in itself admirable for its beauty and generality. But to this we reply, that we require our Permanent Mathematical Studies, not as an instrument, but as an exercise of the intellectual powers: that it is not for their results, but for the intellectual habits which they generate, that such studies are pursued. To this we may add, as we have already stated, that in most minds, the significance of analytical methods is never fully understood, except when a foundation has been laid in geometrical studies. There is no more a waste of time in studying Geometry before we proceed to solve questions by the Differential Calculus, than there is a waste of time in making ourselves acquainted with the Grammar of a language before we try to read its philosophical or poetical literature. And a knowledge of the Sciences, as they have historically existed, is the best mode of enabling ourselves to understand their ultimate and most recent generalizations, as a knowledge of the etymology of words, and their transitions from one shade of meaning to another, is the best mode of learning to perceive all that is implied by words in their later use. There is therefore no waste of time, or perverseness of taste, when the mathematician retains and upholds, as an essential part of a general education, mathematical reasonings different from those which he would himself study or employ, if he had to deal with difficult and extensive problems. He does this, just as the most accomplished scholar

requires the student to study his grammar, though he himself has outgrown such study. Nor does the most careful regard to the maintenance of our geometrical studies, on this ground, imply any want of the intellectual taste which can perceive the beauty, and the intellectual power which can follow and continue the processes of the most refined modern analysis.

72 As I have already said, we have to select out of the whole range of modern mathematical literature those portions which are best suited to be admitted, as Progressive Studies, into a Liberal Education. In order to discuss this selection more conveniently, I will divide mathematical writings into three Classes, which I will call respectively *Capital Works*, *Original Investigations*, and *Systematic Treatises*.

By *Capital Works* in Mathematics, I mean works which hold a conspicuous place, both in mathematical history and in mathematical literature; this distinction being secured to them by their containing comprehensive and important truths connected by solid reasoning, and in them first presented as a connected whole. Such are the *Principia* of Newton, the *Mechanica* of Euler, the *Théorie des Fonctions* of Lagrange, the *Mécanique Analytique* of the same author, the *Application de l'Algebre à la Géométrie* of Monge, the *Mécanique Céleste* of Laplace.

By *Original Investigations*, I mean such publications as Memoirs in the Transactions of Scientific Bodies, and the like, in which mathematical investigations of detached problems are presented. Such investigations may afterwards be included in more complete Treatises; as many of Euler's and Laplace's investigations and original memoirs were afterwards included in those Capital Works of the same authors which have just been mentioned; or they may as yet not have taken this place in mathematical literature, as is the case with many highly important memoirs of

modern mathematicians; for instance, Poisson and Gauss among foreigners, and several of our own countrymen.

By *Systematic Treatises* I mean Treatises compiled out of the two preceding classes of works, of Elementary Treatises, intended as introductions to such works. Such are Lacroix's larger *Traité des Calcul Differential et Integral*, and his smaller *Traité Elémentaire* on the same subject. Such are the innumerable *Elementary Treatises* on the Differential Calculus, on Mechanics, and on other subjects, which have been published in recent times in France, Germany, and England.

I do not pretend that this division of modern mathematical literature can always be applied without difficulty; but, without attempting any rigour in the separation, the distinction will enable me, I hope, to speak intelligibly.

73 I remark, then, in the first place, that candidates for our highest mathematical honours ought to be encouraged to acquaint themselves with Capital Works, rather than with Systematic Treatises in which the same results are presented, more symmetrically and simply perhaps, but by mathematicians of inferior eminence. The historical interest belonging to every great work, added to its intellectual value, makes it fit that a man of liberal education, whose studies extend to the subject of the work, should be acquainted with the work itself, and not with any transcript of it. Moreover, it is always instructive and animating to study the works of men of genius. The mind appears to be elevated and ennobled by direct intercourse with the highest minds. On this account I recommend, for the highest students, Newton's *Principia*, rather than Maclaurin's account of Newton's Discoveries; Euler's *Mechanica*, rather than any modern Collection of Mechanical Problems; Lagrange's *Mécanique Ana-*

lytique, rather than Poisson's or Francœur's *Mechanics;* Laplace's *Mechanics of the Universe*, rather than Pontecoulant's. The derivative works which I have mentioned are excellent for their proper purposes; but the great original works are the proper study of a man who would pursue mathematics for the highest purposes of intellectual culture.

74 The works which I have enumerated in Article 72, as Capital Works, appear to me to suffice for the purposes of the highest Education; although others of equal, or almost equal, eminence might be added to the list, and will, of course, be read by a person who would be an accomplished mathematician. I think there are no works which have claims upon our notice superior to those above enumerated. Euler's other works, as for instance, the Treatise *De Motu Corporum Rigidorum*, and the solutions of *Isoperimetrical Problems*, have been so far superseded by more general methods, that they are not Capital Works in the same degree as the *Mechanica*. The *Calculus Integralis* of Euler is truly a Capital Work; but does not make so great a figure in mathematical history as the others which we have mentioned; and in which its substance, so far as most purposes are concerned, is included. Clairaut's *Theorié de la Lune*, Dalembert's *Dynamique*, and various other works, on the other hand, are of capital importance in mathematical history, but are included, as to their import, in the great works of Laplace and Lagrange. And since it is not possible to require or suppose, even in our highest students, an acquaintance with *all* the great works of mathematicians, I think it will be found that the list which I have given is ample, without being overwhelming as to its extent.

75 Whether any given mathematical work can properly be distinguished as one of the Capital Works of the subject, is a matter to be decided by the general

and permanent judgment of the mathematical world; and it must therefore be difficult to decide this question with regard to any new work. It is desirable, for the purposes of Education at least, that we should not be hasty in elevating the works of our contemporaries into this rank, and directing the attention of men to them as part of their educational studies. For the list of Capital Works which we already possess is sufficiently ample to occupy the time and thought, even of the most gifted student: and to encourage a too ready pursuit of novelties, tends to promote the neglect or superficial study of the older works. For the same reason, it is not desirable, in general, to require or suppose in our students a knowledge of *Original Investigations*, which have not yet found their way into Capital Works, or Systematic Treatises. To urge young men, even of the greatest talents and industry, to rush into the vast field of mathematical memoirs which exists in the Transactions of Societies, and in detached Opuscules, would be to bewilder and overwhelm them. Such a course of reading is fit only for those who make mathematics a main business of life. And such a study could lead to no advantage comparable with the study of the great works of the best authors. I do not say that active-minded and industrious students should be prevented from pursuing such a line of reading, as far as their taste and their time will allow: but this is not the course of reading which we ought to encourage by the turn which we give to the mathematical instructions and requirements which our education includes.

76 Perhaps we may be a little more facile in encouraging the study of new investigations with regard to practical problems, than in recondite and speculative subjects. Problems of Engineering and Practical Mechanics naturally receive new solutions, as, in the progress of Art, they take new forms; and

it is desirable that our mathematical education should make our students acquainted with the best and most recent solutions of such problems; because, by this means their mathematical knowledge has solidity and permanence given it, by its verification in facts, and its coincidence with the experience of practical men. Hence, I would advise that we should introduce among the books of which we encourage the study among our best mathematical students, three excellent works of recent date: namely, Poncelet's *Mécanique Industrielle*, in which he has given modes of calculating the amount and expenditure of *Labouring Force**; Professor Willis's *Principles of Mechanism*, in which he has classified all modes of communicating motion by machinery, and investigated their properties; and Count de Pambour's *Theory of the Steam Engine*, in which a sound mathematical theory is confirmed by judicious experiments. The study of these works would put our students in possession of the largest and most philosophical doctrines which apply to Engineering; and would thus give a tangible reality and practical value to their mathematical acquirements; while, at the same time they would find, in the works thus brought before them, excellent examples of mathematical rigour, ingenuity, and beauty.

77 Besides the great works of mathematical inventors, there have been produced many Systematic Treatises, in which the original inventions have been collected, methodized, and often simplified. I have said that our best mathematical students are to be directed to the great original works, rather than to these compilations. But in some measure, it will be necessary for all students to have recourse to such works.

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* This term appears to me the best translation of Poncelet's term *Travail;* and I have accordingly used it in *The Mechanics of Engineering,* in which I have given some of Poncelet's results.

It is, for instance, more convenient for all students to acquire their knowledge of the Differential and Integral Calculus in a systematic work like Lacroix's *Traité*, rather than to gather up the various artifices of the Calculus out of the successive works of their inventors. And for the like reason, the *Collection of Examples of the Applications of the Differential and Integral Calculus*, by Dr Peacock*, and the *Collection of Examples of the Application of the Calculus of Finite Differences*, by Sir John Herschel, (both originally intended as a Supplement to the Translation of Lacroix's smaller Treatise) may be recommended as containing, within a convenient space, the substance of many investigations very instructive, but too numerous and extensive to be studied in their original form. To these works on Pure Mathematics, we may add Mr Airy's *Tracts* on certain subjects of Applied Mathematics, namely, the Lunar and Planetary Theories, the Figure of the Earth, Precession and Nutation, and the Undulatory Theory of Optics. These works are proper subjects of the labours of our best mathematical students.

78 With regard to students who have inferior ability and diligence, but who still are candidates for distinction in their mathematical studies, their course of reading must necessarily be different from that which I have described. Their acquaintance with analytical processes, and their habits of general reasoning will, in most cases, not allow them to go far in the reading of such Capital Works as we have spoken of; and they must, for the most part, acquire their knowledge from Systematic Treatises, and principally from *Elementary Treatises*. The selection of the Elementary Treatises

* This work may now be considered as replaced by the *Examples of the Processes of the Differential and Integral Calculus*, published in 1841, by the late lamented Mr Gregory; Dr Peacock not having had leisure to publish a second edition of his "Examples."

which are thus to be used is an important point in a scheme of education; and on this subject I shall venture to make one or two remarks.

79 In the first place, I remark that the Elementary Treatises which we use in our course of Education ought not to be too rapidly changed. For the change itself is an evil, inasmuch as it turns the student's attention to new proofs, instead of the application of known truths; and excites a craving for fresh novelties, in the place of a desire to overcome known difficulties. And moreover the new Elementary Treatises which are produced in modern times, for the most part, treat their subjects more entirely in an analytical manner than their predecessors had done; and are therefore more unfit for general educational purposes for the reasons already given in Section 5. If new Elementary Treatises of an analytical cast are easily introduced into our Educational System, the result will be very pernicious. If this be the case, the new parts of our course will naturally attract the most notice, and the greater part or the whole of the student's attention will be employed upon such novelties, without any real profit. For this change in the Elementary Treatises which are commonly read is not attended with any real progress of the sciences treated of. In every subject, treated analytically, the earliest steps of generalization admit of being variously presented; and every writer, and almost every teacher, thinks he can make some new advance in generality and symmetry. And all those devices, while new, please some readers, though they leave the science where they found it. Mere novelty appears like improvement, because it implies activity of mind in him who produces it. And thus, if new Elementary Treatises be readily admitted, the student will be perpetually carried by his teachers or his fellow-students from one elementary form of the subject to another. Instead of employing his mental labour in mastering

the difficulties of any one connected course of study, his thoughts are occupied in pursuing these detached novelties, and in considering which of them is most worthy of admiration, or in conjecturing which is most likely to receive honour. The result of such an occupation will probably be that he will know nothing well. He will ascribe an exaggerated value to those parts of his studies in which the new methods differ from the old. The conceit of a supposed knowledge of something which his predecessors did not know, will take the place of the satisfaction which he might feel from understanding what generations of thoughtful men before him have understood, or from following the intellectual processes by which real difficulties are overcome.

80 A too facile admission of new elementary works and new forms of old truths into our educational scheme, is likely to occasion a multiplication of such works, to the detriment rather than the advantage of our mathematical literature. For such works, produced on the first suggestion of some slight advance, fancied or real, in simplicity or generality or ingenuity, would not be likely to obtain any wide or permanent notice among the general mathematical public. Works so produced at a place of Education, might form a perpetual stream of transient local literature; and the students, in bestowing their attention upon such works, might be toiling on in paths held in no value in the rest of the mathematical world; and might be bestowing much labour on mathematical subjects, without approaching to any community of thought with the good mathematicians of their own and preceding times. In order to avoid such evils, I conceive that no book should be adopted into a course of education except by proper authority, and after mature deliberation. I shall afterwards venture to suggest the grounds on which such a choice should turn, and the nature of the authority by which the decision might be carried into effect.

81 It will of course be understood, from what has been said, that even when Elementary Analytical Treatises upon the various branches of mathematics have been selected and adopted in our educational course, they are not to supersede the Permanent Studies of which we have already spoken (17). Conic Sections, Mechanics, Hydrostatics, Optics, and Explanatory Astronomy, in their hitherto common form, should be mastered by every mathematical student; however he may afterwards study these subjects in the shape in which they have been presented by modern analysts. He will travel all the more securely in his analytical course in each subject, from having already gone over a part of the same ground, with the clear intuition which belongs to geometrical reasoning.

82 It may be remarked that the works which I have mentioned in Article 72 as "Capital Works," except Newton's *Principia*, are all by foreigners, and with the exception of Euler, by French writers of modern times. No English mathematician will be surprised at this; for the French mathematicians have undoubtedly of late been our masters and teachers. The pertinacity with which the English mathematicians clung to Newton's methods, and the mathematical controversies which soon after his time arose between Englishmen and foreigners, for a long time prevented his countrymen from adopting and following out the analytical generalizations introduced by his continental contemporaries. Yet it is not because we have no English works worthy of the mathematician's study, that I have mentioned none in my list, but because it appeared to me necessary to limit the list to a few works of which the eminent place in mathematical literature is clear and undeniable. I might have recommended the beautiful geometrical investigations of Maclaurin; many ingenious solutions of problems by Emerson and Simpson; many labours of Ivory, not

inferior in analytical elegance to any works of continental analysts. But this would have made the mass of subjects too large for a course of Education. The English mathematician will hardly fail to acquaint himself with these works, when he is out of the hands of his teachers. For the same reason I have not spoken of the mathematical labours of the Bernouillis, which form such remarkable points in mathematical history, or of those of many other great mathematicians. I speak only of Mathematical Education: and I am convinced that I have provided sufficiently for the mathematical progress of our best students, by placing before them the works already enumerated, as the highest subjects of their educational study.

83 If it be objected, that since I have allowed that the tenacious adherence to Newton's methods checked the progress of Mathematics in England, I shall discourage such progress by obstinately retaining his works as our Permanent Studies; I reply, that I do not require our mathematicians to stop with those works, but to begin with them, or at least to make them a part of their studies. Let our mathematical students, by all means, go on with their analytical teachers as far as they will and can; but they will not do this the better, for being ignorant of Newton; and as I have said, the works of their analytical teachers cannot discharge the educational office which our Permanent Studies, and Newton among them, are required to discharge. We have around us many instances that those who are most fully acquainted with Newton's works are most likely to go on as successful rivals of the foreign Analysts in the solution of difficult problems. Indeed, no persons in our own time appear to have studied Newton's works more carefully than Lagrange and Laplace themselves.

84 If it be said, that by beginning with Geometry we shall lose all chance of having a school of English

mathematicians able to compete with the mathematicians of other countries; I reply, that I do not believe this to be the case, because I believe such a mathematical education as I have described to be the one best fitted to give the student a complete understanding of mathematical processes; and therefore, the most likely to lead to a solid and extensive progress. I do not believe that men will make better analysts, because they are ignorant of geometrical mathematics, but the contrary. And I do not think it has been found that those who have exclusively studied analysis have been the persons to make the greatest advances in mathematical science in our own times.

85 But I reply further, that the use of mathematical study, with which we have to do, is not to produce a school of eminent mathematicians, but to contribute to a Liberal Education of the highest kind. I am, indeed, fully persuaded that the Mathematical Education which I have described is that most adapted to evoke the mathematical talent of the nation; and that among students so taught, we shall have a better chance of giving to great mathematical genius its full scope, than by involving them in discussions about elementary symbolical novelties. But even if I thought otherwise; if I thought that a course beginning with analytical generalities was the most likely to give us a celebrated School of English Analysts, I should still think that while such Permanent Mathematical Studies as I have recommended are most likely to impart the intellectual culture which belongs to a Liberal Education, they should be steadily retained in the seats of English Education.

Having thus considered the nature of the Permanent and of the Progressive Mathematical Studies which belong to a Liberal Education, I proceed to make some remarks on Classical Studies, as belonging to such an Education; and therefore under the same aspects of Permanent and Progressive Studies.

SECT. 7. *Of Classical Educational Studies, Permanent and Progressive.*

86 Classical Studies necessarily occupy an important place in Education, both as Permanent Studies which connect men with the culture of past generations, and as Progressive Studies which engage them in the speculations, discussions, and mental movements still going on among men. The former office more especially belongs to the literature of Greece and Rome. An acquaintance with that literature has been a leading character of all literary educated men in all ages. This study has educed men's apprehension of the powers of Language in their highest form, as we have already said; and has connected man with man, giving them a common acquaintance with standard books of history, poetry, philosophy and morality. There has also, as we have said, been diffused among classical students a knowledge of philology, by means of the grammatical and critical comments to which the study of standard authors has led. These effects have been more generally produced by the Latin literature, for Latin has been more generally read than Greek. The study of the Latin authors has never been interrupted among cultivated men. The language has always been known to such persons. For many centuries it was the language of a great part of the civilized globe; first, as the language of the Roman Empire, and then, as the language of the Western Church; and, till within a short time, of the whole literary world. Through this long prevalence, this language contains in its literature the works which have most influenced every age, up to modern times. The languages of many nations in modern Europe are mainly derived from the Latin, and those which are not so derived, are still much tinged by the mixture of Latin words and modes of speech. In English, in particular, this mixture is very large;

and the connexion of our language with the Latin is so intimate, that the reader who has no knowledge of that language will inevitably miss some part of the meaning of our best writers. In general, the study of Latin, as a portion of a Liberal Education, is directed mainly to the principal writers of the best times; for example, Livy, Cæsar, Sallust, Tacitus, Lucretius, Virgil, Horace, Ovid, Cicero. And a sound knowledge of these authors is, in truth, a sufficient educational basis for a knowledge of the Latin literature of all ages, and for a due apprehension of the influence which these great models of composition have exercised upon the vernacular literature of each country, and especially upon its poetry and criticism.

87 But a knowledge of the Greek language and literature is also necessary to complete this classical culture; both on account of the manner in which the greatest Roman writers were stimulated and formed by the example and teaching of their Grecian predecessors; and also, on account of the direct operation of the Greek writers upon modern thinkers and writers, ever since the revival of the study of Greek literature in the fifteenth century. In philosophy, the Roman works do little more than transmit to us the influence of Greek speculations: in history, Herodotus and Thucydides occupy a greater place in the thoughts of cultivated men than any Roman historians; and even in poetry, although the tradition of the Latin forms and style of composition has been more extensive and continual than of the Greek, the Greek classical writers have, in later times, been more diligently studied, and more warmly admired, than the Roman poets. No one can be considered as furnished with the knowledge, tastes, and sympathies which connect the successive generations of liberally educated men, who is not familiar with Homer and the Greek Tragedians, as well as with Virgil, Horace, and Ovid. These two great

families of writers, the Greek and the Roman Classics, form the intellectual ancestors of all the cultivated minds of modern times; and we must be well acquainted with their language, their thoughts, their forms of composition, their beauties, in order that we may have our share in that inheritance by which men belong to the intellectual aristocracy of mankind. The study of these title-deeds and archives of the culture of our race must be a permanent portion of the best education of men, so long as the tradition of such culture is preserved upon the face of the earth.

88 But though the classical writers are to be looked upon mainly as Permanent Studies, in their educational office, they are also the subjects of Progressive Studies in every age, and especially in ages of great intellectual activity. The full understanding of these writers implies views of the structure and relations of language, of the principles and significance of philosophy, of the origin and progress of states, which views, each age, borrowing much from its predecessors, moulds in some degree for itself. Ancient Philology, Philosophy, and History, are the subjects of progressive speculations. Those persons in our own time, for instance, who have most diligently studied these subjects, have been led to views which have in them a considerable share of novelty; and men's minds are still employed in eager endeavours to obtain a more complete and profound insight into the causes on which philological and philosophical and historical progress depend. The origin, growth, revolutions, and decline of languages, systems, and states, are now, as they have almost always been, matters full of interest for the classical student. A Classical Education would not be the highest education, if it did not impart to the student a share in this interest;—if it did not give him some acquaintance with such speculations as they are carried on in his own time, and enable his mind to

go along with them. To carry on such speculations is, for Classical Scholars, the business of life: but in this, for the same reason as in other departments of knowledge, this business ought to be begun in the educational period of life. Our education is limited and incomplete, if it do not lead our students into the portal at least of this great edifice, on which thoughtful and learned men are constantly labouring. Classical learning, in order to be a worthy part of a Liberal Education, must include Progressive as well as Permanent Studies.

Having thus shown that Classical, as well as Mathematical Educational Studies are partly of a Permanent and partly of a Progressive kind, I may make some remarks on Classical, of a similar tendency to some of those which I have made respecting Mathematical, Studies.

89 In the first place, it is important to keep the two kinds, the Permanent and the Progressive Studies, distinct; and especially, not to allow the latter to supersede the former, or to impair the attention given to them. The Permanent Classical Studies, which give a thorough acquaintance with the Greek and Latin languages, and a familiarity with the best Classical writers, are indispensable, both as cardinal parts of a Liberal Education, and as necessary to any intelligent participation in the progress of speculations concerning the language, philosophy, or history of the Greeks and Romans. No second-hand knowledge of the philological criticism, philosophical doctrines, and political events of these nations, can at all compensate, as a branch of education, for the lack of a knowledge of the original authors in the original languages. If a person do not read and understand the Greek and Latin poets, historians, and philosophers, he cannot be deemed to have received a Liberal Education, though he may be ever so well acquainted with the discussions which have

taken place in modern times respecting the antiquities and histories of those nations, or the peculiarities and merits of their writers. To be liberally educated, a man must have acquired knowledge of the languages so that it is a solid and permanent possession, as the actual knowledge of a language is: and he must have familiarized himself with the classical writings, so that they have imbued and moulded his mind, as the literature with which we are familiar in youth does. If he have not done this, it is to no purpose, as constituting a really good education, that he reads translations, and criticisms, and dissertations. By such kinds of study he may know as much about the Greek and Roman writers, as a man, by the study of Peerage Books, may know much about the aristocracy of his own country; but he cannot by such a study imbibe that spirit of classical literature which is, as we have said, the inheritance of the intellectual aristocracy of the world.

90 I remark, in the next place, that it is not enough for our purpose to study the literature of one of the two languages. I have already (73) given reasons why the cultivation of the Latin language and literature is not sufficient, except the study of Greek be added to it. Still less is the study of Greek sufficient for the classical part of a good education, if the Latin language and literature be neglected, or slightly attended to. For however admirable may be the Greek models, and however superior in many respects to the Latin writers, Latin literature has, after all, exercised a far larger sway over the civilized and literary world, than Greek. Greek may be the finer study, but Latin is the more necessary accomplishment. For many centuries, in modern times, Greek was comparatively little known; and during those centuries, the Latin writers operated powerfully in the literary and intellectual culture of men's minds. Nor has this tradition of the Roman influence ever ceased or been in-

terrupted. Latin models, trains of thought as expressed by Latin writers, Latin as a language with which all educated persons are familiar, are far more generally and promptly operative among cultivated men, than Greek literature is. To neglect Latin, and to concentrate our classical study upon the Greek writers, would be to put ourselves out of sympathy with the literary world of all past ages, and, in a great degree, of our own also. And if this were done out of an ardent admiration for the Greek language and nation, as compared with the Latin, it would not the less be a mistake in Education; for Education has it for its business, not merely to find something which we can admire, and to dwell upon that; but to place before us objects which cultivated men in all ages have admired and dwelt upon, and thus to connect our minds with theirs. To turn from Latin and to confine our studies to Greek, on such grounds, would be to confound Progressive with Permanent Classical Study: it would be to let the assumed progress of literary taste in the present day break off the tradition of literary sympathy with past generations. It would be, in Classical Studies, the same kind of error as the substitution of Analytical for Geometrical Methods in Mathematics, of which we have already explained the ruinous effect upon education.

91 It may perhaps be said by some, that a knowledge of the Latin and Greek languages is not necessary in order that we may share in the influences which the thoughts and writings of the classical authors have exercised upon succeeding ages, since we may become acquainted with these authors by means of translations. So far as such authors are intelligible, it may be said, their meaning may be expressed in our own language; and in fact, all the principal classical authors have been translated into modern languages, and may thus be studied without the labour of mastering the original

tongues. This may be said: nor do I deny that a certain portion of classical culture may be thus received; but such culture must be very imperfect. For all translations must be very defective in conveying the impression of the original; as every one who has read an original work, and a translation of it, must be aware. In poetry, the defect is immense. We have, in our literature, nothing closely resembling or equivalent to the Greek and Roman forms of composition; and the finest beauties of poetry consist in expressions and touches which cannot be transferred from one language to another. Our possession of a foreign language, and that language one so different in its structure from our own, and from modern languages in general, as Greek and Latin are, gives a peculiar aspect and colour to all that we apprehend through such a medium. The criticism which is applicable to the original work must bear quite as much upon the language as upon the matter, and must necessarily lose its significance if we have before us only a translation. In short, knowledge acquired by translations can hardly be considered as education, in any proper sense of the word. It evokes none of those peculiar powers by which the mind deals with language. When, however, we possess the Greek and Latin languages, and are already familiar with the best classical authors, it is by no means clear that we may not usefully extend our acquaintance with Greek and Latin literature by means of translations; for most students will read English with more facility and rapidity than Greek or Latin; and he who possesses the languages, will constantly be led to compare the translation with the original, and thus will become acquainted with the spirit and form of the work, as well as with its substance and meaning. Translations of Greek and Latin authors have undoubtedly been very effective in extending a knowledge of Classical literature, even among classically educated men. The discussions and

comparisons to which the translations have given rise, have made the originals better known; and by means of such translations, the classical authors have promoted the culture of many persons who could not read the originals. Thus such translations have extended the range of the sympathies by which classical studies bind men together.

92 It might at first appear as if the existence of translations of Classical Authors would make it difficult to ascertain whether the student who is required, as a part of his education, to translate or *construe*, as it is called, such authors, does so from his knowledge of the language, or from his acquaintance with the translation. But all classical teachers are aware that this is, in reality, no difficulty at all. As we said before, with regard to examinations in Geometry (53), a question or two with reference to the grammatical construction of a passage is quite sufficient to enable the teacher to decide whether the learner performs his task by rote or with intelligence. Moreover the student may be required himself to write or speak in the language, and will then make it evident whether he possesses the language or not. With regard to the Latin language, such exercises have always been part of the usual classical discipline; and are a requisite part of the education which is to connect a man with the literary community of past and present times.

93 With regard to the fidelity and accuracy with which translations convey the meaning of the original, each translation will of course have the tinge of its own period in the national literature to which it belongs, but it is not likely that much progress will be made from age to age in better understanding the sense of the ancient authors. Scholars in all periods, at least since the revival of literature, have well understood the Greek and Latin languages, and what the best authors have written in those languages. It is not likely that

we have, in modern times, any one who knows Latin better than Erasmus did, or Greek better than Bentley. Still, new translations of ancient authors may be made useful works, as parts of Progressive Classical Studies. They may convey the sense in phrases suited to our modern apprehension; and they may have, appended to them, notes and comments, by which the newest views of philologers, antiquaries, and historians may be exhibited to the modern reader. This advantage of new translations belongs especially to works relating to philosophy: for the language of philosophy, to be generally intelligible, must be modified from age to age, more than that of poetry or history, as new philosophical views succeed each other in our own nation. And the continued study of the ancient philosophers by modern philosophical scholars may really bring to view much more clearly their meaning and import, than, to other readers, however well versed in the general significations of words, it has before appeared. And thus translations of the philosophical works of Plato, and of Aristotle, especially if philosophical and critical comments be annexed, may be a most effective and instructive mode of showing to the world the progress that our classical scholars have recently made in the study of the Greek philosophy. Such translations have accordingly appeared in recent times by eminent philosophers and scholars in Germany and in France. I am not aware that anything of the same kind has been attempted by our English scholars. And yet I cannot imagine any boon which they could confer upon the world, at the present time, which would be more interesting and instructive than one of this kind: a translation, for instance, with illustrative comments, of the Republic of Plato, or the Ethics of Aristotle. Such translations, so executed as to convey the meaning and force of the philosophical reasoning to the English reader, would be a worthy evidence of the philosophical

scholarship of our times, and a means of extending its beneficial influence to a wider circle than that of mere scholars, or even of the present generation.

94 Translations or Editions of Classical Authors, accompanied with commentaries of a philological, philosophical, antiquarian, or historical character, are natural and obvious means of laying before the literary world the progressive speculations of classical scholars. But such speculations appear in other forms also, as Dissertations, Controversial writings, and the like; and in works of a more independent form, as Histories of Ancient States and Races, Customs and Opinions. Among such works, whether commentatorial or independent, we may reckon many as *Capital* Works; such as the works of Sigonius on Roman, and Meursius on Greek Antiquities; of Scaliger on Chronology, and Cluverius on Geography. And a fully-instructed classical scholar will be acquainted with the works of such authors, as a fully-instructed mathematician will be acquainted with the works of Archimedes and Euler. In Classics, however, still more than in Mathematics, there is a tendency to study the Elementary Books of recent writers, founded, it may be, at second or third hand, upon the labours of great men, rather than the works of the great men themselves. But yet in Classics, as in Mathematics, for the most part, the Capital Works—those which have made each its epoch in the study of ancient literature—are the most instructive and striking books which can be read; and Compilations, which are supposed to include all that great scholars have established with regard to antiquity, do really impart only a vague, dim, and incomplete knowledge, compared with that which arises from the habit of consulting the great original works of celebrated philologers, antiquaries, and historians. These Capital Works bearing upon classical literature belong to various periods, and are of various extent; as Bentley's

Dissertation on the Epistles of Phalaris; Potter's *Greek Antiquities;* Porson's Preface to his edition of the Hecuba; Wolf's Preface to Homer; and the like. Several have been produced in our own time: thus, Müller's *History of the Dorians*, Bœckh's *Public Economy of Athens*, Niebuhr's *History of Rome*, have recently been main subjects of attention of the classical students of this country; and these may be taken as exhibiting the leading points in the progressive classical studies of the modern world.

95 We may say with regard to classical, as we have said with regard to mathematical studies, that a system which, consisting in private teaching, substitutes some unpublished views of the teachers respecting the subjects taught, for the study of the capital published works on those subjects, is likely to deprave our education, by bringing before the student knowledge which has only a conventional value, acknowledged in a certain circle, in the place of the works which the whole literary world admires; and by substituting for a participation in the general recognition of excellence, a complacency in some supposed peculiar superiority of criticism.

96 The knowledge of the Latin language which belongs to a liberal education when complete, includes not only the power of translating Latin into English, but also the power of writing Latin. The latter faculty is not, indeed, so essential a part of a good education as the former; for a student may feel the force of the language, and admire the beauties of the classical writers, without being himself able to write correct Latin with facility, or to write good Latin at all. Writing Latin, as well as translating Latin, must be practised, in order that the student may write the language correctly and well. The faculty, if formed, must be formed by exercise, especially directed to that end; and such exercise is not at present an indispensable

part of a liberal education. Some generations back, the faculty of writing and speaking Latin was indispensable to a liberally educated man; for Latin was the universal vehicle of intercourse, both written and oral, among liberally educated men of different nations.

97 And this brings to view another way, in addition to those already mentioned, in which the study of the Latin language connects us with the general course of European civilization. For Latin was, for all literary purposes, as much the language of all Europe during the middle ages, as it was of Rome at the time of Augustus. Divines, Jurists, Philosophers, Historians, Statesmen, Critics, Commentators, used no other language, till modern times: and though the style of the writers of the middle ages is so inferior to that of the classical times, that it can no longer supply us with models, the train of thought is often full of interest and value. The study of the writers of the middle ages is not to be spoken of as a part of our permanent classical studies. But these writers offer very important subjects of study to those who in various ways pursue their researches beyond the boundary of our permanent studies.

98 The general practice of writing Latin which gave rise to such works as I have just referred to, no longer prevails. Nor is the Latin language now the means of intercourse between strangers. So far as Englishmen are concerned, the wide difference which has been established between their pronunciation of Latin and that of all other nations, has made it difficult to use the language for such purposes, even in cases of necessity. The means at present employed for social and literary communication among persons of different nations are modern languages; and these are learnt with a view of speaking and writing them so as to answer the purposes of such intercourse; but Latin is no longer learnt with a view of its answering

such purposes. To write Latin is now no longer an art of social intercourse, but a literary exercise. It is an accomplishment, however, which very naturally grows out of and follows upon an intimate acquaintance with the best Latin Authors. A student who is familiar with the most elegant and expressive phrases which the Roman writers have employed upon various subjects, will probably be able to find combinations of them by which he may express his own meaning, or that of English Authors, passages of whom he may wish to clothe in a Latin dress. In this way, writing in Latin or translating into Latin, is both a test and a discipline of Latin scholarship. And the art has held this place during every age of the civilized European world. To appreciate and sympathize with the difficulties and triumphs of such a task, is one of the characters of a person who has imbibed the traditional spirit of European education; and the practice of writing Latin, extended so far as is requisite for this purpose, is one of the permanent portions of a liberal English education.

99 The writing of Latin verse has long been one of the usual portions of a classical education in England, especially as conducted at the great classical schools which have flourished among us for so many generations. This practice is in some measure recommended by the same reasons as the writing of prose Latin. A student will have his attention sharpened with regard to the turns of poetical expression and the rules of versification of the Latin poets, when he makes it his habitual business to imitate them; and he will thus become more familiar with their beauties, at least with those which he especially makes his model. It has often happened among Englishmen that the habit of writing Latin verse has been retained through all the distractions and occupations of a life of active business and elevated office; and has thus kept alive

the sympathy in classical literature which belongs to a liberal English education. Where the student's other pursuits allow sufficient time for the cultivation of this accomplishment, it adds much to the completeness and elegance of his Latin scholarship; especially if his mind have an aptitude for such poetical exercises. But on the other hand, it is to be recollected that the accomplishment of writing Latin verse with a considerable degree of elegance, does not necessarily or universally imply the faculty of writing correct Latin prose, or even of translating Latin into English correctly. A facility and skill in writing Latin verse are acquired by a special practice in that employment; and this practice does not discipline the student effectually in a general knowledge of the language. In short, a person may write Latin verses well, and yet be a very indifferent Latin scholar:—unacquainted with Latin literature in general, and liable to gross mistakes in translating Latin authors. This being the case, it is evident that the writing of Latin verse ought to come after the interpretation of Latin authors and the writing of Latin prose, in the order of classical study. After a due degree of proficiency in the latter two branches of scholarship has been secured, the first may be very fitly cultivated as a supplementary grace. But to make the writing of Latin verse a primary part of classical culture; and to exercise the student abundantly in this, while the writing of Latin prose, aud even the intelligence of the Latin language itself, are comparatively neglected, is to pervert this part of education. So cultivated, the Latin language no longer answers those purposes which we have assigned to it, as an element of a liberal education. So cultivated, the Latin language is far from holding its proper place as a part of the education of Englishmen.

100 Some of the same reasons which exist for practising the writing of Latin prose, exist also for

writing Greek prose, or for translating passages of English or Latin into Greek. Such a practice fixes the attention upon the forms of expression used by Greek authors, and makes students familiar with those passages which they make their models. But, on the other hand, there is not the same reason for acquiring a familiar use of Greek as there is of Latin: for Greek is not, and never has been, a language of familiar use among scholars and men of letters. The writing of Greek is, in a far greater degree than the writing of Latin, a mere literary exercise; a trial of skill, like the imitation of the style of a standard author in our own language. As writing Latin verse ought not much to occupy the student's time, till a skill in writing Latin prose is secured; still less ought the writing of Greek prose to hold a leading place in the classical student's employments. This exercise may perhaps come with advantage at an advanced period of the progress of a scholar of eminent aptitude; but it cannot be considered as at all essential to the character, even of a good Greek scholar. Many, perhaps most, of the more distinguished Greek scholars who have existed, would probably have failed in an attempt to write Greek well. It is possible that practice directed to this special point may enable young students at the present day to perform such tasks with surprizing correctness and ingenuity: but such practice can hardly form a large part of the general course of classical teaching, without leading to losses which far overbalance this gain. It is almost inevitable that in such a course of instruction, the far more valuable object of attaining a real and complete acquaintance with all the best classical authors must be abandoned, as well as the possession of an easy and correct Latin style: for if the possession of a Greek style be aimed at, it must almost inevitably become the student's main object, in consequence of the great attention which it will require.

101 We may make nearly the same remarks with regard to composition in Greek verse, which we have made respecting composition in Greek prose. It is very likely that an accomplished Greek scholar may, by practice, pursued through a love of the language, and of its best models of excellence, acquire a habit of successfully imitating those models; and, especially, some one particular author, or class of authors. He may, for instance, succeed in expressing the thoughts of modern dramatic writers in an imitation of the language of the Greek tragedians. The performances of some modern scholars have shown that an extraordinary degree of success is attainable in such exercises. But it does not appear judicious to make such performances an essential part of Greek scholarship; or even a necessary test of an accomplished Greek scholar. If they are so treated, they are likely to draw to them a disproportioned amount of the student's time and attention; and, however completely such an accomplishment may be acquired, it does not imply any profound or extensive acquaintance with Greek authors in general. We may even add, that this accomplishment may he pursued in such a manner as to direct the student's labours from good Greek authors;—when, for instance, the faculty is cultivated by studying rules and collections of phrases made for this purpose; or, by imitating previous imitations which we conceive to be remarkably successful. Such modes of classical study are very unworthy of being parts of a Liberal Education.

102 Without pretending to define with any exactness the amount of attention which may advantageously be given by the classical student to those higher classical accomplishments;—Greek prose and Latin and Greek verse composition;—we may say, in general, that they are the higher accomplishments, and not the essential instruction of the scholar. A person may be

educated in the highest degree without possessing these; for no man can possess all accomplishments. And to sacrifice to these that which is essential to a good education,—an exact and extensive acquaintance with the classical authors in their original languages,—is to deprive our education of real meaning and value. It is to sacrifice the substance of a good classical education to a very shallow semblance of superiority; for though a scholar who has been practised in these accomplishments, may seem, to an ignorant spectator, to be superior to the great scholars of former times, who did not possess them; any one really acquainted with the study of languages knows that this seeming is altogether illusory. The performance of such exercises may show that the modern scholars can do what the good scholars of former times could not do; but it does not show that he can do what they could do; or that he knows what they knew. The substitution of such exercises for general scholarship is the corruption of classical education; as it would be the corruption of gymnastics to substitute some practised feat of agility for a general discipline of wind and limb.

103 I have stated Latin to be a more important element of a liberal education than Greek. To this it may be objected, that the Greek literature is of a higher character of excellence than the Roman;—that the minds of the Greeks were more thoughtful, more acute, more refined, more poetical; and that the Romans, in their literature, were little more than imitators of the Greeks. To this we should reply, that the peculiar power and character of the Grecian intellect and genius were, indeed, among the principal reasons which made the literary productions of the Greeks the standards of excellence, and the subjects of study for all succeeding ages; and that Latin literature very probably owes much of the notice it has drawn, and the influence it has exercised, to the merits which the

Romans derived from their Greek masters. And this superior beauty and originality of the Greek writers is a very sufficient reason why any scholar may prefer them as the subjects of his own private study, and give more attention to them than he would otherwise have done. But this relative superiority does not deprive the Latin literature of its positive place in a liberal education; nor destroy the force of the reasons which render a sound knowledge of the Latin language, and a familiarity with the best Latin authors, necessary attainments of a well-educated man. The extended and more profound study of the Greek writers, which their greater beauty and originality may very naturally procure them, is something beyond the common course of education. It is rather a result of individual taste, than a rule for general culture; rather a part of the studies of the man, than of the business of education. It is absolutely necessary in education, to give so much time and attention to the Latin language, that we cannot give to Greek a greater amount of these, in proportion to its greater merits as estimated by its admirers. And to preserve this proportion by diminishing the amount of time and attention given to the Latin, is to do homage to Grecian genius, by making the most important part of our classical education worthless.

Sect. 8. *Of the Value of Permanent Studies.*

104 Perhaps some persons may object in general to our assigning so prominent a place in a Liberal Education, to what we have called Permanent Studies: that is, to certain fixed specimens of solid reasoning, and models of literary excellence. They may say, that the mind, thus bound to certain predetermined subjects, will become narrow and servile;—that study, thus bestowed by successive generations on subjects authoritatively fixed, leads to a stationary and com-

mentatorial literature, like that of the commentators on Aristotle, in the middle ages;—that the essence of mental activity consists in advancing from point to point, and not in clinging blindly to established points;—that the study of fixed subjects pursued in a prescribed manner, can do no more than fill the mind with certain conventional forms, and can produce no real education.

105 This, and much more of the same kind, may be said; and the reply to such remarks is so important in its bearing upon the subject of Education, that in stating it, I would beg the reader's especial attention. I reply then, that by the importance which we assign to Permanent Studies, we do not make our education stationary and unprogressive, because, along with these studies, we recommend also Progressive Studies, in which the subjects taught are brought up to their most recent condition; and the books on which our students are employed, are the Capital Works which mark the most recent epoch in each branch of literature and science. But in order to prepare the student for the reading and understanding of such works, there is a necessity for Permanent Studies, by which the habits of following scientific reasonings, and interpreting classical writings, may be formed and fixed. The progress of the human mind is, undoubtedly, one of the main objects of Education; and the progress of the individual mind, as a participator in the faculties and fortunes of the mind of man in general: but in order to present and future progress, an acquaintance with the past is requisite. In order that we may share in what men are doing in the world of intellect, we must share in what they have done. In order that we may walk onwards, we must feel the ground solid under our feet. Considered with reference to mental progress, a large portion of education is preparatory only; but it is an indispensable preparation. Any attempt to put aside

this permanent preparatory portion of education, would make our education worthless. It would make our real progress impossible. The past alone can make the present and the future intelligible. If we reject the discipline of our Permanent Studies, we may indeed still learn to use the phrases in which men express the recent Progress of science or literature, and may flatter ourselves that we share in the superiority which such a Progress bestows; but, in reality, such phrases have for us no real meaning. They are mere empty forms of language. The charge of filling the mind with conventional forms, void of real value and efficacy, lies far more truly against those who pretend to teach new truths to persons incapable of understanding them through their want of ordinary culture, than to those who dwell long upon those parts of human science and literature which have, in all ages, been found to be the most effective means of cultivating the intellect and the taste.

106 For in fact, (and this brings us to some of the other forms in which the objection is put,) the mind is not narrowed or made servile, by dwelling long upon models of real excellence, whether literary or intellectual. Works, which have acquired a sway over men's minds, and retained it for ages, by their truth, by their fidelity to the deepest and most universal parts of men's nature,—such works may continue to occupy the time and thoughts of our students, without giving ground for any fear that their minds will thereby become inert, or frivolous, or formal. We are to recollect that, when we insist upon Permanent Studies, we do not mean, by such Studies, any merely conventional selection of books or subjects. We take our selection from the universal voice of civilized man. The objects on which we permanently dwell are Homer, Æschylus, Sophocles, Herodotus, Thucydides, Demosthenes, Terence, Virgil, Horace, Cicero, Livy, Tacitus. We

shall hardly be told that men's minds will become servile and narrow by dwelling upon the works of these writers till they fully understand them.

107 Even when such authors are studied and pondered over with the help of commentators and annotators, it does not appear likely that any intellectual harm will arise from such a commentatorial literature, if the commentator be really read in subordination to the author, which we require and assume. And in the same manner with regard to mathematical subjects; we need not be afraid that men's minds should become inert or narrow by dwelling upon the books of Euclid, or Archimedes, or Newton, till they fully understand them; and if, for this purpose, they find some comments and explanations necessary, it would be very foolish to take alarm at the sound of the word "commentator." We know that in these authors there is an irresistible reasoning, leading to solid truth, which may be understood by reasoning men, and which, being understood, must be valued as truth. If the commentator helps us, then, to understand the reasoning, and to perceive the truth, he renders us a good service. He puts us in possession of some of the indestructible intellectual possessions of our race; and thus aids us in our purpose of feeling our participation in the universal reason of mankind, and in its results. If, in doing this, we dwell long upon the subject, it is not that we are thus acquiring stationary habits of mind; it is that we are learning that, without which we must be for ever stationary. It may be that in those abstruse studies we advance slowly to the full apprehension of the cardinal truths there exhibited; but till we have apprehended them, we cannot really understand anything which lies beyond them. If we are so slow as to need a long time, or the aid of commentators, in order to understand the ancient reasonings, we cannot make ourselves quick by passing them

by, not understood. If we cannot understand that which wise and thoughtful men have written and have understood in the ages which have preceded us, we have not unfolded in us that intellectual element, in virtue of which men so reasoned. Our reason is not educed; we are, in that respect, uneducated.

108 And when the study of works of reasoning, by the aid of commentators, is likened to the study of Aristotle in the middle ages, we are to recollect that, in those periods, the works of Aristotle were studied, not as reasoning, but as authority. The commentators were employed in interpreting his dogmas, not in explaining his arguments. Aristotle himself is remarkable for the want of real mathematical insight, in the mathematical illustrations which he has introduced; and when the sway of that which passed for his philosophy was overthrown, the main instrument in the reform was, that mathematical education of man which we are here recommending, and which can only be carried on by the study of mathematical works occupying a permanent place in education on account of their real truth and excellence.

109 We have already mentioned the fear which, in speaking of education, men sometimes express; that fixed subjects of educational study should become an exercise for the memory, rather than for the intellect;—the forms of speech, which seem to contain the knowledge required, being, in fact, retained by rote, and uttered with no real intelligence. We have stated that this fear is one with very little foundation; since one or two very simple questions will at once ascertain whether the student really understands the language which he pretends to translate, or the reasoning which he pretends to give. We may add, that if, in such employments, especially with slow intellects, memory and repeated attention come in for a share of the student's success in performing his task, we are not on

that account to suppose that the reason is left unculti vated. The truth is, that, in most persons, it is only by such exertions of memory and attention that the reason can be cultivated. To overcome the difficulties of a long train of mathematical reasoning, is one of the best ways of cultivating the reason; but to do this, is, with most persons, a matter of time and thought; and of memory also; for while the student is attending to one part of the chain, he loses, for the moment, his clear apprehension of the other; and only bears it in mind as what he had before proved. But by successive efforts of this kind, the whole becomes clear, and the reason acquires the power of grasping the whole at once. And thus the reason is educated by means of the memory. And the same is the case, not unfrequently, with the interpretation of difficult passages in ancient authors. Such interpretations, accepted at first upon authority, and retained in the memory, are afterwards made more fully intelligible by similar examples, till at last they are seen to belong to the genius of the language. Such exercises of memory and attention are the necessary means of intellectual culture. It is, no doubt, possible that the comment or the interpretation may be lodged in the memory, without producing any effect upon the reason; and in this case, it is an acquisition of small value. But then, in this case, it is also possible that the mind may be one to which it is difficult to impart anything much more valuable. The reason may be so inert and obscure in its operations, that the education of that faculty cannot proceed very prosperously by any process. The exercise of the memory may lead to the best developement of the mental faculties which their native constitution will permit. The case in which it is most likely that the employment of the memory will lead to no real education of the mental faculties, is when the memory is employed principally, not upon

old, but upon new points of literature and science: for, in such a case, the traditional knowledge which alone can make the new advances fully intelligible, being wanting, the phrases which express the novel views, and the processes which are supposed to replace the ancient demonstrations, will really be mere formalities;—extraneous matters contained in the memory as a repository, but not assimilated by mental operations, and converted into intellectual nutriment.

110 The opposition between information merely accumulated in the memory by labour, on the one side; and acts of understanding and reasoning on the other, is often dwelt upon as very important in directing the conduct of education; and no doubt is so. But, as we have seen, the relation of these operations is misconceived, if it is conceived as a mere contrast: for the labour of attention and the exercise of memory are the means by which we form active habits of reasoning and expressing reasons. Juvenile views of education are especially apt to fasten upon and to exaggerate this contrast. Schoolboys and very young students, and those of them especially who are most impatient of steady thought and continued labour, find an easy gratification of their self-complacency in identifying all intellectual labour with the want of originality and vivacity of mind. It is their practice to affix terms of grotesque contempt to the mental habits which they thus wish to depreciate: and some of these terms are sometimes used indiscriminately for all exercise of the memory, whether in its necessary educational functions, or in that forced preparation for examinations which is, as we shall see, a pernicious vice in educational systems. For instance, the former as well as the latter is sometimes, by thoughtless people, called *cramming*. Such terms, once put in circulation, exercise an almost unbounded sway over the young men's minds, and deprive them of the use of reason on these subjects. The

contemptuous phrases so used seem to remove at once all intellectual dignity and value from the subject of such satire, in the eyes of the young satirist. We may pass by this schoolboy trick, as too shallow to cause any confusion. But that it can succeed even with boys, shows how necessary it is to estimate duly the office of labour, industry, and attention, in the business of education.

111 Even with men, as well as with schoolboys, contempt and ridicule, directed towards one or another part of the methods of education, may interfere with a sound judgment on the subject. The methods of education which have been in use through all ages have had their technical terms, rules, and customs. All methods which are to be applied to great numbers of learners by ordinary teachers, must have such technicalities. But all technicalities, detached from their use and meaning, are easily made objects of ridicule and contempt. The technicalities of education, which are rendered familiar to the boy before he can understand their purpose, may easily provoke a smile in the man; especially if, in a more advanced season of life, he finds that his understanding retains its hold of the subject in other ways than by means of these technicalities. Hence one man speaks with ridicule of the Rules of Arithmetic as commonly given; for instance, the Rule of Three Inverse, the Rule of Five, Alligation, Barter, and the like. Another laughs at the technicalities of the common grammars; gerunds in *di*, *do*, and *dum;* supines in *um*, and *u;* deponent and impersonal verbs; and so on. We are not at all concerned to maintain that these are essential or important parts of education; but that which it is necessary for us to recollect is, that some *such* technicalities as these are essential parts of every general method of education;—that such technicalities are not at all necessarily useless because they do not explain themselves, or because they depend upon

views which are fanciful, or even false;—and that in the course of education, boys must often learn and apply technical phrases and technical rules, before they can understand them. It usually happens that boys who are made to learn and apply rules, begin to see the meaning of the rules, when their habits of thought are further unfolded; and though this may lead their friends or themselves to suppose that the rules at first were of no value to them, this supposition would be a great mistake. Boys can easily learn to apply rules, before they can easily learn to understand them; and are likely to understand them the better, from being already familiar with the mode in which they are applied. The memory may be brought into extensive action, before the understanding can; and may be made to assist powerfully in unfolding the understanding, by supplying it with materials to operate upon. If no boy was allowed to learn anything of which he did not, at the time, understand the reason, no general system of teaching could be applied; the progress of learners must be slow and irregular; and after all, there is no ground to believe that boys so taught would understand their rules better than those who begin by applying, and end by understanding the reasons of them. For it can admit of no doubt that to understand the rules and their reasons *at a subsequent period* is a necessary portion of the system of education to which they belong. To make the student understand fully both the rules of arithmetic and grammar, and their reasons, is an important step in that higher education which succeeds the education of the schoolboy. But on this ground, no valid argument against any particular form of such rules can be drawn from the ridicule to which they are subject, as being unintelligible to the boys who use them.

112 Nor is it, as we have said, any sufficient condemnation of such rules and technical expressions, that

they are founded on fanciful, or even false opinions. It may be true, that supines are mere nouns; that deponents are really passive verbs; and the like: yet no disadvantage arises from the use of such terms as *supines* and *deponents* to mark those cases. Or rather, it would be a great disadvantage that the learner should not know the meaning of such terms; so as to be able to understand those grammatical discussions in which they are employed. It may be that many of the Rules given in the common books of Arithmetic are arbitrary and superfluous, and that they might all be reduced, with advantage, to a smaller number. As they are given, they serve at least to classify and multiply examples of numerical operations, and are themselves multiplied examples of the simpler and more comprehensive principles to which the student is afterwards to be led, when his mind is matured and prepared for dealing with such principles. The boy learns rules as rules, which he can do easily and well; and the youth learns reasons and principles all the more easily, because the process of learning rules has preceded. But these considerations belong rather to the mode of teaching, which will be a subject for our attention hereafter.

113 It may be said that by thus defending and commending the use of the rules and technicalities belonging to the old methods of teaching, we do not adequately appreciate the great recent improvements in education; the new views of grammar and of the relations of language, and of the foundations and reasons of arithmetic, algebra, and geometry;—and the simplicity and clearness which have been introduced into the teaching of these subjects. To this I reply, that the new views of the fundamental principles, both of philology and of mathematics which have recently been published, have been, as I believe, very efficacious in promoting a better understanding of those subjects; but that they have not produced this effect merely in virtue

of their being better views, superseding worse, but in virtue of their being the results of the activity of thought and research of the Teachers. For though technical phrases and rules and maxims may be very useful instruments of education before they are fully understood by the learners, they cannot be used with any great efficacy for such purposes, except they are understood by the *Teachers:* and the new views of recent speculators, regarding language and antiquities, geometry and algebra, have been the results of their endeavours to ascertain fully the significance, truth, and foundations of the doctrines which the traditional forms of classical and mathematical literature take for granted. Precisely because the new doctrines are expressions of advances towards clear insight and full conviction in the minds of the Teachers, they are better doctrines *for them*, and enable them to teach better, than, without such an intellectual movement going on among them, they could have done. Such a mental advance will make their instructions both more rationally sound, and more zealous and persevering, than they would otherwise be. I believe it will be found that this is the source of any greater effectiveness of modern systems of teaching classics and mathematics which may have occurred, rather than any virtue inherent in the new methods themselves. When the expressions which convey the new views have come, in their turn, to be familiar technicalities, dimly understood; and when the new methods are applied by a number of teachers, of ordinary zeal and intelligence, to learners of all variable degrees of capacity, it is probable that the average success of the new methods will not be much greater than that of the old ones; and certainly it does not appear likely that the new methods will produce better scholars and better mathematicians, either in the most eminent cases or on the average, than the old methods produced. There appears to be no disadvantage, but rather a con-

siderable means of instruction, in having our education consist of ancient methods, which though sound and good, may be simplified, extended, and clothed in a deeper significance by newer methods which the teacher himself suggests. The new method comes as a commentary upon the old; and gives to the education so conducted the combined advantages of the stability of a fixed system, and the vivacity of a present reform.

114 It is, therefore, with no want of admiration for the subtilty and comprehensiveness of intellect which has been shown in many recent views of Algebra and Geometry, that I recommend our adhering to the ancient methods of treating such subjects, so far as the general purposes of a liberal education are concerned. Such views are truly admirable, as corrections, and extensions, or it may be as the antithesis of the established and traditional modes of treating the subjects; but if they were to become themselves established and traditional, they would be (as I have already endeavoured to show) far less effective in the discipline of the reason, than the older methods; besides depriving us of the continuity of that intellectual tradition which I have already spoken of, as one of the great ends of mathematical teaching in the course of a liberal education. I recommend the rejection, in our ordinary educational system, of the many novelties in notation and expression which have recently appeared in our Cambridge Mathematical works; but I admire the mathematical talents of those who have produced these works; and I think that such speculations are both very remarkable manifestations of mathematical skill and thought, and very fit subjects of attention for our mathematical students, where they reach the higher stages of their progress.

115 There is one leading question, in such an education as we are contemplating, on which I have already spoken, but on which it may not be useless to

add a few words:—I mean, the question whether both mathematical and classical instruction should be considered necessary in the case of every student. It is sometimes said that we shall educate men better, by encouraging in each that study for which he has talent and inclination;—not tormenting the man of classical taste with fruitless lessons of algebra, or the man of mathematical intellect with obscure passages of Greek. It is said, sometimes, that by such a genial education alone, do we really *educate* the man, or *bring out* his genius;—that the seeming of mathematical prowess, or of classical learning, which we wring by force from ungenial and unwilling minds, is of no value, and is no real culture. But to this we reply, that if men come really to understand Greek or Geometry, there is then, in each study, a real intellectual culture, however unwillingly it may have been entered upon. There can be no culture without some labour and effort; to some persons, all labour and effort are unwelcome; and such persons cannot be educated at all, without putting some constraint upon their inclinations. No education can be considered as liberal, which does not cultivate both the Faculty of Reason and the Faculty of Language; one of which is cultivated by the study of mathematics, and the other by the study of classics. To allow the student to omit one of these, is to leave him half educated. If a person cannot receive such culture, he remains, in the one case, irrational, in the other illiterate, and cannot be held up as a liberally educated person. To allow a person to follow one of these lines of study, to the entire neglect of the other, is not to educate him. It may draw out his special personal propensities; but it does not draw out his general human Faculties of Reason and Language. The object of a liberal education is, not to make men eminently learned or profound in some one department, but to educe all the faculties by which man shares in

the highest thoughts and feelings of his species. It is to make men truly men, rather than to make them men of genius, which no education can make them.

116 But even with regard to men of genius, it is not true that they have generally been men of one kind of cultivation only, or capable only of one kind of intellectual excellence. The case has been quite the reverse. During the middle ages, and down to the last century, the greatest mathematicians were almost invariably good classical scholars; and good scholars were almost invariably well acquainted with mathematical literature, and often very fond of it. And this connexion, in the main, has continued to our own day, so far as the mathematics and classics belonging to a liberal education are concerned. Not to speak of living persons, whose career at Cambridge might be adduced to prove this, the greatest Greek scholar of the last generation, Porson, was fond of Algebra, and was a proficient in it;—and if we run over the highest wranglers of the last sixty years, we find at every period, men known to be well versed in classical literature, as Otter, Brinkley, Outram, Raincock, Wrangham, Palmer, T. Jackson, R. Grant, and many others.

117 Indeed, there can be no doubt but that the clearness of mind and vigour of character which make a man eminent in one line of study will also enable him to master the elementary difficulties of another subject, if it is fairly brought before him as something which must be done; although, if it be presented to him as a matter of choice whether he will make the attempt, caprice, fastidiousness, and the pleasure of doing what he can already do easily and well, may make him turn with repugnance from a subject in which he has not learned to feel any interest.

118 To which we may add, that to be able to command the attention and direct the mental powers, so as to master a subject which is not particularly

attractive to us, is a very valuable result of mental discipline. Whatever acuteness or sagacity a man may have on a special subject, if he be so helpless or so fastidious that he cannot employ his thoughts to any purpose or any other subject, we cannot consider him as a well cultured person: nor ought we to frame our education so as to give to men such an intellectual character.

We come back therefore to the doctrine stated sometime ago, that mathematical and classical studies, both Permanent and Progressive, are the leading and essential parts of a liberal Education for Englishmen. We have already, in some measure, pointed out the kind of Mathematics and of Classics which are to form the matter of such teaching as we contemplate; but we must now speak more at length of the methods according to which this teaching is to be conducted.

Chapter II.

ON THE METHOD OF TEACHING IN CLASSICS AND MATHEMATICS.

Sect. 1. *Of College Lectures and Professorial Lectures.*

119 Having considered in some measure what is to be taught to students, as the mathematical and the classical part of a liberal Education, I now proceed to make some remarks on the manner of teaching. Different methods may be adopted for this purpose; and these differences of method lead to such differences of character and result in the education so given, as are deserving of our very serious consideration.

The Classical and Mathematical Education, of which we have to speak, may be considered as consisting mainly in that given at School, and that given at the University. And first, I shall speak of Classical Education.

120 The teaching of Latin and Greek at school is necessarily in a great measure oral. After preparing himself by the aid of his dictionary and grammar, the boy *says his lessons*, in which he *construes* a portion of Latin or Greek aloud, and then, if required, *parses* some parts of it, being often corrected and informed by his master in points where he is wrong or ignorant. This being done by boys collected in *classes*, each boy is instructed, not only by what is said to himself, but also to his class-fellows. He may profit by the notice taken of their errours and defects, as well as of his own, and by their knowledge of what he does not know. Besides this, he is interested by the community

of interest which they all have in the same object, the mastery of the difficulties of the Latin and Greek authors; and if he be of an ambitious temper, he is stimulated to exertion by the desire of excelling his companions, or at least of not being left behind by them. This living personal intercourse of the scholars with the master and with each other, maintained by a scheme of daily and hourly occupations entirely subservient to it, takes a strong hold of the schoolboy's mind and character; and makes the season of schoolboyhood a most important part of education; perhaps even more important than the subsequent season of university life.

121 But how great, and of what kind, shall be the influence of university life upon the student, must depend upon the system of teaching existing in the University; and especially upon this point:—whether the system does or does not include any habits which bring the students into constant oral intercourse with the teacher in the presence of each other, such as takes place at school. Such habits have constantly prevailed in the Colleges of the English Universities. In these institutions, Classical Lectures are given; of the nature of Lessons at school, although dealing with more comprehensive and profound views of language and antiquity. The Tutor assembles his Pupils in his Lecture-room, at stated periods; and, requiring them in turn to consider portions of the classical subject selected for their study, he corrects their mistakes, and gives them information connected with the subject as supplied by his own reading and reflexion. And the same process takes place in Mathematical studies, or at least in the most elementary of such studies. The pupil is required to prove orally a proposition in Euclid or in Mechanics, and is interrogated as to the connexion of the steps of the proof, or as to the application of the proposition to a particular case; while

the lecturer, by his comments and additions, analyses or extends the propositions beyond the form which they possess in the text book, or brings new problems before the pupil.

122 Although, in such College Lectures, the views may often be as comprehensive and profound, and the learning as extensive, as are found in the Lectures of Professors in other Universities, it has been the practice, in recent discussions on this subject, to distinguish between College Lectures and Professorial Lectures: and the distinction is an important one, if it be understood as implying that, in Professorial Lectures, the student is a listener only, and is not called upon to show, by taking any part in the lecture, that he is a prepared listener. The distinction being thus understood, if we inquire whether College Lectures should be superseded by Professorial Lectures in our University, we cannot hesitate to reply, that such a change would be a grievous damage to English Education. Without at all denying the value of Professorial Lectures for their own particular purposes; (and for these purposes they are largely delivered and attended in the English Universities) such Lectures cannot take the place of College Lectures, so as to produce their beneficial effects. These effects are of the same kind as those which we have already mentioned. The hold which studies so pursued obtain upon the student's mind and character, in virtue of their forming part of a daily employment, which brings him into intercourse with his tutor and his fellow-students, placing before them a common subject of mental activity, disclosing to him their characters, instructing him both by their mistakes and by their knowledge, and impelling him to study by the necessity of being constantly ready with his own share of the work. In Professorial Lectures, on the other hand, the student is supposed to be induced to listen to the Lecture by the solid rea-

soning, extensive learning, new views, or peculiar eloquence of the Professor; who follows out his speculations, unfettered by the necessity of connecting his exposition with the imperfect learning of his hearers. To return to the distinction of educational studies, of which we have spoken already, Professorial Lectures are especially suited to those which we have called Progressive Studies, in which the student is to be instructed in the views at which his most active-minded contemporaries have arrived. But with regard to Permanent studies, the impression which, in a Liberal Education, they ought to produce upon the mind, is eminently promoted by College Lectures such as we have described; and can, by no means, be derived from Professorial Lectures alone.

123 There are some difficulties which belong especially to College Lectures; or, rather, there are some difficulties which belong to all higher teaching, and which become apparent in College Lectures; while they are masked in Lectures when the Professor alone speaks. All teaching of the higher portions of educational subjects requires a knowledge of the lower portions; thus, as we have seen, the Classical teaching, which takes place in College Lectures, requires the pupils to be able to construe the Latin or Greek author who is the subject of the Lecture. This previous knowledge the pupils of the English Colleges ought to acquire, and, in a great degree, do acquire, at school. And the principal remedy for any defect in such preparation which may exist generally, is an improvement in the teaching of Latin and Greek at the schools. It seems also highly desirable, in order to render the teaching of our Colleges really efficacious, that pupils, in entering them, should be subject to an examination, by which it may be ascertained that they really have such a knowledge of Latin and Greek, (and also in elementary Mathematics) as may enable

them to take their proper part in College Lectures. They ought to be able to construe at least the easier authors; and, with a little preparation, to construe them correctly and well; in order that they may join in the Lecture with profit and convenience to themselves and their companions. It will be impossible to carry on the teaching of a College with spirit and effect, except this condition be insisted on; and if it were insisted upon by Colleges in general, there can be no doubt that the general standard of attainment of boys leaving school would be brought up at least to this point. For the length of time which boys spend at school, before they go to College, is ample and abundant for their acquiring this degree of proficiency under moderately good teaching. So long as youths who cannot construe Cicero and Xenophon are admitted into our Colleges, the teaching of their lecture-rooms must necessarily want the flow, and interest, and dignity which would most fully fit it for its object.

124 So far as the easier and earlier subjects of College teaching are concerned, this step, the insisting upon an adequate previous preparation of the youths who come to College, is the true remedy for the difficulties of the case; and no other can really avail. But when some considerable progress has been made by a body of pupils in the subjects taught at College, wide differences of proficiency soon make their appearance; and such differences are glaring, even from the first, when no sufficient test of preparatory proficiency is applied. These differences form a difficulty in College teaching; for when they exist, the Lecturer must either leave behind him, in his progress, the most slow and ill-instructed of his class, or he must retard the natural pace of the active and intelligent students. Much may be done to palliate this inconvenience, without breaking up the class. Pupils who come to College ill prepared, or of dull intellect, may be assisted by Private Tuition,

employed in subservience to the College Lectures. Or, while in the lecture-room all go on with the general business of the course, the more able members of the class may, in addition to this, be engaged in tasks proposed to them alone—translations or compositions, theorems or problems;—while their more tardy companions are barely travelling onwards with them through the subject. But this process, if carried far, destroys the community of study in the class. In a large body of pupils, the inconvenience may be remedied by dividing them into subordinate classes, according to the degree of their proficiency, and providing lecturers for each sub-class. And so far as this course is practicable, it completely meets the difficulty. It is, however, still to be recollected that it is desirable, as far as possible, that the subjects in which the higher and the lower students are engaged, should form part of one general course of learning; so that the pupil who has fallen behind in his progress shall not find himself turned into a path in which idleness and delay are specially provided for; but shall be able, at any future time, when his exertions are more effective, to recover his lost ground, and resume his place with the more forward students.

125 The size of the classes which are thus divided by the difference of capacity and diligence in the pupils, is a question which must be determined, in a great measure, by the nature of the teaching which the subject requires. The higher we advance, especially in mathematical studies, the more widely does one man's intellect and power separate itself from another's. In the highest subjects, therefore, the number of men who can be profitably taught together in one class must necessarily be very small; perhaps not more than three or four. But in the earlier steps of College teaching, for which, as we have said, the pupil ought to bring from school an adequate preparation, the classes may

be of considerable size ;—perhaps thirty, or even forty, is not too large a body. The extended feeling of a common interest in the subject ; the manifestation of the varieties of intellectual character and habits among the pupils ; the larger stock of knowledge which they probably possess among themselves, are advantages which may be set against the disadvantage obviously belonging to a large class ; namely, the smaller share which each pupil must have of the Teacher's attention and of the work to be publicly done in the lecture-room.

126 Though College Lectures are, as we have seen, quite necessary in order to keep up and carry on that real knowledge of Latin, Greek, and Mathematics, which are essential parts of a Liberal Education, lectures of another kind, which we have distinguished as Professorial Lectures, have also their place, and a very important place, in such an Education. In such lectures the Lecturer presents his subject in some form which aims to be instructive or striking, by containing the results of extensive reading and careful thought, or by exhibiting lucid arrangement, or difficulties solved, or new views ; or, in the material sciences, by presenting experimental exemplifications and illustrative apparatus. Such lectures tend to make the hearer feel that he is a sharer in the present as well as the past progress of literature and science ;—that he is a citizen of an intellectual republic, which has the advancement of knowledge, and the discovery of truth for its constant aims. The charm which belongs to such lectures, when they are delivered by able and diligent professors, will very often take a strong hold upon the mind of the intelligent student ; and impart to him a fervour of thought and a largeness of comprehension, which cannot be communicated in any other manner. Such, for instance, appear to have been the lectures of Niebuhr upon Roman History and Antiquities. To attend such

lectures, is an event which stimulates and expands, in an extraordinary degree, the minds of the more intelligent students: and to have the opportunity of attending such, is a very happy circumstance in any one's university education.

127 The defects of Professorial Lectures, are, that courses of such Lectures, delivered by any, except very able and diligent professors, can convey no knowledge which is not to be found, and in many cases in a better form, in published books; and that they convey little knowledge to unintelligent or inattentive students, such as must occur in every large body of young men. The first defect is in a great measure compensated by the feeling of sympathy in a common intellectual object, which a large lecture-room inspires, and by the advantage of receiving that view of the subject which a thoughtful man has derived from all that has been done up to the present time. The possibility of those who profess themselves students not profiting by instructions so given, universities have sought to guard themselves against by instituting examinations which shall test the student's proficiency in the educational studies to which he is directed.

Of examinations, and their conditions, I must speak at some length; but I find myself previously called upon to make a few further remarks upon College Lectures and Professorial Lectures.

Sect. 2. *Of Mr Lyell's Remarks on the English Universities.*

128 The preceding pages express opinions, upon the subject of College and University teaching, which I have, for the most part, already published. When these pages were already written, I found that the opinions, as formerly published, were assailed in a work in which I had never imagined I should find them discussed, Mr Lyell's *Travels in North America*. Having

accidentally stumbled upon this attack, in a work so popular in its form and matter, and giving in its title so little warning of its controversial character, it may serve to illustrate the subject if I briefly notice Mr Lyell's criticisms.

129 Mr Lyell refers to that part of my former publication in which I gave, as appeared to me, strong reasons why Permanent Studies (as I have here termed them) should occupy a prominent place in a university system; and why College Lectures, as the best modes of teaching these studies, are highly valuable parts of our education. To my arguments in favour of Classical and Mathematical Studies, he gives his assent and applause; but he blames me, because I have, as he says, "defended the exclusive monopoly enjoyed by these subjects, in the education of young men at Oxford and Cambridge, from the ages of eighteen to twenty-two." In support of this charge, he quotes passages in which I have argued that "philosophical doctrines" cannot supply the place of mathematical and classical studies in University Education; an opinion which he had seemed himself to adopt in the preceding page, when he said that my arguments on this subject are "unanswerable, and enforced with great eloquence and power." I am sorry that my powers so inadequately responded to my intentions, when, a few pages earlier (p. 41), I tried to show, what I asserted, that though the progressive sciences "cannot do the work of mental cultivation, they are highly valuable acquisitions to the student, and may very beneficially engage his attention during the later years of his University career." I urged, in support of this view, arguments of the same kind as those which I have already employed in the present volume. I said, "A considerable general knowledge of the modern progressive sciences is as requisite to connect the educated man with the future, as a thorough acquaintance with ancient literature is

to connect him with the past. Except he knows what has been done and is doing, in the way of extending our knowledge of the earth, its elements, and its inhabitants, how can he judge what are the probable prospects of our knowledge? And if he be indifferent to this, how can he feel that interest in the future fortunes of his race, which becomes a person of his lofty extraction?" This, and more to the same purpose, I have said, in passages close to those to which Mr Lyell refers, when he charges me with defending the exclusive monopoly enjoyed by Classics and Mathematics in the education of young men at Oxford and Cambridge. Such passages in my book may very easily, and I dare say, very truly, appear to Mr Lyell too feeble and narrow for the dignity of the subject: but such passages, I cannot but think, ought to have prevented Mr Lyell from accusing me of writing to the very opposite effect. However inadequate these arguments in favour of including the progressive sciences in University Education, may have appeared to him, they were at least arguments for such inclusive system, and not for a monopoly which excluded those elements. Yet it would seem that I have written so ill on this subject, that, not only I have not satisfied Mr Lyell, but have even failed to make him comprehend what it was that I wished to prove.

130 Still I cannot but think that Mr Lyell should have included in his notice such passages as the above, when he was collecting passages which, he says, "may lead us to infer that the optimism of the Master of Trinity is not of that uncompromising kind which should make us despair of his co-operation in all future academical reforms." Mr Lyell perhaps could not be expected to know that during the whole of my long residence in the University, I have been constantly engaged in urging and attempting reforms (of course in conjunction with many other persons); and that

many of these reforms, of very important kinds, have been carried into effect. But if he wished to say anything about my views with regard to the improvements of English Education, he might reasonably, I think, have been expected to give some attention to what is said on the subject in the pages from which he was quoting. And if he felt any disposition to pursue further an inquiry so unimportant to him, he might have referred to what I have written in the *Philosophy of the Inductive Sciences*, in the chapter *On Intellectual Education*. (B. xiii. c. 3.)

131 In trying to divine what it is that has so completely prevented Mr Lyell from apprehending my meaning and purpose, I can only conjecture that he has in some way established in his mind an opposition between a College System which he supposes to exist at Oxford and Cambridge, and an ideal Professorial System, which he thinks ought to be substituted in its place; and that he has selected me as the assumed champion of the side which he is resolved to assail. I can no otherwise account for the polemical attitude which he has chosen to assume towards me. For the College System which I defend, agrees with the Professorial System which he recommends, in the feature which he thinks most important, the division of departments. This division has long existed at Cambridge. The Private Tutors, and, for the more advanced students at least, the Public Tutors also, have their separate subjects. The Tutors each confine their lectures to their separate provinces, in which their favourite studies have lain; and to these they give their labour, as especially as if they were Professors of their selected subjects. We have, in this respect, nothing to prevent our realizing all the advantages which Mr Lyell anticipates (p. 221) from a "Professorial System" of which this is the essential character.

132 And, on the other hand, I cannot believe that

Mr Lyell thinks of the other general characters of an English College System, as necessarily evil; for he mentions them with apparent approbation when he finds them in New England (p. 265): namely: "a full staff of professors, with their assistants or tutors, superintending at once the moral conduct and intellectual culture of the students." Such is the scheme of our English Universities; and I do not conceive that any great advantage would be gained by calling our College Lecturers, Professors, instead of Tutors.

133 There is indeed one collateral argument of mine which appears to displease Mr Lyell in a degree to me unaccountable; and from this alone he quotes the passages which he condemns. I had stated, as one reason for the use of mathematics and classics in our education, that these subjects tend to produce deference and respect from the students towards the Teacher: since in these subjects the knowledge which the well-instructed Teacher possesses, cannot be deprived of its value by any turn of taste or any advance of discovery. Now since Mr Lyell and I appear to agree in the result of this view, namely, that mathematical and classical studies ought to be carefully upheld in university teaching, it need not have so much disturbed him that I have added this, which he thinks a bad argument, to others which he praises as good. But it would seem as if he could not read this argument with calmness: for he goes on to say; "In commenting on the above passages I cannot refrain from remarking, that if the teacher of philosophy cannot command the respect of his pupils, he must be ill qualified for his post." This is undoubtedly true. Yet still we know that there are portions of "philosophy" which undergo revolutions, and in which the teachers of systems that have thus become obsolete are no longer listened to with admiration and respect by those who have become aware of the newer views; and it

appears to me to be a recommendation of Permanent Educational Studies, that they are not liable to these revolutions: and that the students of each generation are not likely, on this account, to think slightingly of the teachers of the generation which preceded. Mr Lyell himself, indeed, thinks respect from pupils towards teachers desirable. But "no one," he says, "who is master of his favourite science will fail to inspire the minds of his more intellectual scholars with a love of what he teaches, and a regard and admiration for their instructor." This is, I think, highly probable. I am so far from doubting it, that I believe it to be true of subjects in which the supposed science is altogether empty and fallacious. I believe that not only a philosophical and eloquent lecturer on Geology or Chemistry, but that an ingenious and enthusiastic lecturer on Craniology, or Animal Magnetism, will generally inspire a large portion of his audience with such feelings. But I do not think anything worthy to be called a Liberal Education could be carried on by the operation of personal character and influence of this kind. To educate young men, we must direct the general course of the studies of all, and not merely excite the admiration and enthusiasm of a few. The deference and respect towards their teachers which such a direction of their studies supposes in the students, are maintained by the teaching of that which is in itself true and admirable, and in which he who has mastered the subject has a clear and uneffaceable superiority, which no change of current opinions can alter. And the respect and deference of pupils, so produced and so employed, appear to me, notwithstanding Mr Lyell's impatience of the statement, to be very important elements in Education.

134 Throughout Mr Lyell's remarks on this subject, there seems to prevail a confusion of two things, which any one, who has been really engaged in the

responsibility of Education, is in no danger of confounding;—the teaching of those who are eager to learn, and the educating of those who are averse or passive. Mr Lyell, apparently, has in his mind the image of a Lecture-room crowded with eager listeners; and he quite loses sight of the question, how he is to realize this picture out of a number of *given* young Englishmen. He says, A good professor will inspire his *more intellectual* scholars with a love of what he teaches, and a regard and admiration for their instructor. Granted. We know and rejoice that this is so; and that it is so, is one of the happy parts of the Educator's lot. But still to him the question will occur, What is to come of his *less* intellectual hearers? or of those who do not choose to hear? or of those who having heard a little, have no desire to hear more? I do not know in what manner Mr Lyell proposes to deal with these classes of persons; or whether he would be content to leave them to themselves. If he did so, I think he could hardly call this treatment an Education. Again, he says (p. 306), "Do not these (Classical and Mathematical Studies) belong precisely to the class of subjects in which there is least danger of the student going wrong, even if he engages in them at home and alone?" still having in his mind students who are resolved to go onwards, and are exposed to no danger but that of going wrong; whereas, as we know, the danger, with regard to many of our English youth, is that in such matters, if left to themselves, they are well content to stand still. Mr Lyell has given us his views respecting our system of Education, but he has only taken into his account the question what system is best for the best pupils. This very much impairs the value of his advice, for there we have no difficulty at all. The eager and intelligent pupils who crowd Mr Lyell's ideal Lecture-room, are those who do well in every system. They are the delight of the in-

structor's life, and the reward of our labours. Mr Lyell has a very wrong opinion of us, if he thinks we should not desire to have the whole youth of England such as his imaginary pupils;—such as, we are happy and grateful to say, a large proportion of our pupils are. But still, all are not of this kind, and the difficulties of Education arise from the difficulty of dealing with those who are of a different stamp:—the less intellectual, as I have already said, or the inert, or the frivolous. On the treatment of a body in which there is a large mixture of such characters, Mr Lyell throws no light whatever. Yet we require a system which shall produce some effect, even upon such: not, indeed, a system constructed for them alone; but a system which shall be best for *all;* bearing in mind, not only the best natures, whom it is so delightful to think of, and from whom every system brings out abundant good; but also, all the characters which that "*all*" includes, and the meaning of Education, which is, to bring out from all something good which they may have in common.

135 It is strange that Mr Lyell should, throughout his remarks on the Universities, speak as if it had never occurred to him to doubt that, if good lectures are given on the progressive sciences, and students are left at liberty to attend them, they will do so. We know that, whatever his American experience may have suggested to him, we have little reason to indulge ourselves in any such persuasion in England. The most admirable courses of lectures, containing views striking from their novelty and largeness, often fail in attracting an audience, even in populous and intelligent London; and it is to be supposed that in any University town, in which young men are collected, their love of lighter employments will prevent their crowding the lecture-room, as effectually as the occupations and apathy of the inhabitants of the metropolis. And, at

any rate, mere open lecture-rooms will not teach all students. When the lecture-rooms of the Professors in Oxford and Cambridge, a very few years ago, were filled with University students, these were still only the most intelligent and active-minded, and there remained a great majority quite insensible to the attractions of progressive sciences so treated.

136 The University of Cambridge, on account of the existence of this large class of pupils, and in order that they might receive some tinge, at least, of the University studies, instituted various Examinations. The remedy itself is not without its evils, as we well know. We should be glad to have any better measure pointed out to us: but, till that is done, we must endeavour to discover how the evil, to which the employment of examinations is subject, may best be avoided or alleviated.

137 Mr Lyell seems to have fallen into some confusion on another point. He speaks (p. 306), "of confining instruction to pure mathematics, or the classical writers; more especially *if the latter are not to be treated in a critical spirit:*" as if I had recommended such a course. Certainly if I had recommended that our classical teachers in this University should not treat their subjects in a critical spirit, I should have given advice at variance with their practice at all times up to the present, as recent publications proceeding from persons of that class most abundantly show. I said, indeed, not that our teachers should not treat ancient authors as critical scholars do, but that students ought not to treat their teachers in that critical spirit which is opposed to a spirit of respect.

138 Mr Lyell gives us, as his view of the office of an instructor of one of our young men, that he "shall teach him to weigh evidence, point out to him the steps by which truth has been gradually obtained in the inductive philosophy, the caution to be used in

collecting facts and drawing conclusions, the prejudices which are hostile to a fair inquiry; and while the pupil is interested in the works of the ancients, shall remind him that as knowledge is progressive, he must avail himself of the latest acquisitions of the age in order to attain views more comprehensive and correct than those enjoyed even by predecessors of far superior capacity and genius." Having myself constantly tried, in various ways, to inculcate these lessons, and having published, with that view, works of considerable labour and extent, I trust I shall not be deemed insensible to the value of such maxims. But I must confess that I much doubt whether they produce any great effect by being uttered to young men *as maxims*. I think the order of dependence according to which these maxims become truths realized in the mind is the reverse of this. They are the Philosophy of Science. The Philosophy of Science cannot be learnt without the History of Science. The History of Science cannot be understood without a knowledge of Science itself. The wider Sciences cannot be followed without a knowledge of Mathematics. Therefore I would teach, first, Mathematics; then, the Inductive Sciences; then, the History of Science; and then I should hope to be able really to impress upon my pupil those philosophical monitions which Mr Lyell desires him to receive.

139 Mr Lyell thinks that students at the University ought, without loss of time, to be acquiring habits of thinking and judging for themselves. I think so too. I think also that the only true preparation for thinking soundly and judging rightly, on points of progressive science and literature, is to be found in a thorough acquaintance with the Permanent Studies of which I have spoken, and which I have recommended on that very ground. But Mr Lyell seems to think that the respect which I recommend as the proper feeling of Pupils towards Tutors may interfere with

the formation of such habits, of men thinking and judging for themselves. This would be intelligible if Mr Lyell were one who thought it an essential requisite to men's thinking and judging for themselves, that a large portion of them should think Sophocles and Thucydides poor writers, and Euclid and Newton weak reasoners; for those who so thought and judged for themselves, would probably not have much respect for their Tutors who might try to explain to them the beauties of classical or the reasoning of mathematical writers. But Mr Lyell does not, I think, desire this kind of freedom of thought and opinion, as an evidence of the soundness of our education. And on the other hand, I agree with him, that in sciences rapidly progressive, and therefore varying from time to time in their current doctrines, the hearer (whether he attend lectures on such subjects in the educational period of his life, or after it is concluded,) should judge for himself, as far as he is fit to do so. But because such subjects are mutable from time to time, and doubtful, at least in some points, I think them unfit to form the basis of our education. I do not know how far Mr Lyell differs from me in this; but at any rate my opinion is quite consistent with a strong wish that the Progressive Sciences should hold a prominent place in our university teaching when a due proficiency in the Permanent Educational Studies has been secured. This I desire as strongly as Mr Lyell himself; and I had tried to say it strongly, in the little book which Mr Lyell has chosen to criticise for saying the contrary. I shall hereafter offer some suggestions as to the manner in which this object may be forwarded.

140 I see no reason to believe that the introduction of a proper portion of progressive science into the university system may not be effected in the University of Cambridge, by the Senate of the University, acting in the same spirit and in the same manner in which it

has, in recent years, introduced so many important changes into its educational system. Mr Lyell thinks, with regard to his own university of Oxford, that such a result is to be despaired of; and he desires a Royal Commission to be sent thither as a counterpoise to the *vis inertiæ* of the colleges (p. 311). Such an interference from without, with the legislation of the universities, would, I am fully persuaded, be productive of immense harm. It might destroy all the advantages of the existing system: but that any thing so thrust into the structure of these ancient institutions would assimilate with their organization, or work to any good purpose, I see no reason to hope. Such a measure could hardly be attempted without producing a sentiment of being wronged in the majority of the existing members of the University, which would deprive the new scheme of all co-operation on their part. Mr Lyell (p. 312) says that such a Commission might undertake university reform in the temper which I have recommended, "bringing to the task a spirit, not of hatred, but of reverence for the past, not of contempt, but of gratitude towards our predecessors." But I see little augury of such sentiments in Mr Lyell's own statements of the kind of reform which he thinks needed; and still less, in the language in which the like measures are urged by other persons.

141 Mr Lyell seems to make it one of his objections to the existing system of the English Universities, that it is of modern origin. He appears to hold, with a writer in the *Edinburgh Review*, that the ancient system of the Universities was one in which Professorial Lectures were the main instrument of teaching; and he has given a long detail of facts the object of which appears to be to show this. In all this history, it appears to be forgotten that the main exercises of the University, in the ancient times, were Public Disputations upon certain points of the established doctrines.

These Disputations were the evidence which the University required of the student's attainments: and his main employment was, I conceive, to acquire a skill in such Disputations by similar exercises, performed in his own College, or at least among his fellow-students. These College Disputations held the places, in a great measure, of the College Lectures of later times, which are also preparations for University Exercises. The Professorial Lectures must, in the more ancient, as well as in the modern times of the English Universities, have formed a small part of the student's University employments.

142 But I suppose Mr Lyell would not himself attach much weight to this argument of his, from the asserted practice of a remote antiquity. The College system has, as he allows, prevailed in the English Universities from the time of the Reformation, which is surely antiquity enough, if antiquity is to guide us. The defenders of the College system have never, so far as I am aware, rested its defence mainly upon its remote antiquity. They have spoken of its advantages; and these are of a kind on which Mr Lyell himself appears to look with approbation, when he finds them in America. If we can secure these advantages, we shall not readily consent to part with them in order to go back to the condition which he represents as existing before the Reformation.

143 A return to an obsolete state of things on the ground of antiquity is generally a mischievous innovation. The College system in the English Universities has that support from antiquity which is really important; namely, the authority of the Statutes by which the Colleges have been governed for three centuries*.

* I insert here the chapter in the Statutes of Trinity College which establishes College Tutors. I believe the principal of the other Colleges have the like laws.

144 It is true, that in most cases the statutes contemplate the resident fellows in general, and not

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"CAP. 10. *De Tutorum et Pupillorum officio.*

"EST ea quidem ineuntis ætatis imbecillitas, ut provectiorum consilio et prudentiâ necessariò moderanda sit; et propterea statuimus et volumus, ut nemo ex baccalaureis, discipulis, pensionariis, sisatoribus, et subsisatoribus Tutore careat: qui autem caruerit, nisa intra quindecim dies unum sibi paraverit, è Collegio ejiciatur. Pupilli Tutoribus pareant, honoremque paternum ac reverentiam deferant, quorum studium labor et diligentia in illis ad pietatem et scientiam informandis ponitur. Tutores sedulò quæ docenda sunt doceant: quæque etiam agenda instruant admoneantque. Omnia Pupillorum expensa Tutores Collegio præstent, et intra decem dies cujusque mensis finiti æs debitum pro se et suis omnibus Senescallo solvant: Quod ni fecerint, tantisper commeatu priventur, dum pecunia à se Collegio debita dissolvatur. Cautumque esto ne Pupillus quispiam vel stipendium suum à Thesaurariis recipiat, vel rationem pro se cum eisdem aliquando ineat, sed utrumque per Tutorem semper sub pœnâ commeatûs menstrui à dicto Tutore Collegio solvendi fieri volumus."

These Statutes have recently undergone a revision, with the view of removing discrepancies between the letter of the law and the modern practice. The only alteration which was introduced into this chapter (except the omission of the last sentence, now superfluous), was the addition of the following clause:

"Singulis autem Tutoribus permittimus unum pluresve a Sociis Collegii idque ex nominatione magistri sibi adsciscere, qui opem illis ferant in exercitationibus quotidianis habendis atque in Pupillis ad eruditionem bonosque mores instituendis."

This clause recognizes the liberty of a Principal Tutor to engage some of the other Fellows as Assistant Tutors, which has commonly been the practice for some years, the Assistant Tutors being generally selected on account of their attainments and reputation in the subject, Classics or Mathematics, on which they are intended to give Lectures.

There is nothing in this Statute, either in its original or present form, inconsistent with the practice of having only two or three Principal Tutors in the College. On the other hand, there is nothing which would prevent a greater number of the Fellows acting as Tutors, according to the Statutes, if circumstances should render such a change desirable.

two or three of them only, as Tutors who are to receive pupils. The restriction at present habitually prevailing, of the Public Tutors in each College to two or three, is a modification of the original scheme which is clearly within its limits. This modification has never, in practice, been treated as unchangeable. It is upheld on the ground of its advantages, which in the present state of the University of Cambridge at least, are very manifest. For each of these Public Tutors joins with him one, two, or three of the younger Fellows, as Assistant Tutors; and these his assistants give lectures to his pupils, each on that branch of Classics or Mathematics to which he has especially attended. These Lecturers, each employing himself habitually on some special department of learning or science, may be considered as being, in that respect, analogous to Professors in other Universities: and the pupil receives the benefit of their lectures, as a part of the instruction which his Tutor has to provide for him. By the practice of having in each College two or three Public Tutors only, the pupils enjoy this advantage at a very moderate expense (ten pounds a year in all): while the office of Tutor, at the same time, is made lucrative enough to retain in College men of high talent and reputation. If Fellows of Colleges had only three or four pupils each, either all men of great ability and acquirement would quit the employment, and seek success in professions better rewarded, or else the payments of the pupils must be made much greater than they now are.

145 It may be said that the lectures of the Public Tutors are not, at present, the most prominent part of the instructions which the pupils receive. Mr Lyell states, (that of which we have frequent complaints among ourselves also,) that Private Tuition has in a great measure superseded this Public Tuition;—that besides the public Lectures of Tutors and Assistant

Tutors, and often to the neglect of them, pupils have recourse to Private Tutors, to prepare them for the University Examinations; and that thus, the expenses of a University Education are much increased; (the payment to a Private Tutor being £40 or £50 a year) the studies of the pupils made more narrow and conventional; and the most laborious of the University teachers kept back in their intellectual progress.

146 I have no wish to deny either the existence, or the importance of this evil. One of the objects of the present volume is, to suggest measures which may have a remedial tendency in this respect. But I see no reason whatever to believe that Mr Lyell's remedies would avail us. I return therefore to the discussions in which I was engaged when I was compelled to enter into the digression which this section contains. Among the processes which have been proposed and employed as remedies for some of the evils which have been noticed, are Examinations; and of these I now proceed to speak.

SECT. 3. *Of Examinations.*

147 Examinations, no less than Lectures, are to be considered as *means* of Education. Since the proximate aim of Lecturers often is to prepare students for undergoing an examination, it is sometimes imagined that Lectures are means to Examinations as ends. But, in fact, Lectures and Examinations are alike means to a common end. The knowledge which, in such examinations as we have to speak of, the student brings out of his acquisitions, he is required to produce, in order that he may be induced to acquire it. Whatever honour or profit may be the prize of examinations, in a course of Education, the honour and the profit are not the ultimate objects of the system. They are instruments which have it for their purpose to make men give their attentions to those studies of

which the educational course consists. In the student's individual purposes, it may be the object of study to obtain prizes; but in the purpose of the educational legislator, it is the object of prizes to promote study; and the prizes which he proposes, and the conditions to which he subjects them, are regulated by his views as to what the best course of study is.

148 Examinations, in teaching bodies in general, and in the English Universities especially, are not adopted with a view to supersede, but to aid the influence of Lectures. They are instituted commonly, as I have already said (136), in order to guard against the possibility of students not profiting by the instructions given in the system, or to distinguish and reward a proficiency in the studies which the system includes. But we may conceive an Educational System consisting of Examinations alone; requiring students to pass Examinations, or tempting them to do so by honours and rewards, but not requiring attendance at courses of Lectures, either College or Professorial. This practice has been adopted, in some measure at least, in the administration of the University of Dublin; but it has never been at all admitted into the English Universities. In those, attendance upon College Lectures has always been a part of the system; and a residence of a certain period, under the restrictions of College life, has always been required as a condition, no less essential than the passing of Examinations, to the acquisition of the Degrees which mark the completion of the student's educational course in the University. If we were to make the Examinations alone the essential part of the system in the English Universities, we should no longer have any reason for requiring a certain amount of residence in College, from the student who applies for a Degree. In that case, the University would merely have to ascertain whether the candidate could pass the appointed Ex-

amination; and would have no occasion to inquire whether he had acquired his knowledge in the College Lecture-room, or in his own study, or under the eye of a Private Tutor within the University, or in the house of a Private Tutor in some remote part of the kingdom. In this case, the University might consist of non-resident students, except at the time when the Examinations summoned them into attendance: and the Lectures, both of College Tutors and of University Professors, would be mere opportunities, which students might avail themselves of, or not, at their pleasure.

149 That this would be a very bad method of education I shall not stay to prove. Knowledge acquired merely with a view to Examinations is generally very shallow and imperfect, and soon passes out of the mind, when the occasion which prompted the effort is past. Knowledge thus acquired for a special occasion, does not take possession of the mind as that knowledge does which is imparted in a gradual manner by a continued series or course of studies, each step being viewed with reference to its difficulties and applications, and secured before a progress is made to the next; as will be the case in a well-ordered course of College instruction. Besides this, the advantages are lost which we have described as properly belonging to College Lectures;—the general operation of social study, and of the mutual influence and common sympathy of a considerable body of students. Even in cases in which the Examinations for University Degrees have had the greatest importance given them, in France, for example, it has still been found necessary to require a previous residence of two years in an authorized College, as a condition which the candidates must fulfil*. To make Examinations alone the essential

* *Rapport de M. Thiers sur la Loi d'Instruction Secondaire*, 1844, p. 66.

parts of the system, in the English Universities, would be to render the Colleges incongruous and superfluous part of those bodies.

150 But it is not enough that we require the students both to pass the University Examinations, and to reside for a certain time in the Colleges in which their studies are to be prosecuted, except we also secure a correspondence between the Questions proposed in the Examinations, and the instruction given in the public course of the Colleges. If this correspondence do not exist, the University Examinations will still be effectively the only essential mode of the University's teaching, and there will be a tendency to neglect and evade the teaching of the Colleges. This correspondence is more especially important in the Permanent Studies of our Educational System; for these especially require to be mastered in the complete and gradual manner which I have described; both on account of their own importance, and on account of their being the necessary basis of all higher and wider acquirements. If the University Examinations allow candidates to receive degrees and honours without a thorough possession of this elementary knowledge, and do not ensure its acquisition in the Colleges, the education must be very defective, however imposing an array of difficult and extensive Questions the Examinations may exhibit. And, in the Progressive Subjects of study also, however profound and comprehensive may be the points brought into view in the examinations, it is desirable that there should be correspondence between the views of the examiners and the instructions given to the students, either in their Colleges, or by the University Professors: for, otherwise, the Examinations alone will be looked to for guidance by the students, and this is a guidance which will lead, both to the evils of which we have spoken, and to others of which I shall shortly have to speak.

151 There may be College Examinations, as well as University Examinations; and these may be ordered in such a way as to maintain and enforce a methodical and progressive course of study, such as, I have said, ought to be pursued in Colleges. Such Examinations ought so to succeed each other, and so to have their subjects assigned, that they may lead the student through the series of studies which belong to a Liberal Education; and in the first place, as we have said, through a series of well selected classical and mathematical studies. In such a course, the Examinations of the first year ought to correspond with the Lectures of the first year; the Examinations of the second year with the Lectures of the second year; and so on. And there ought, in this case also, to be a correspondence between the knowledge imparted by the Lecturers and that required by the Examiners. If this be so, the prospect of the Examination will fasten the attention of the students upon the Lectures, and exercise an influence even upon those who might otherwise have been careless hearers. But in order that this influence may be properly supported and confirmed by the University Examinations, which, so far at least as they lead to Degrees, will be permanent in their operation, there must be a correspondence between the University Examinations and the College Examinations. The latter, in their successive stages, must form parts of a connected scheme of knowledge, which the University Examinations require in its totality, when the student finally becomes a candidate for Degrees and Honours.

152 But this correspondence between the teaching of Lecturers and the views of Examiners, which is so desirable and so important, it is not always easy to secure. Even in the Permanent Studies, the Greek and Latin languages and the prescribed course of Elementary Mathematics, there is room for discrepance.

Examiners may differ amongst each other, and consequently may differ with Teachers, as to the degree of literalness in a translation which is consistent with its being English, or as to the degree of freedom which is consistent with its being faithful; besides the differences of opinion which may often exist as to what the meaning is. And there may be, though less frequently, doubts whether the proof of a proposition or the solution of a problem in Geometry or Mechanics be satisfactory. Still in a general way, the practice of translating Greek and Latin, of proving propositions in Euclid and Mechanics, of solving equations or finding *maxima*, kept up in the Lecture-room, will form a good preparation for the like performances in the Examination-hall. In these cases, the mode of dealing with the subject is determinate, and cannot be much varied. But when we come to knowledge of a more speculative and excursive kind, there is more room for discrepance between what is taught by one person and what is demanded by another. The views of the grammar, antiquities, history, and philosophy of Greece and Rome, entertained by different scholars, have been and are very different; and especially, their views are different as to what points it is most important for the student to dwell upon. The same is the case in all the higher parts of Mathematics. In every branch, one mathematician pursues a geometrical, another, an analytical track; one aims at the solution of special problems, another at the establishment of general formulæ; and so on. It may easily happen that the Teacher takes one side and the Examiner another in such alternatives; or that in some similar way, the Lessons which have been given to the student have failed to prepare him to follow the course of the Examination, or to satisfy the requirements of the Examiner. When this happens, the students who have followed the prescribed Lessons are disappointed and discou-

raged, because they are frustrated of their expected reward, success in the Examination. The teaching which tends to such disappointment loses its hold upon the student; the machinery of the Educational System no longer works well, and ceases to produce its effect.

153 It is the more important to establish a close correspondence between the Examinations and the Lectures of our Educational system, inasmuch as, however ingenious and profound may be the Lectures delivered to the students, the attention given to them, in a system in which Examinations are the door to distinction, will be very feeble and scanty, if they do not in a great degree prepare students for the Examinations. If indeed we have not, in our system, Examinations which lead to honours and rewards, we may have our students led to give their attention to the teaching of Tutors and Professors, by their love of knowledge, their deference for their teachers, their admiration of the eloquence and wisdom of the lecturer, or the like motives. But these motives lose much of their force, when they come in competition with the love of distinction. When emulation is introduced into our system, we must reckon upon it as an overwhelming force, in comparison with which the love of knowledge and the admiration of excellence on its own account are but weak and ineffective influences. If we employ this principle of emulation, we must so direct it that it shall lead men to study what we wish them to learn. We must make our Examinations require that knowledge which we wish to have imparted in our Lectures. If we do not do this, we shall have the zeal and energy, at least of the most active-minded and ambitious of our students, directed to our Examinations, and to the modes of succeeding in them; whatever merits the Lectures of our Tutors and Professors may possess. Hence, if we do not establish an organic connexion of the Examinations with the College Teaching and Pro-

fessorial Lectures, there is a strong tendency to a system of mere Examinations; which is, as I have already said, a very imperfect system of Education, and one which leads to very serious evils.

154 Among the evils to which an Educational System of mere Examinations leads, is, that it tends to place all the effective teaching in the hands of Private Tutors, as I have already remarked. This cannot take place without greatly impairing the character of the instruction given. For public Lecturers and Professors will naturally endeavour to present the subjects, of which they treat, in a manner in which philosophical connexion and intellectual interest are strongly brought into view. And, moreover, in College Lectures, the student is especially required to overcome, either by his own mental efforts, or with the aid of his Teacher, the real difficulties of the subjects, so as to acquire a clear view and full possession of its principles. But Private Tuition, directed, as we are now supposing, to the mere object of preparing students for the Examinations, will aim only at providing them with answers to such questions as are likely to be asked by the Examiners. In such Tuition, it will not be deemed a matter of any consequence that the Student has a permanent and thorough hold on fundamental principles, or that he really sees his way through the difficulties which belong to them. Even if he be provided by the Private Tutor with the answers to such difficulties, he will, probably, possess these answers only as matters lodged in his memory, and not as the result of mental effort and insight. He receives them as answers which are to satisfy his Examiners, not as those which satisfy himself. Hence, such teaching produces a condition of intellectual dependence, highly unfavourable to the mental vigour and activity, and the real culture, which are the main objects of a Liberal Education.

155 A system in which the instructions of Private

Tutors supersede College Lectures, labours under still other evils when viewed with reference to other aspects of English College life. For the Tutors by whom College Lectures are delivered are, as we have seen, understood to be not only Tutors, but Guardians of their pupils. They are recognized, by the laws and customs of our Colleges, as standing in the place of a parent, and having it for their business to watch over the social and moral habits, as well as the intellectual progress, of the student. And their opportunities, both of judging of the conduct of their pupils, and of influencing them for good, are much assisted by the daily intercourse which takes place when the Tutor directs the studies of the pupil. The influence of this kind which operates in such cases has always been looked upon as one of the most precious portions of English University Education. But when the teaching passes into the hands of Private Tutors, this influence of the Public Tutor is much impaired, by the diminished habit of confidence of the pupil, and, perhaps, by the diminished occasions of his intercourse with the Tutor. And this loss is not usually compensated in any degree by the Private Tutor's agency. He has no public character by which he is responsible for any moral care of his pupil, and he acknowledges no such responsibility. All that he undertakes, or is expected to do, is to prepare his pupil for the Examinations. His business is not with his pupil's morals, but with his classical or mathematical attainments. The establishment of such a system of mere Private Tuition would be a grievous declension from the system of College Education hitherto aimed at in the English Universities.

156 These evils, thus resulting from a system of mere Examinations, will be much increased if the system be one of mere *paper* Examinations; the answers being given in writing, and afterwards inspected by the

Examiners only. For, in this scheme, there is no opportunity of testing, by questions such as the occasion and the preceding answers may suggest, whether the verbal reply to the questions be really accompanied by any intelligent thought in the mind of the *examinee*. And the answers of each person being unknown to his fellow-students, there is no public manifestation of the excellence which obtains success; which, in a more open system of examination, operates beneficially, by the example which it offers, and the sympathy which it draws. Even if the questions be published, still the kind of knowledge which the Examiners consider as meritorious is very vaguely and ambiguously indicated by the questions, as I have already said. The standard of excellence is nowhere exhibited to the public, and is to be found only in the breasts of the Examiners. However highly the Examiners may be esteemed for ability and integrity, the want of any habitual manifestation of that which they consider excellence, must involve the minds of candidates in perplexity. Those candidates who are eager for success, will try to obtain guidance from those who are supposed to have any peculiar sagacity, or peculiar information, which may enable them to foresee the course of an Examination, or the judgment of Examiners. They will try to procure, as their Private Tutors, those persons who have recently been successful in the Examinations; or, if the constitution of the University allows it, those who have been, or are to be, Examiners; and will receive their instructions with passive and unquestioning mind, not as the means of understanding languages and sciences; but as being, for their purpose, the standard of truth and of excellence.

157 The evil will again be increased, if the Examiners are not permanent officers, or members of a permanent official body, but a perpetual succession of persons new to the office. For a body of Examiners,

permanent, or slowly changing, has its traditions, which give a certain degree of fixity to the matter and method of the Examinations, even when they are left free by the laws: but when there is not this influence operating in favour of fixity, each new Examiner will have a propensity to put forwards his own favourite subjects, and to introduce the newest steps, which, as he conceives, have been made in the application of knowledge, and the mode of presenting it. Hence the Examinations will, in their subjects and course, undergo perpetual innovations, which will still more drive the candidates to seek guidance in such Private Tuition as I have described; and will prevent that patient and persevering study of standard truths and models, which I have mentioned as essential to the beneficial influence of Permanent Educational Studies.

158 I do not draw the above sketch of the evils belonging to a system of mere Examinations, as a representation of what exists among ourselves; but as a picture of what we are to avoid. We have at work among us some of the tendencies which I have pointed out; and the consequences which these tendencies, when fully developed, must, as we have seen, produce, are strong reasons for repressing and counteracting them. One main means of doing this is, as I have said, to secure a correspondence between the Examinations of the University and the College Lectures; and also, with regard to some of the subjects of our teaching, a correspondence between the Examinations and the Lectures of the Professors. And I shall proceed to offer some remarks on the way in which this correspondence may be established and preserved.

159 I have already stated that, in order to make our Education really an intellectual culture, we ought to have our Permanent Studies established among us in a Standard Form; namely, Classical Authors, and Standard Systems of Elementary Mathematics (54).

Having such a Standard Form for our studies, we shall not have much difficulty in accommodating our Examinations to our Lectures, and our Lectures to our Examinations. But there are some further remarks with regard to the means of securing such a correspondence, which apply to Progressive as well as to Permanent Studies; and these I shall now proceed to state.

160 There is one arrangement which will naturally give rise to that correspondence of the Lectures and the Examinations which we have seen to be so desirable and important; namely, that in which the Lecturers or Professors are themselves the Examining Body; for they will then, of course, so shape their Lectures as to prepare their pupils for the Examinations; and so conduct the Examinations as to encourage and reward attention to their instructions. Objections are sometimes made to this arrangement; but where it is attainable, its advantages much preponderate*. It is conceived that it may tinge the whole course of study with the *mannerism* of the Professors or Lecturers: but this danger is slight, especially when the Lectures and Examinations are public, and the mode of appointing the Lecturers or Professors such as to make them able and zealous officers. The value of any branch of literature or science as an element of Education, will be little impaired by its bearing traces of the mannerism of the teacher; besides which, the system is no less likely to be affected by the mannerism of the Examiners, when they are a distinct body from the Teachers. If the Examiners be a body more rapidly changing than the Professors or the Lecturers, the danger is greater on this side; for, as I have already said, in a body of Examiners so consti-

* See *Principles of English University Education*, p. 60, for remarks on this subject.

tuted, there is a tendency to the love of novelty and the infusion of individual notions. If we had a body of Professors and Teachers established as a permanent Examining Body, it might be expected that their Examinations would be more stable, coherent, and definite, than those of a rapidly changing series of Examiners.

161 But there is a real and weighty objection to the identity of the Teachers with the Examiners, in the difficulty of carrying it into effect upon a large scale. For if teaching be a laborious task, examining a large number of men in subjects of great extent is no less so; and the combination of the two offices, to be discharged with reference to the whole University, would make the task of the University Teachers too oppressive. It is only in bodies of moderate extent, as single Colleges, that such an arrangement can be practised; and even in such cases, other Examiners are generally combined with the Teachers, partly as a relief of the labour, and partly as a mode of making the whole College participate in the business of Education. But in a University, where the Examinations include Candidates who have received their instruction in different Colleges, the Examiners, so far, at least, as the subjects of College Lectures, namely Classics and Elementary Mathematics, are concerned, must be a body distinct from the Teachers; although, of course, many of the same individuals may belong to both. And we must consider other ways than the identity of the acting persons, by which the necessary correspondence of Teaching and Examinations may be secured, and the evils of a system of mere Examinations avoided.

162 I have already said that the evils of a system of Education depending entirely upon Examinations for its efficacy, are much greater in a system of mere *paper* Examinations; in which the answers of the examinees are given upon paper, and afterwards read and judged by the examiner.

An Examination conducted *vivâ voce*, the questions being asked and the answers returned by word of mouth, has several advantages over an Examination on paper. One of the greatest of these, supposing of course the University in general to be admitted to the Examination-hall, is its publicity. The questions and the answers are heard by all who choose to hear, and there is a constant and ready means of learning the course taken by the Examiners, and the character of the performances which are approved. The Teachers can constantly compare their course of instruction with the standard of excellence on which the Examiners proceed, and can compare both with that Idea of a good Educational System, to which both ought to conform. Moreover the University Examination conducted *vivâ voce*, naturally gives interest and importance to College Lectures, which are conducted in the same manner, and which may thus become a preparation for exercises to be performed before the University. Again, the knowledge, quickness, and happiness of expression which are displayed by a student who passes a *vivâ voce* examination well, will draw to the proceeding a degree of sympathy which can never be given to a paper examination. Add to which, that special difficulties and points of importance naturally become prominent in habitual subjects of oral Examination, and become familiar to the minds of students by attendance at the Examinations. On all these accounts a public oral Examination is a good instrument of Education.

163 Though Examinations conducted *vivâ voce* have these advantages, they have, in a great measure, been superseded by paper Examinations in the University of Cambridge. This has arisen from various causes; and among others, from certain inconveniences attendant upon *vivâ voce* Examinations, and certain advantages or supposed advantages in paper

Examinations. I will make a few remarks on these points.

The inconveniences which may be alleged against oral Examinations are mainly these;—they require from the Examiners a great sacrifice of time, and great knowledge combined with great invention and readiness;—from the candidates, they require presence of mind, and some fluency, as well as knowledge;—they are suited only to the lower teaching, and do not enable us to carry the examination into the profounder parts of the subject; at least in subjects like analytical mathematics, which address themselves principally to the eye. We must say a few words of each of these difficulties.

164 When the answers are given on paper, all the *examinees* may write at the same time, and the answers may be afterwards perused at the leisure of the Examiners. But in an oral examination, the examinees must be interrogated in succession, and the merit of the answer estimated on the spot. Hence two hundred students may be examined on paper in a few hours; and their papers read with sufficient care, by a well prepared Examiner, in a few days. But if two hundred students are to be examined orally for an hour each, (an insufficient time for an Examination which is to have important results) since the Examiners can hardly be expected to work more than four hours a day, the Examination would continue above two months. Such a calculation as this is decisive against making the whole of our university Examinations oral. To which we may add, that many or all the purposes of Examinations may be better answered by making a part only of the Examination oral, and conducting the rest entirely on paper. Even when this is done, and when, of the Examinations, such a part only is oral as is requisite to give to the system the benefit of that mode of action, several

weeks every year must be occupied by the oral Examinations, in a university which contains any considerable number of students. Accordingly, such is the employment of time at present in the University of Oxford, in which the oral Examinations are an important part of the system; and such was the time employed in the University of Cambridge a few years ago, in public Disputations held in the presence of the Moderators or Examiners, which might be considered a kind of *vivâ voce* answers to Examination Questions. In order to retain the advantages which belong to oral Examinations, the Examiners must be content to make this sacrifice of time and labour; but then, we conceive that the effectiveness of our system, which depends, as we have seen, upon this kind of publicity, makes the sacrifice worth the while; and this employment of the Examiners is also not without other advantages.

165 With regard to the attainments which are requisite in *vivâ voce* Examiners, no doubt, a full and ready possession of the subjects of Examination is indispensable. This, however, the Examiners must at any rate possess, in order that they may be able to discharge their office properly. Their continued public appearance for a series of weeks in a situation in which they have constantly to show that they do possess these accomplishments, is an excellent test of their fitness for the office; deters unfit persons from accepting it by the fear of public failure; brings deserved honour as the reward of eminent fitness; and affords a sphere in which the eminent talents and knowledge of a few may exercise their influence in instructing and stimulating many. The objections to oral Examinations, therefore, founded upon the high attainments which they require in the Examiners, appear to be rather reasons for than against the system. When such Examinations have been discontinued or neg-

lected, there may for the moment be an inaptness for conducting them, even among good scholars and good mathematicians; but this inaptness would soon be removed by a little practice. The establishment of oral Examinations, as a necessary part of the exercises which lead to University honours, would doubtless soon produce a sect of accomplished Examiners, able to discharge the requisite offices.

166 A similar reply must be made to the objection (for it is sometimes urged as an objection), that oral Examinations require of the examinee, not only knowledge and thoughtfulness, but presence of mind and power of clothing his knowledge in words. It can hardly be denied that presence of mind and power of expression are desirable qualifications; and if it be possible that a thoughtful person full of knowledge, when suddenly required to subject himself to an oral Examination, should do himself injustice from his lack of these qualities, it cannot be doubted that if he were constantly to look forward to this public exhibition as a part of the University course, and were daily prepared for it by a like practice in the College lecture-room, he would generally overcome the difficulty, as men overcome the like difficulty in other cases. Every boy acquires presence of mind and fluency enough to say his lessons at school, and why should he find any difficulty in continuing the practice at the University?

167 Perhaps one reason which has led to the neglect of oral examinations in Greek and Latin, is the belief that they are suited only for school;—that they may bring out the lower, but not the higher attainments of a scholar. Construing is sometimes dealt with as if it were a useful instrument to detect gross ignorance, but not available to exhibit eminent knowledge. Yet the mode in which oral translation keeps its place in the Examinations at Oxford shows that a contrary opinion prevails in that university. And even

looking at the practice according to the view entertained at our public schools, we may see that it is capable of being a manifestation of profound knowledge and refined taste. We may perceive this in Dr Arnold's account of his view, as to what this exercise ought to be*. He distinguishes *construing*, in which the Latin or Greek is rendered word by word into English, from *translating*, in which whole sentences are *read into English*. And recommending this latter course, as alone fit for the more advanced scholars, he requires the translation to be subjected to conditions which make it, as he says, "an exercise in extemporaneous English composition." He requires, for instance, that where the order of the words in the original is emphatic, it shall be preserved as nearly as possible in the translation; and that this be done without violating the idiom of our own language. Further, he recommends that in the choice of his words, and in the style of his sentences, the scholar should follow the age and character of the writer whom he is translating. Thus he would have Homer translated by words mainly of Saxon origin, the sentences being a series of simple propositions. In translating the tragedians he would have such a mixture of Saxon and French derivations as we have in Shakespeare; and the like in other cases. It is evident that to translate thus, and at the same time, to supply, when demanded, the knowledge of grammar, history, antiquities, &c., which are requisite for the explanation of the translated passages, is a performance which may bring into play the highest scholarship, knowledge, and talent. There must be a great defect in a system of classical instruction and examination when it does not include in it oral translation, directed by these views, or at least directed by a con-

* *Journal of Education*, 1834, reprinted in his *Miscellaneous Works*, p. 353.

viction that it is a very important exercise, capable of great excellence. The opinion that such translation is a convenient cover for inaccurate scholarship, can only be true, Dr Arnold very justly says, through the incompetency or carelessness of the teacher. If the force of every part of the sentence be not fully given in an examination, the examiner judges accordingly; but if the examinee employs English, however idiomatic or elegant, which does not express the original, his translation is set down as bad by the judicious examiner, however much it may be admired by the ignorant bystander. He is not necessarily set right, because the Examination is not a lecture; but he is judged to be wrong; and in most cases this judgment will be sufficiently well known to produce its effect.

168 With regard to Mathematics, as I have already said, Geometry and Mechanics are well suited to be the subjects of oral examinations. This is rendered more easy, if the Diagrams which occur in those subjects, and the letters which mark their parts, are assumed as fixed and known; and such examinations may be extended to Newton's *Principia*, in which the Diagrams are thus fixed and known. A set of Diagrams for the Elements of Mechanics, generally recognized like those of Simson's Euclid or of Newton, would enable us to examine orally in that subject much more readily and quickly than we can do without such help. The main parts of such examinations as we now speak of should be the proofs of the standard propositions of the subjects, and such subsidiary questions as serve to ascertain that the examinee understands the proof, and can apply the same principles in cognate cases.

169 There prevailed till lately in the University of Cambridge, a *viva voce* exercise, principally in Mathematics, which may here be noticed. I speak of the Disputations in the Schools, which were formerly re-

quired of all Candidates for Degrees, but which are now discontinued. Each of these Disputations turned on three Theses or Questions, of which, latterly at least, two were of a mathematical and the third of a moral nature. The Opponents adduced arguments in a logical form, and in Latin, against the Theses of the Respondent, which were generally taken from well-known works, as those of Newton, or Cotes, or Wood; and these arguments the Respondent had to refute, or to *take off*, as it was called. This exercise was much facilitated by the general familiarity with the diagrams of Newton, Cotes and Wood, which then prevailed. It was eminently fitted, in my opinion, both to produce and to test a thorough acquaintance with the subjects thus disputed on; for the arguments were often very perplexing; and yet it was certain that, inasmuch as they seemed to contradict demonstrated truths, there must be some fallacy in them. To be able always to detect the fallacy at the moment, required both a very firm hold of the subject, and great clearness and quickness of mind. If I may be allowed to speak of my own tastes in reference to this matter, I must say that, both as Disputant and as Moderator, I always took a most lively interest in these exercises; and was never satisfied, after an argument had been brought, till I saw the fallacy. But these exercises gradually lost their interest for the students, because they were superseded, in their bearing upon University distinction, by the subsequent examinations of the same Students in the Senate-House. The *Questionists*' performances in the Schools produced no direct definite effect, and finally produced no effect at all, upon their places in the *Tripos Paper*. When matters came to this point, the Questionists went through the Disputations as a form, taking no thought about the meaning of the arguments which they read. The last time that I was Moderator, I tried in vain to lead, either the

Respondent or the Opponents, to understand the arguments, or to look for the fallacies of them.

170 Yet I am fully persuaded, as I have said, that to discover the solutions of such difficulties is an excellent mathematical discipline. It would, I think, be difficult to restore the Disputations in their ancient form, and even in any modified form. Men are now so unfamiliar with Latin, and Latin is so ill suited to express our modern mathematics, that the employment of that language for such a purpose is not to be thought of. Yet such Disputations could not be carried on with any degree of precision or coherency, without some technical forms of expression; and all the existing technical forms being Latin, it would not be easy to supersede them by English technicalities. We have seen that on this ground one of our classical scholars has been compelled to retain the Latin for his critical notes, whilst employing English for his notes of explanation*. Again: the technical forms employed in such Disputations must be logical forms; for the technicalities of Disputation are one of the main subjects of logic; but we are here very little acquainted with logic; nor would it, I think, be easy to revive the study of it to such an extent as a correct conduct of Disputations would require. I think, therefore, that any attempt at reviving the Mathematical Disputations of our Schools must be looked upon as chimerical.

171 But I think the same beneficial effect which these Disputations were fitted to produce upon the Questionists, along with the beneficial effects of oral examinations, of which I have before spoken, might be produced by another mode of proceeding. I have already intimated that the Moderator, in such disputations, may take the arguments out of the hands of the Opponent, and may himself put them to the Re-

* Mr Shilleto's *Demosthenes De falsa Legatione.*

spondent, and require them to be answered. And the Examiner may, without the form of a Disputation, do the same thing. We may propound difficulties against the received doctrines of the subject which the examinee professes to have studied, and may require him to solve them. This indeed is a mode of oral examination which differs from common interrogations respecting received proofs, only in making the difficulties which are propounded to the examinee a little more elaborate than the obvious obscurities of a demonstration. By means of difficulties thus proposed to the examinee, both his possession of the subject in question, and his power of mathematical reasoning, may be very thoroughly tested. Such an examination may very well be made an important element in assigning to a student his place in the classes of mathematical honours. And such exercises being held in public, and attended by those who are afterwards to become candidates, may produce, in the mathematical portion of our System of Education, the benefits of an oral examination which we have spoken of as so desirable. We may afterwards speak more in detail of the mode in which this suggestion may be carried into effect.

172 With regard to the remaining objection, of those above mentioned, to a system of oral examination;—that such Examinations cannot be extended to the profounder parts of knowledge, and especially of mathematical knowledge;—undoubtedly the weight of the objection must be acknowledged; and from the undeniable force of this consideration, we are led to conclude that our system of examination ought not to be entirely oral; a conclusion to which we are led by several other considerations. We have already stated that an examination of any serious extent, if entirely oral, will require too great an expenditure of time to allow it to be applied to a great number of candidates: add to which, it is desirable, not only in analytical

mathematics, but in other subjects, that the examinee should be led to produce his knowledge, not only in the sudden shape of oral answers, but also in such a form as he can give it with more thought and deliberation, upon paper. It is not only necessary as a matter of convenience, but highly desirable on account of the exercise itself, that there should be portions of the examination in which the answers are given upon paper: and these may consist of translations of Latin and Greek passages into English; of dissertations on philology and antiquities; of proofs of mathematical propositions or solutions of problems proposed; of explanations of, and comments upon, the principles of such proofs. They may also contain translations out of English into Latin prose, or original Latin composition; and, in a moderate degree, according to the conditions of the examination, translations of Latin and Greek verse into English verse, of English verse into Latin and Greek verse; and perhaps the writing of Greek prose.

173 I will venture to suggest a step which may be taken in paper examinations, in addition to the usual practice; and which would, I think, give to paper examinations a considerable portion of the beneficial effect of oral examinations. The reasons which make it desirable that examinations should be public, hold for the publicity of the answers given by the examinees, as well as the questions proposed by the examiners. It appears very desirable that, in every Examination, the answers, or at least some of the best of them, should be made accessible to Students and to Teachers who wish to consult them. Such papers would be interesting and instructive to all concerned in the educational system; they would show the kind of knowledge required by the examiners, and afford examples of a certain degree of excellence in the requisite performance.

174 Among the reasons which have recommended

written examinations, besides the comparative ease of conducting them, which I have already mentioned, I may notice the manifest fairness of giving the same questions and exercises to all the candidates, which is easy in a written examination, but impossible in an examination conducted *vivâ voce;* at least if the examination be a public one. In a public oral examination, even in the same subject, two candidates may have passages or questions of very various difficulty assigned them, however carefully the examiners may try to equalize the examination; and may, consequently, appear to be very unequally dealt with. And there is also an appearance of justice in the greater amount of time which the paper examination allows for the examiner to peruse, estimate, and compare the answers. The judgment formed of oral performances must, necessarily, be rapid, and may easily be conceived to be hasty and inaccurate.

175 These considerations naturally produced a favourable opinion of paper examinations; and to this has been added a belief, that such examinations are sufficient for the purposes of Education. It has been conceived, of late years, that Education consists in acquiring certain portions of knowledge, or, as it is called, Information; that a written examination may ascertain whether a man has acquired this Information; and that by acquiring such information in examinations at our Universities, we may secure the Education of our Students. But it will appear, from what has been said, that any Education, which deserves the name, cannot be so secured. Education, such as we have shown that it must be, to answer its higher purposes, consists, not in accumulating knowledge, but in educing the faculties of man. It does not consist in *information*, in the modern sense of the term, but in the formation of the mind. It requires, not merely occasional performances, but permanent habits; not merely the

achievement of the Examination-hall, but the daily exercise of the Lecture-room. The sympathy with the past and present generations of cultured men, which a good education implies, cannot be proved by any transient test of Question and Answer. It must be nurtured and brought into view by the constant intercourse of intelligent men, occupied in intellectual pursuits, and conscious of the working of each other's minds upon a common object. The prospect of an examination may stimulate the attention in such exercises; but it cannot make either individual study or private tuition produce the effect of such exercises, and answer as a substitute for them, in the course of Education.

176 Examinations, as to their subjects, are either *special* or *general: special*, when they refer to a prescribed and limited range of subjects, as for instance, certain selected classical works, or certain branches of mathematics and no other: *general*, when they include the whole body of approved classical authors, the examinee not knowing beforehand from what work the passages proposed to him will be taken; or the whole course of mathematics, from the lowest to the highest portions.

Special Examinations are very useful auxiliaries to the Teaching by Lectures which takes place in Colleges. An Examination in the subject of the Lectures, known as appointed to come on when the Lectures are over, tends strongly to fix attention upon the Lectures: always supposing, as we have already said, that a due correspondence between the Examinations and the Lectures is secured. And a series of Examinations on the successive portions of a good course of Mathematical study, and on a good series of Classical works, including poetry, history, and philosophy, would be a very valuable part of a liberal education, if thus combined with a corresponding series of Lectures. Even if the University or the Colleges were to provide and

enforce such Examinations only, without the corresponding Lectures, the series would form a sort of Education; for each subject would, in a greater or less degree, lead to the next; and would be prevented from entirely slipping out of the mind after it was once learnt, by its being in some measure connected with the next, and involved in it.

177 But if the University have none but General Examinations, it must be considered as abdicating the function of teaching altogether. A University conducted on such a system, is no longer an Educating, but only a Prize-awarding Body. When the University assumes this character, it is natural that ambitious persons who resort to it should try to go through all their course of study before they come to the University, and should wish, while they are there, to employ themselves only in competitions for Prizes; and in such processes of "getting up" their subjects, by their own exertions, or by the aid of Private Tutors, as may be likely to lead to the attainment of Prizes. So far as this becomes the case with a University, all the machinery of Collegiate and Professorial Lectures, with the other features of College life, are extraneous to the main business of the University. How remote such a condition of things is from that which has always been conceived to exist in the Universities of Oxford and Cambridge, I need not attempt to explain to my readers. Those bodies have always been considered as eminently and characteristically Educating Bodies; and it is only recently and partially that the other character, of mere Prize-awarding Bodies, has become so prominent, as to make it necessary to draw attention to the dangers which may arise to the older office, from the operation of the newer.

Sect. 4. *Of the Relation between the University System and School Teaching.*

178 Since the Universities of Oxford and Cambridge are Educating Bodies, and are to be maintained as such, the previous preparation of those who are sent to these Universities ought to be conducted upon this supposition. If the Universities of Oxford and Cambridge were, like the University of London, bodies whose sole function it was to award prizes, confer degrees, and the like; it would be sufficient if schools, and early teachers of boys going to the University, prepared them to be examined. But since young men are sent to Oxford and Cambridge, not merely to show what they have learnt, but also to learn; the teaching of schools should have, for one of its objects, to fit them for being, while at the Universities, further educated. And this view of the relation of our Schools to our Universities will suggest some important maxims with regard to the general conduct of the studies of young men. For instance, this being the case, the object of schoolmasters and early Tutors ought to be, not to carry their pupils through all the subjects of University teaching, from the lowest to the highest, so much as to teach them thoroughly well in the lower subjects, and to prepare them by a good fundamental instruction for a progress in the higher subjects, when the University course brings them to that stage. The school course should not, as soon as the schoolboy has acquired an imperfect and limited knowledge of Latin, urge him on as fast as possible in Greek, carrying him into the most difficult authors, and requiring him to write Greek verse and Greek prose. The aim ought rather to be to secure a very exact and tolerably extensive knowledge of the Latin authors; for instance, Virgil, Ovid, Horace, Terence, Cæsar, Sallust, Cicero; and to consider a thorough acquaintance with these

authors as more essential than a like knowledge of the Greek writers. The writing of Latin prose ought to be sedulously cultivated at school, for it is only by practice that any excellence and facility in this exercise can be acquired; and the same may be said of composition in Latin verse, where there appears to be time and talent for this accomplishment. To sacrifice these parts of scholarship to the practice of composition in Greek prose and verse, with a view to University prizes, is a complete perversion of the business of Education, and must interfere with the genuine classical culture of the student.

179 And in the same manner, in the mathematical portion of school teaching, the object ought to be, not so much to teach what will fit the pupil for the University Examinations as for the College Lectures. And as the basis of all real progress in mathematics, the boy ought to acquire a good knowledge of Arithmetic and a habit of performing the common operations of Arithmetic, and of applying the rules in a correct and intelligent manner. This acquirement appears to be often neglected at our most eminent classical schools. Such a neglect is much to be regretted; for the want of this acquirement is a great practical misfortune, and is often severely felt in after life. Many persons who are supposed to have received the best education which the country affords, are, in all matters of numerical calculation, ignorant and helpless, in a manner which places them, in this respect, far below the members of the middle class, educated as they usually are. We are here, however, concerned, not so much with the practical evils arising from the neglect of Arithmetic in our higher education, as with the effect of this neglect in making all sound mathematical education at a later period impossible. And this evil is in no degree remedied by employing the schoolboy on some of the subjects which enter into the University course, as

Geometry and Algebra. These he may speedily learn when he arrives at the University, if he have been properly grounded in mathematical habits: but Arithmetic he cannot then learn to any purpose. Arithmetic is a matter of habit, and can be learnt only by long-continued practice. For some years of boyhood there ought to be a daily appropriation of time to this object. Geometry and Algebra do not require so much time. Geometry is a matter of reasoning; and when the proofs are once understood, the student has little more to do. And although Algebra requires, like Arithmetic, the habits of performing operations on symbols, the operations of Algebra are learnt with comparative ease, when those of Arithmetic are already familiar.

180 Indeed we may say that, in general, boyhood is fitted for the formation of practical Habits, and that the aptitude to attend to general Reasonings comes with more advanced youth. In the most natural course of public education, at School we learn to *do*, at College we learn reasons *why* we do. At School we learn to construe and to cipher; at College we are invited to follow the speculations of Philologers, and to attend to the proofs of the rules of Arithmetic. And the tastes of boys, for the most part, correspond to this distribution of employments. They can learn to perform and apply the rules of Arithmetic, and they take a pleasure in the correctness of their operations, and in the manner in which the rules verify themselves; but they find it irksome to follow the reasoning of Euclid, where the interest is entirely of a speculative kind. The interest which belongs to demonstration, as demonstration, comes at a later period, when the speculative powers, in their turn, begin to unfold themselves, and to seek their due employment.

181 Perhaps, too, the interest of demonstration is greater when the truth proved is one with which we are already familiar in practice; as when the reasons

are rendered for the common Rules of Arithmetic. In such cases, by having the speculative side of the subject brought before us, we obtain a view altogether new of an object previously quite familiar. Many persons must recollect having experienced this impression who, having learnt as mere Rules, the method of finding the greatest common measure of two numbers, or the third side of a right-angled triangle when two sides are given, have afterwards been introduced to the Demonstrations of these Rules. Demonstrations which are regarded with this interest, are a very effective means of unfolding the reasoning powers. And it is well worth consideration, whether, with a view to the encouragement of such mental processes as these, the mathematical education of boys at school might not be extended to practical methods, much further than is commonly done, at least at Classical Schools. It would appear to me to be a great improvement, if boys were not only made to learn Arithmetic, but also Mensuration at school:—I mean the practical Rules of finding, from the necessary data, the areas of triangles, circles, sectors; the solid contents of prisms, pyramids, cylinders, spheres, and the like. Such knowledge would be, upon innumerable occasions, of great value in the business of life; and would make the proofs which speculative geometry gives, of the truth of such Rules, both much more intelligible, and much more interesting than they generally are. That schoolboys can learn so much of Mensuration as I here speak of, and will usually take a pleasure in learning and applying it, the experience of many of our commercial and other schools abundantly shows.

182 There are other practical matters in mathematics, which might, so far as time allows, be learnt at school; for instance, the use of Logarithmic Tables, and perhaps the solution of triangles by Trigonometrical Tables. There is the more reason for teaching these

practical processes, to the schoolboy, inasmuch as if not learnt then, they are rarely performed with facility and correctness by the student at the University: for though the theory of the processes is brought before him, he has not time to familiarize himself with the practice. I am persuaded that if boys at classical schools were well exercised in Arithmetic and Mensuration, with the use of Logarithmic Tables, they would find this a more congenial employment than going over the proofs of geometrical propositions; and would come to the University prepared to pursue their mathematical studies with alacrity and intelligence; instead of finding in them, as they so often do now, a weary and obscure task, which they engage in only as a necessary condition of some other object, and which produces little effect in that education of the reason which is its proper end.

SECT. 5. *Of preventing Superficial Reading.*

183 We have already said that, inasmuch as, in a good education, we must educate the Reason as well as the Literary Taste, we must require of our students a mathematical combined with a classical culture. To effect this combination is a matter of no small difficulty; among other accounts, on the account just alluded to;—that when we require of our students both classical and mathematical attainments, if one of the two subjects be looked upon with dislike, it will often be attended to in such a manner as to produce little intellectual improvement. The difficulty just spoken of does not at all liberate us from the obligation of pursuing our object. If the difficulty were insurmountable, a Liberal Education would be impossible, and we should have to consider whether it were worth the while keeping up our universities, as means of gratification for the lovers of classical or mathematical pursuits, when they were deprived of ulterior value. But

the fact is, that a Liberal Education is not impossible, as the experience of all ages has shown; and we have not any reason to despair that we may, by a proper adjustment of our educational institutions, educate at the same time the Literary Taste and the Reason. And as a part of these arrangements we must consider in what manner we may provide for a combined classical and mathematical culture, and may avoid the evils which arise from either of the two being forced and superficial, so as to produce no real and permanent impress on the mind.

184 One process by which we may hope to avoid the failures in the business of education which arise from forced and superficial study, is this: we must require evidence of the student's thorough knowledge of the lower parts of each subject, before we allow him to compete for the honours which are assigned to excellence in the higher portions. We must be well satisfied that he can construe common Latin and Greek correctly and well, before we allow him to aim at prizes which are to be won by writing Latin or Greek verses. We must be satisfied that he understands the common algebraical expression of a curve, and a common mechanical problem, before we give him credit because he writes down some wide generalization of modern analysts applied to curves or to mechanical relations. This precaution is far from being so superfluous as might be imagined; especially if the examination be a mere paper examination. For, in mathematics for instance, when the analytical generalization, correctly written, comes before the examiner, it is difficult or impossible for him to know whether the writer understood it, with its reasons and its bearings. And by accepting such a performance, when it is really a mere matter of memory, great injustice may be done to a competitor, who, not aiming at these ambitious generalities, has made himself fully master of the more

limited principles which he pretends to know, and is able to apply them in their proper significance.

185 We should, by these considerations, be led to recommend that, in the general Examinations of a University, students should be so examined that it shall appear that they are fully possessed of their lower mathematical subjects, before they are allowed to compete for the prizes which are assigned to high mathematical proficiency. Retaining the distinction which we have already explained, of Permanent Studies and Progressive Studies in mathematics, we may say, that all students should be ascertained to have attained a sound knowledge of the Permanent Mathematical Studies, before they are admitted as competitors to those examinations for honours, in which an acquaintance with Progressive Mathematical Studies is required. If this condition were established and enforced, we cannot doubt but that it would prevent students from hurrying on, in their reading, to the widest generalizations and newest methods of analytical authors, leaving the elementary principles and their simpler applications very imperfectly possessed and understood; a line of reading which there is reason to believe is now not uncommon.

186 Something of the same kind may be said of classical studies: but in these, the precipitate advance from the lowest to the highest usually takes place at an earlier period; often, as we have said, at school, before the student arrives at the University. The Examination by which this subversion of the due succession of the student's classical labours is to be prevented, ought therefore, in the state of things which here prevails, to take place at an early period of the student's University progress. Indeed, considering that the evil which it is sought to remedy, is one which prevails rather in the conduct of classical studies before the University career than during its progress, it would

seem that the purpose would be best answered by placing the Examination at the time when the student enters upon the University. An Examination taking place at that time, in which the power of construing Greek should be required, and a correct and familiar acquaintance with Latin, would secure to the Universities those conditions without which they cannot effectually discharge their office, namely, a higher Classical teaching than is given in Schools; and would in a short time produce a material improvement in those schools in which there exists such perversions of sound educational methods as I have spoken of.

187 Such an Examination, requiring a familiar acquaintance with Latin, and a competent knowledge of Greek, in every student who was admitted to reside in the University, might advantageously be combined with a thorough examination in Arithmetic; of which, for reasons above mentioned, a full and ready knowledge should be considered as requisite for every one entering upon his university career. If the students of our Universities began their College and University life with the attainments required in such an Examination as I have just described, (which are by no means beyond the reach of ordinary schoolboys,) and if, from the point thus secured, they were conducted onwards by a progressive scheme of College Lectures and Examinations to the final Examinations of the University, framed upon such principles as have been explained, I do not think it can be doubted that the Education of a great part of our students would be much more complete and satisfactory than it now is, without any impediment of any disadvantageous kind being thrown in the way of a love of knowledge and a love of honour such as now prevail.

188 I have spoken of a progressive scheme of College Lectures and College Examinations, by which men should be led to the final Examinations of the

University for Degrees. It will, of course, be impossible to frame a scheme which shall be suited to all the varieties of talent and attainments which will exist in a numerous body of students; and I have already said something of the means by which a general College System may be adapted to pupils of various degrees of ability and industry. But it is not necessary, nor is it desirable, that prescribed College studies should occupy the whole of the student's time of study. The more active and intelligent minds will find additional employment for themselves in favourite provinces of literature and science. Moreover, in addition to the course of instructions and Examinations appointed for the general mass of students, the Universities offer, to the more able and more ambitious among them, occasions and temptations to exertion, in the various prizes which have been at various times established; these prizes being, for the most part, held forth as the rewards of individual exertion, and not connected with any progressive Scheme of College and University teaching. I speak of Medals for Prize Poems, of University Scholarships, and the like. Such prizes are proper objects of ambition to those students who, by their previous attainments, or their energy, are able to strive for them without too much interrupting their participation in the general scheme of College and University teaching. But to make such prizes the student's main object in his University career, is to run into the errour which we have already mentioned (177). It is to look upon the University, not as a teaching, but as a prize-awarding body. The fatal consequences of the prevalence of such a view with regard to the general position of the University, we have already spoken of. We may add, that the effect upon the mind of the candidate himself is entirely adverse to the progress of his intellectual Education. He who employs his time at the University in a series of struggles for detached prizes,

is likely to go backwards, rather than forwards, in his intellectual culture, while this his practice continues. For the preparation for an examination or a prize, has, in its immediate influence, little that improves the mind. On such occasions, knowledge is acquired by forced efforts, for a temporary purpose, is imperfectly assimilated, and is soon lost again. In such a course, there is no connected system of study, no intellectual progress, no pursuit of knowledge and truth for its own sake. A University life, filled with such attempts, is a career of ambition, of which the objects are trifles, because they are stripped of their educational value. In order that the students may not be too much occupied with these merely occasional objects, it is desirable that the progressive scheme of studies which is sanctioned by the Colleges and by the University, should be invested with such dignities, honours, and advantages, as to make it the main object of the great body of the students;—the guide which regulates their studies, and the source from which they hope to derive their most valuable and most valued distinctions.

189 The views which I have brought forwards and attempted to establish in the preceding pages, offer many maxims which are applicable to the present state of Classical and Mathematical Teaching in the University of Cambridge;—some of them applying in support and confirmation of our present practices; others of them pointing out changes by which our system might become more efficacious in promoting a Liberal Education among our students. I shall take the liberty of tracing more particularly the application of remarks of the latter kind, in a spirit as far removed as possible from any willingness to find fault, or levity in proposing change. I have already said that several important changes have recently been introduced into the system of this University; others are still suggested; and it appears proper to consider what is the general ten-

dency of these changes, and whether it leads to a result of which we approve. I have endeavoured to lay down principles by which we may form some judgment on such points. But in order to apply these principles, I must place before the reader a general view of the recent changes which have been made in the Educational System of this University. After such a survey, we shall, I trust, be enabled to see how we may preserve what is beneficial in the tendencies of our recent changes, and how we may avert the evils which have been pointed out in the preceding pages as the results of errours in Educational Legislation.

Chapter III.

ON THE RECENT AND PRESENT CONDITION OF CLASSICAL AND MATHEMATICAL EDUCATION AT CAMBRIDGE.

Sect. 1. *Of Recent Changes in the Educational System of Cambridge*

190 The preceding remarks on the subjects of Educational study, and on the methods of Teaching such subjects, are, for the most part, general, and apply to all Institutions of the nature of Colleges and Universities. They have been stated however with a more special reference to the present condition of the University of Cambridge: and several of them will, I hope, be found to have a useful bearing upon the circumstances of that condition, and the matters which may come under discussion with reference to that subject. In order to prepare the way for such an application of what I have said, I must give some account of changes which have taken place in the University system in late years.

191 The system of the University, till within a few years, was one in which Logical Disputations on certain selected philosophical Questions were the main exercises: such Disputations being held both for the purpose of familiarizing the students with the doctrines of the received Philosophy, and of assigning due distinction to the best proficients in the art of disputation.

When the students had been duly exercised in this art for the appointed time in the Public Schools of the University, (for which they were prepared by

frequent Disputations in their own Colleges,) they were examined in the Public Schools by the Proctors, Moderators, and other Regent Masters of Arts; and their fitness for the Bachelor's Degree thus ascertained. The phraseology of our common University language, and of our formal documents, still indicates this state of things. Those who obtain our highest mathematical honours, are *Wranglers* or Disputants; those who are on the point of being candidates for the Bachelor's Degree are *Sophists*, or *Sophs*; also *Questionists*: the *Supplicat* for such a degree certifies that the candidate has performed all the *Responsions*, *Oppositions*, and other exercises, required; and he is presented by the *Father of the College* and admitted by the Vice-Chancellor as *idoneus ad respondendum questioni*.

192 In order that the reader may have a fixed point of departure, by reference to which he may understand the more recent changes, I will copy Dr Jebb's account of the exercises and examinations of the University as they existed in his time, that is in 1772. This account was applicable with little alteration till the change effected by the Grace of 1827.

After stating the manner in which the names of the students are collected in a book by the Moderators, Dr Jebb proceeds: "These Moderators are annually chosen upon the tenth of October. Their proper office is to preside, alternately, at the public exercises of the students; and to examine them, at the time of their offering themselves for their degree.

"These public exercises are held in the afternoon, for five days in the week during term time; the moderator appearing a little before two, and frequently continuing in the schools till the clock strikes four.

"Upon the first Monday after the commencement of the January term, the Moderator, whose turn it is to preside, gives written notice to one of the students

in his list, that it is his pleasure he should appear in the schools, as a disputant, on that day fortnight.

"This person, who is now called the 'respondent,' in a few hours after he has received the summons, waits upon the Moderator with three propositions or questions; the truth of which he is to maintain against the objections of any three students of the same year, whom the moderator shall think proper to nominate, and who on this occasion are called 'opponents.'

"The questions, proposed by the respondent, are written upon separate papers, according to a form, of which the following is a specimen:

"Q. S.

"Planetæ primarii retinentur in orbitis suis vi gravitatis, et motu projectili.

"Iridis primariæ et secundariæ phænomena solvi possunt ex principiis opticis.

"Non licet magistratui civem morti tradere nisi ob crimen homicidii."

"——Resp. Jan. 10mo."

"At the bottom of three of these papers, the Moderator writes the name of a student, whom he thinks capable of opposing the questions of the respondent, with the words, 'Opponentium primus, secundus, or tertius,' denoting the order, in which the opponents are to appear.

"One of these papers is sent to each opponent; and from that which remains, the Moderator, at his leisure, transcribes the questions, together with the names of the respondent and opponents into his book.

"When one Moderator has thus given out the exercise for a week, he sends the book to the other, who proceeds according to the same method, and then returns the book to his colleague.

193 "The fortnight for preparation being expired, the respondent appears in the schools: he ascends the rostrum, and reads a Latin dissertation, (called with

us a 'thesis') upon any one of the three questions he thinks proper; the Moderator attending in his place.

"As soon as the respondent has finished his thesis, which generally takes ten or fifteen minutes in the reading, the Moderator calls upon the first opponent to appear. He immediately ascends a rostrum opposite to the respondent, and proposes his 'arguments' against the questions in syllogistical form.

"Eight arguments, each consisting of three or four syllogisms, are brought up by the first opponent, five by the second, and three by the third.

"When the exercise has for some time been carried on according to the strict rules of logic, the disputation insensibly slides into free and unconfined debate: the Moderator, in the mean time, explaining the argument of the opponent, when necessary; restraining both parties from wandering from the subject; and frequently adding, at the close of each argument, his own determination upon the point in dispute.

"These exercises are improving; are generally well attended; and, consequently, are often performed with great spirit. But many persons of good judgment, observing, with pain, the unclassical Latin, generally uttered by the student upon these occasions, have maintained, that the knowledge of that language is not promoted by the present method of disputation; and have delivered it as their opinion, that these exercises should be held in English, in order to their absolute perfection.

194 "The three opponents, having, in their turns, exhausted their whole stock of arguments, are dismissed by the Moderator in their order, with such a compliment* as in his estimation they deserve: and

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* For instance, *Optimè disputasti.* Hence Senior and Junior Optimès.

the exercise closes with the dismission of the respondent in a similar manner.

"The Moderator, upon his return to his chambers, records the merits of the disputants by marks, set opposite to their respective names.

"This exercise, with the preparations for the subsequent examination in January, appears to be sufficient employment for the last year. And the apprehension of it is so alarming, that the student, after two years and a quarter's residence, during which time no proof whatever of his proficiency is required, frequently seeks to avoid the difficulty or disgrace, by commencing fellow-commoner, or, by declaring his intention of proceeding in Civil Law.

195 "These exercises being duly performed, the Vice-Chancellor appoints three days, in the beginning of the January term, for the examination of the 'Questionists:' this being the appellation of the students, during the last six weeks of their preparation.

"The Moderators, some days before the arrival of the time prescribed by the Vice-Chancellor, meet for the purpose of forming the students into divisions of six, eight, or ten, according to their performance in the schools, with a view to the ensuing examination.

"Upon the first of the appointed days, at eight o'clock in the morning, the students enter the Senate-house, preceded by a Master of Arts from each College, who, on this occasion, is called the 'Father' of the College to which he belongs.

"After the Proctors have called over the names, each of the Moderators sends for a division of the students: they sit with him round a table, with pens, ink, and paper, before them: he enters upon his task of examination, and does not dismiss the set till the hour is expired. This examination has now for some years been held in the English language.

196 "The Examination is varied according to the

abilities of the students. The Moderator generally begins with proposing some questions from the six books of Euclid, Plane Trigonometry, and the first rules of Algebra. If any person fails in an answer, the question goes to the next. From the elements of mathematics, a transition is made to the four branches of philosophy, viz. Mechanics, Hydrostatics, apparent Astronomy, and Optics, as explained in the works of Maclaurin, Cotes, Helsham, Hamilton, Rutherforth, Keill, Long, Ferguson, and Smith. If the Moderator finds the set of Questionists, under examination, capable of answering him, he proceeds to the eleventh and twelfth books of Euclid, Conic Sections, Spherical Trigonometry, the higher parts of Algebra, and Sir Isaac Newton's *Principia;* more particularly those sections which treat of the motion of bodies in eccentric and revolving orbits; the mutual action of spheres, composed of particles attracting each other according to various laws; the theory of pulses, propagated through elastic mediums; and the stupendous fabric of the world. Having closed the philosophical examination, he sometimes asks a few questions in Locke's *Essay on the Human Understanding*, Butler's *Analogy*, or Clarke's *Attributes.* But as the highest academical distinctions are invariably given to the best proficients in mathematics and natural philosophy, a very superficial knowledge in morality and metaphysics will suffice.

197 "When the division under examination is one of the higher classes, problems are also proposed, with which the student retires to a distant part of the Senate-house, and returns, with his solution upon paper, to the Moderator, who, at his leisure, compares it with the solutions of other students, to whom the same problems have been proposed.

"The extraction of roots, the arithmetic of surds, the invention of divisors, the resolution of quadratic,

cubic, and biquadratic equations; together with the doctrine of fluxions, and its application to the solution of questions "de maximis et minimis," to the finding of areas, to the rectification of curves, the investigation of the centers of gravity and oscillation, and to the circumstances of bodies, agitated, according to various laws, by centripetal forces, as unfolded, and exemplified, in the fluxional treatises of Lyons, Saunderson, Simpson, Emerson, Maclaurin, and Newton, generally form the subject matter of these problems.

198 "When the clock strikes nine, the Questionists are dismissed to breakfast: they return at half past nine, and stay till eleven; they go in again at half past one, and stay till three; and lastly, they return at half past three, and stay till five.

"The hours of attendance are the same upon the subsequent day.

"On the third day they are finally dismissed at eleven.

"During the hours of attendance, every division is twice examined in form, once by each of the Moderators, who are engaged for the whole time in this employment.

"As the Questionists are examined in divisions of only six or eight at a time, but a small portion of the whole number is engaged, at any particular hour, with the Moderators; and, therefore, if there were no further examination, much time would remain unemployed.

199 "But the Moderator's inquiry into the merits of the candidates forms the least material part of the examination.

"The 'Fathers' of the respective Colleges, zealous for the credit of the societies of which they are the guardians, are incessantly employed in examining those students, who appear most likely to contest the palm of glory with their sons.

"This part of the process is as follows:

"The Father of a College takes the student of a different College aside, and, sometimes for an hour and an half together, strictly examines him in every part of mathematics and philosophy, which he professes to have read.

"After he hath, from this Examination, formed an accurate idea of the student's abilities, and acquired knowledge, he makes a report of his absolute or comparative merit to the Moderators, and to every other Father who should ask him the question.

"Besides the Fathers, all Masters of Arts, and Doctors, of whatever faculty they be, have the liberty of examining whom they please; and they also report the event of each trial, to every person who shall make the inquiry.

200 "The Moderators and Fathers meet at breakfast, and at dinner. From the variety of reports, taken in connexion with their own Examination, the former are enabled, about the close of the second day, so far to settle the comparative merits of the candidates, as to agree upon the names of four-and-twenty, who to them appear most deserving of being distinguished by marks of academical approbation.

"These four-and-twenty are recommended to the Proctors, for their private Examination; and, if approved by them, and no reason appears against such placing of them from any subsequent inquiry, their names are set down in two divisions, according to that order, in which they deserve to stand; and afterwards printed; and read over upon a solemn day, in the presence of the Vice-Chancellor, and of the assembled University.

201 "The names of the twelve, who, in the course of the Examination, appear next in desert, are also printed, and are read over, in the presence of the Vice-Chancellor, and of the assembled University, upon a day subsequent to the former.

202 "Four additional names are generally inserted in the former list, (which is called the list of the Wranglers, and Senior Optimes) at the discretion of the Vice-Chancellor, two Proctors, and the Senior Regent; and the numbers are sometimes varied, from a regard to accidental circumstances. In the latter list, or that of Junior Optimes, the number of twelve is almost constantly adhered to.

203 "It is to be observed, that no student can be a candidate for the medals, annually given by the Chancellor, for the encouragement of classical learning, unless his name appears in the former of these lists.

204 "The students, who appear to have merited neither praise nor censure, pass unnoticed: while those, who have taken no pains to prepare themselves for the Examination, and have appeared with discredit in the schools, are distinguished by particular tokens of disgrace."

205 In this stage of the history of the University, the Disputations, to which as we have seen, great importance was attached, formed a prominent *vivâ voce* element in the system, and undoubtedly produced much of the beneficial effects which we have noticed as belonging to that element; namely, the sympathy of the students in a common subject (158), the fixation of their attention on difficulties and their solutions; the discipline of promptness and clearness in the disputant, as well as of knowledge, and also, as we have stated (165), the public evidence of the fitness of the Moderator for his important office.

206 But even in this stage, there were causes at work which tended to give the paper part of the system an ascendancy over the oral portion. One of the principal of these was probably the difficulty of combining the results of oral and written examinations in the arrangement of the candidates. We see in Dr Jebb's

account traces of considerable vagueness in the mode of aiming at this arrangement. The students were, as we have seen (195), formed into divisions of six, eight, or ten, according to their performance in the Schools, with a view to the ensuing examination; and the Moderators settled the comparative merits of the candidates from the variety of reports of the Fathers of Colleges, Masters of Arts, and Doctors of all Faculties: and then the list of Wranglers, Senior Optimes, and Junior Optimes, was formed. It must have been very difficult for the Moderators to avoid inconsistency and injustice, in combining such various elements of judgment; and accordingly, we have reason to believe that inconsistency and injustice were not always avoided. Examinations were, at that time, looked upon with unlimited hope and confidence, as instruments of good Education; for no inconvenience had yet been experienced from their prevalence. The Master of St John's (Dr Powell) had introduced a system of Examinations into his own college, which was conceived to produce a highly beneficial effect*. Dr Jebb himself was extremely desirous that the University should institute examinations in which each student should be examined every year.

207 After various exertions a Grace passed the Senate July 5, 1773, of which I subjoin a portion.

"Cum reipublicæ nostræ nonnullis interesse videatur, publicum quotannis totius Juventutis Academicæ examen institui, idque, Ipsi publicè nos et obnixè exposcant et efflagitent:

"Ne rem tam speciosam aut neglectui prorsus habuisse, aut tam novam tantique momenti temerè nimis et inconsulto arripuisse, Academiæ vitio vertatur:

"Placeat vobis," &c. It is decreed that all the Heads of Colleges, the three Regii Professors (of Divinity, Law, and Medicine), the Two Senior Tutors of Trinity and of St John's, and the Senior Tutor of every other College, be a Syndicate to

* Jebb's *Works*, Vol. II. p. 275.

deliberate on the propriety, and if adopted, on the details, of the Annual Examination.

We may see, in the phraseology of the above grace, very palpable evidence of impatience at the importunity which had pushed the proposal so far; and it cannot surprize us that the Syndicate when assembled rejected the proposal of an annual examination. This importunity had already been felt to be so troublesome, that Dr Powell had suggested the propriety of a grace to prevent Dr Jebb offering any more graces on this subject. And thus the proposal of annual University examinations was put aside.

208 Still, however, the University was not satisfied with the condition of its studies and examinations, as appears by the following Grace of the ensuing year; although it does not appear that the appointment of this Syndicate led to any practical result.

1774. Feb. 17. "Cum plurimis in ore sit; "Literas humaniores atque ipsa Matheseωs et Philosophiæ Naturalis Elementa penè inculta jacere, Juvenum animis vel secordiâ torpentibus, vel in quæcunque recondita, quæcunque sublimia, impetu quodam fervido ruentibus:

"Placeat vobis ut Ds Procanc., Dr Cooke, Dr Plumptre (Coll. Regin.), Dr Barnardiston, Dr Watson, Dr Hallifax, Dr Waring, Mr Beadon, Mr Collier, Mr Lambert, Mr Wilgress, Mr Dealtry, Mr Longmire, Mr Johannes Hey, Mr Farmer, Mr Gould, Mr Gardner, Mr Paley, Mr Squire, Mr Arnold et Mr Pearce sint Syndici vestri qui convocante Do Procanc. conveniant; collatisque inter se consiliis deliberent et dijudicent quonam potissimum modo hisce malis ingravescentibus nobis obviam sit eundum; et ut eorundem Placitum in scripta digestum, majoris partis totius numeri Syndicorum nominibus subscriptis, ante diem decimam sextam Aprilis proxime insequentis in Senaculo vestro publicetur: ita tamen ut quicquid iis visum fuerit minimè Statuti vim habeat nisi postea vestris suffragiis comprobetur."

No Report of this Syndicate appears in the Grace Book.

209 A few years later, in 1779, we find indications

of the growing importance of the Examinations of the Questionists, of which we have spoken. The Moderators of the preceding year are added to the existing Moderators, as Examiners; and an attempt is made to provide time for the Examinations of the Prælectors and others. The "Classes quam minimæ," here spoken of, as to be published on the fourth day, were familiarly called the "Brackets." In order to give a more complete view of the history of our studies and exercises, I insert two other Graces passed at the same time, referring, one to the Examination in Moral Philosophy, and the other to the requirement of a knowledge of the Elementary before the Higher parts of Mathematics.

1779. Mar. 19. "Cum Philosophia Moralis in Examinatione Quæstionistarum quæ per tres dies continuos in mense Januarii haberi solet, plerisque nimium neglecta videatur idque temporis angustiæ partim, aliis partim causis deberi constet:

"Placeat vobis ut"...The Examination to be continued till 5 p.m. on the fourth day: and on the third day the Examiners to propose *vivâ voce* Questions only in Natural Religion, Moral Philosophy, and Locke.

Mar. 20. The Moderators, and the Moderators of the preceding year to be the Examiners for B.A. These four Examiners to examine only two Classes at a time:—"Quo cautum sit ne Quæstionistæ ab Examinatoribus nimium occupati, aliorum Regentium et Non-Regentium Examinationi minus vacare possent:" except in the examination on the third day in Moral Philosophy.

Mar. 20. On the fourth day the Examiners with the Proctors, at 10 a.m. to place at least thirty names "Optimè merentium in Classes quam minimas prout singuli mereri videantur," and the Examiners to have the opportunity of assistance "Prælectorum aliorumque qui examinaverint, priusquam finalis Honorum designatio fiat, in quâ Moderatores anni præcedentis et Moderatores pro tempore existentes idem valeant."

Same Date. "Placeat vobis ut Tutores Collegiorum Pupillos suos certiores faciant, Senatum velle, et deinceps pro Regulâ, cujus observantiæ Examinatores quotannis instituti sese devinctos intelligant, esse habendum:—

Quod nisi quisquam in Euclidis Geometriæ Elementis et in notissimis Philosophiæ Naturalis partibus versatissimum se exhibuerit, altiora Matheseos nequicquam se assecutum sciat: Quodque in toto Scientiæ Campo Eruditionem limatam perspicuamque potius quam diffusam Honores Academici maneant.

"Postremo ut Regulæ jam sancitæ in omni examinatione in posterum publicè in Senatu habendâ pro Gradu Baccalaureatûs in Artibus serventur."

210 The main subject of the University's solicitude hitherto appears to have been those students who were candidates for honours; the *few;* but in 1791, we find an important Grace, which contemplates the case of the *many*, and establishes a classification of the sophists who fell below the Junior Optimes. These are familiarly called the *Polloi;* and we shall take the liberty of using this name. The Grace by which they are recognized is as follows:

1791. Ap. 8. "Cum in solenni Sophistarum Examinatione complures Sophistarum quotannis reperiantur de quibus non satis cautum sit ut Honores Academicos aut mereantur aut optent: cavendum sit tamen ut nequis temere ignominiâ notetur:

"Placeat vobis ut duo Examinatores anni præcedentis constituantur denuo Examinatores qui Sophistas honoribus Academicis non insigniendos examinent et eorum nomina in quatuor classes videlicet quartam, quintam, sextam, et septimam pro merito distributa publici juris faciant; ita tamen ut nomina in quâcunque classe ordine alphabetico, si ita examinatoribus placeat, recenseantur, et ut septima vel sexta vel etiam quinta classis vacare possit, si eorum omnium merita vel sextam vel quintam vel quartam videantur vindicare."

It is provided that the rights of Proctors, Moderators, Regents, Non-Regents to take part in the Examinations are not to be diminished.

It is added,

"Placeat vobis ut dictorum Sophistarum nomina ne prelo committantur."

211 So far as I am aware, this law of the Univer-

sity has not been superseded by any subsequent Grace. Its directions are very plain:—that the *polloi* are to be divided into classes not more than four; that in each class, the names are to be arranged alphabetically; and that the names, though published, are not to be printed; that is, not printed by authority, as those of the first three classes are. These are very proper and reasonable directions; for an arrangement of the *polloi* according to merit in greater detail, can hardly be effected. The amount of their performances does not allow of an arrangement of each person according to merit; and any attempt to effect such an arrangement, can hardly fail to perplex the Examiners, and mislead the public. If there be 200 of the *polloi*, there cannot be 200, nor 100, nor 50 distinguishable shades of merit among them; and to throw them into four alphabetical classes, is sufficient for their encouragement and guidance. Yet, in this respect, the Grace has been habitually neglected in modern times. I do not know whether it was ever literally obeyed; but, of late years, the whole body of the *polloi* have been arranged in an asserted order of merit, man by man. I believe the inconvenience and difficulty of this proceeding have recently become matter of general notice; and I hope the Examiners in future will remedy these evils by conforming to the law of the University; which, as I conceive, they are bound to do, or, at least, fully justified in doing.

The direction, that the names of the 4th, 5th, 6th, and 7th classes were not to be printed, was suggested, I presume, by the belief that such a notification of these classes would put them too much upon a level with the mathematical *Honours*. The names are not printed on the *Tripos Papers*, as those of the Wranglers, Senior Optimes, and Junior Optimes are; or in the *Cambridge Calendar*. It would, probably, be neither necessary nor easy to prevent lists of the other

classes being circulated in print, now when every thing is printed. But the Examiners may easily, and with great public advantage, conform to the Grace so far as their own conduct is concerned.

212 The Disputations of the *Sophs*, at this period regulated, as we have seen, the Classes *before* the Examination, and had a great share in determining academical reputations. They were a matter of great general interest; and this interest it was wished to maintain. They had hitherto been held after dinner, that is, from two o'clock in the afternoon till four; and it was a common habit of students and of graduates to resort to the Schools after dinner, to witness these exercises. But when the general dinner-hour became later, a corresponding alteration was made in the hours of the disputations by a Grace, which thus begins:

1792. Feb. 14. "Cum Academiæ nostræ plurimum intersit ut sophistarum disputationes quam maxime frequententur, tempora autem hisce peragendis assignata parum convenientia et opportuna jamdiu evaserint:"—

And it provides that thenceforth these exercises shall take place from three o'clock to five in the afternoon.

213 The next step of legislation on the subject implies a growing importance in the Examinations. It is as follows:

1808. Dec. 1. "Cum visum sit plerisque eorum qui nuper in annuâ sophistarum examinatione versati sunt, tempus examini accurate habendo vix sufficere, atque etiam in ratione examinis instituendi quædam in melius mutari posse: Placeat vobis ut Ds Procancellarius, Mr J. Wood, Mr Tavel, Mr Hudson, Mr Barnes (Coll. Regin.), Mr Hornbuckle, Mr Woodhouse, una cum duobus hujus anni moderatoribus, sint syndici vestri, qui collatis inter se sententiis videant utrum aliquid de hâc re vestris suffragiis stabiliendum proferre expediat."

This Syndicate offered recommendations which were confirmed by a Grace, Dec. 15. A fifth day was added

to the Examinations: the Moral Philosophy was made the subject of the fourth day, instead of the third; and the *Brackets* were arranged and examined on the fifth day, instead of the fourth.

214 About this time, or soon after, a new cause of change began to work extensively in the University; namely, the introduction of new mathematical methods among the students of mathematics. The state of mathematics, as then existing in the University, was by no means unsatisfactory, at least, as an instrument of Education. At a period somewhat earlier,—I suppose, soon after the rise of paper examinations,—Manuscript Treatises; privately circulated, had been the main subjects of dependence and study; a result likely to follow from paper examinations. And this state of things produced its natural consequence. The ingenuity and energy of the students was employed, not in overcoming the real difficulties of a standard course of mathematics, but in trying to divine and prepare for the line which the examination would take. But before 1800, this evil had been, in a great measure, remedied by the publication of standard works, and their general acceptance in the University. Such works were Dr Wood's *Algebra*, *Mechanics*, and *Optics;* works admirably constructed for their purpose. About the same time Professor Vince published his *Trigonometry*, his *Fluxions*, his *Hydrostatics*, and his *Astronomy:* but these were works deficient in the judicious selection and simple exposition which belonged to Dr Wood's books; and their influence was much more limited and short-lived.

Besides these works of Wood and Vince, the Mathematical Course at Cambridge might be considered to include the works of Cotes and Attwood, and the *Principia* of Newton. And these works, well studied, were, as I have said, by no means a bad system of mathematical education. Those who had mastered

these works, had overcome the main difficulties of the subject; had possessed themselves of a great store of beautiful examples of mathematical logic and mathematical ingenuity; and could solve most problems of the kind with which English mathematicians had commonly dealt. A person who, at this period, obtained a high mathematical honour, had commonly acquired a command of certain mathematical methods, and a love of mathematics, which he retained through life.

215 But about the time of which I am speaking, the most active-minded English Mathematicians began to perceive that the methods of the French analysts were more powerful, or, at least, more general and symmetrical, than their own: and this perception made them discontented with some of the treatises in common use, which I have mentioned. As this feeling grew stronger and more diffused, it led to the publication of Treatises, on various parts of mathematics, of a more analytical character than those which were previously in use. The processes contained in these Treatises gradually made their way into the University Examinations; and, in the end, displaced altogether the former standard course. Among the most important of the works which produced this effect, I may mention the *Trigonometry* of Professor Woodhouse, and the Translation of Lacroix's Elementary Treatise on the *Differential and Integral Calculus*, by Messrs Herschel, Peacock, and Babbage. I cannot avoid noticing also my own works on *Mechanics;* since the number of editions through which they have gone, and the form given to the subject in more recent Treatises by other authors, show that they had a share in this change, notwithstanding their great defects, of which I am well aware.

216 The persons who produced this revolution in the mathematical literature of Cambridge, laboured in

an honest zeal, with the object of substituting, as they conceived, a better kind of mathematics in the place of a worse. But their success in this respect was a source of considerable inconvenience to the University, with regard to her Educational System. For the standard of her mathematics being again unsettled, while her main machinery was mere Examinations, she was driven towards the peculiar evils belonging to such a combination;—the reign of manuscript treatises, or of printed books quite as transient in their circulation; and the universal dependence upon private Tutors.

Moreover, the nature of the new kind of mathematics, addressing itself, as analysis does, to the eye, and difficult to express in an oral form, made the disputations in the Schools much less intelligible and interesting, and gave an increased importance to the paper Examinations.

217 We have, in the following Grace, an indication of a tendency to some alteration, as early as 1818; although the great change did not take place till nine years later.

1818. Dec. 4. "Placeat vobis ut Ds Procancellarius, Regii Professores Sacræ Theologiæ, Legum, Medicinæ, et Græcarum Literarum, Prof. Calvert, Prof. Sedgwick, Mr Bridge, Mr Woodhouse, Mr Turton, Mr French, Mr Griffith, Syndici vestri constituantur, qui deliberent annon examinationes pro Gradibus novari et amplificari expediat; et si illis aut eorum majori parti (quorum unus semper sit Procancellarius) videatur bonum, qui regulas ad vos referant quibus nova examinatio administretur."

In the Syndicate thus appointed, there prevailed great diversity of opinion upon some particulars; and, through an anxiety felt by the Syndics to satisfy every scruple entertained in the University, the Proposal resulting from their deliberations, fell far short of the general expectation, and did not reach the views of the

Syndics themselves, as one of them* informed the public.

218 In the course of a few years, the Examinations became the only part of the University exercises in which any interest was taken: the disputations, as I have already said, fell into neglect. At the same time the evils of the want of a Standard of study, fixed and known, were felt; and the old evil so forcibly described in the Grace of 1779, was still complained of;—that students, neglecting the Elementary parts of Mathematics, sought to obtain distinction by lucky hits in the higher portions.

The Grace by which it was attempted to remedy these evils, may be considered as the foundation deed of our present system. In order to understand it fully, it may be mentioned, that there had been much discussion in the University respecting the advisableness of introducing other subjects, as well as Mathematics, into the University Examinations. In 1821, Dr Wordsworth, the Master of Trinity, then Vice-Chancellor, proposed a plan for examining the students in Classics and Theology, which met with considerable support, but was rejected by the majority of voices in the Non-Regent House. But in 1822, the "Classical Tripos" was established, as I shall afterwards have to mention; and in this same year, it was also directed by a Grace that those who were not candidates for mathematical honours, should be examined on the fourth day, in the first six books of the *Iliad* and of the *Æneid*. It is to be recollected, also, that in the mathematical examination for honours, as then existing, certain hours for each class were assigned to the solution of "problems" proposed on paper, and certain hours to the answering of "questions from books," which questions were pro-

* Dr Monk, in a pamphlet published under the name of *Philograntus*.

posed *vivâ voce*, though the answers were given on paper. The previous classes determined, at least in supposition, by the exercises performed in the Schools, were at this time six in number.

219 I proceed to give the Grace of which I have spoken and the concomitant Graces.

1827. Mar. 30. "Quoniam experientiâ recentiore compertum sit quod examinationes pro gradu Baccalaureatûs in Artibus minus commodè constitutæ sint, tam propter hodiernam Academiæ frequentiam quam propter studiorum ipsorum mutationem:

"Placeat vobis ut Ds Procancellarius, Dr Wood, Dr French, Domini Procuratores et Moderatores, Mr Peacock, Mr Gwatkin, Mr Whewell, Mr Graham, Mr Chevallier et Mr King, Syndici vestri constituantur, qui de his examinationibus ordinandis consulant et ad vos intra tres menses referant."

Jan. 30. The Syndicate was continued: and was directed to report before the end of Lent Term, 1828.

Nov. 14. The Report of the Syndicate was confirmed; To this effect: Two days to be added to the Examination: five hours added to the time employed in answering Questions from books: the time for Problems unaltered:

Four previous Classes to be made instead of six: the Examiners enabled, when they think fit, to give the same examination to all: the first two days to exclude the higher and more difficult parts of mathematics: the Grace of 1779 is referred to.

The Examinations on Friday to exclude the Differential Calculus: on Saturday, to include the simpler applications of the Calculus. The Questions hitherto proposed *vivâ voce* to be printed. It was hoped, as the Syndics stated, that by this means, the questions might be more generally known, the

students better directed in their reading; the studies of the University become more fixed and definite; and an opportunity be afforded of seeing that all the subjects were duly introduced. The *vivâ voce* part was to contain only propositions contained in the mathematical works commonly in use in the University, or simple examples and explanations of such propositions. Examination papers were not to contain more than can be done in the time. There was added a Table of Times: the Table of Friday, Saturday, Monday, Tuesday, dividing the Examinations of the Four Classes among the two Moderators and Two Examiners. Wednesday, Vacant. Thursday, "as at present." Friday, Brackets. The Report was signed as follows:

Ch. Wordsworth, V.C.	W. Whewell.
J. Wood.	J. Graham.
W. French.	T. Chevallier.
J. Tomkyns, Senior Proctor.	Joshua King.
S. Pope, Junior Proctor.	Henry Coddington.
Geo. Peacock.	W. Maddy.
R. Gwatkin.	

220 1828. March 5. The Bishop of Lincoln, Dr Wordsworth, Dr Turton, Mr Coddington, Mr Maddy, were added to former Syndicate.

May 21. Report on Examination for Ordinary Degrees: that is, those of the *Polloi:*—the Examination to commence the same day as the Examination for Honours: The Examiners' provinces divided: Examination of two equal divisions at separate times. Subjects, Euclid, Arithmetic and Algebra. Homer, Virgil, Paley, Locke: The Examination to be by papers: The Questions to be elementary: Euclid papers to contain twelve propositions

each: Trigonometry and Natural Philosophy at the discretion of the Examiners.

221 Further alterations were soon made.

1831. Mar. 18. "Placeat vobis ut Ds Procancellarius, Dr French, Dr Graham, Prof. Whewell, Mr J. Brown, Mr Gwatkin, Mr King, Mr Cape (Clar.), Mr Bowstead, Mr Hall, Mr Challis, Mr Hanson, Mr Miller, Syndici vestri constituantur, qui consilium ineant et deliberent utrum aliquid in modo Questionistas examinandi qui Academicos honores ambiunt mutari debeat necne, quique ante 26 Maii ad vos referant."

June 1. The Syndicate was re-appointed, to report by the end of next term.

Nov. 16. Mr Martin was added to the Syndicate.

Dec. 6. The time was extended to end of next term.

1832. April 6. Their Report confirmed: The Examination for Honours in Mathematics to be five days instead of four: four hours and a half added: four hours to Questions from books: half an hour to Problems: during the first four days of the Examination the same questions to be proposed to all the classes: the first day to exclude Differential Calculus: the second and third day to include the simpler applications of that Calculus: the fourth day, subjects of greater difficulty with some lower questions: the fifth day, the Classes to be divided between the Two Moderators and Two Examiners.

222 1836. "Placeat vobis ut Ds Procancellarius, Dr French, Dr Graham, Mr Peacock, Mr Whewell, Mr Hughes (Joh.), Mr Bowstead, Mr Smith (Caius), Mr Philpott, Mr Phillips, Syndici vestri constituantur qui inter se consulant utrum expediat immutare aliquid in Examinationibus Sophistarum Juniorum et Quæstionistarum."

1836. July 2. The Syndicate was re-appointed, to report by the end of next term.

1837. Feb. 22. Their Report confirmed:—Subjects for *Ordinary Degrees:* The Acts: one of the Greek and one of the Latin Classics: Paley's Moral Philosophy: and Mathematics according to a Schedule: previous Notice of the Classical Subjects to be given: the Examinations to commence on the Wednesday preceding the first Monday in Lent Term: a Schedule given of Arithmetic, Algebra, Euclid; Mechanics; Hydrostatics: Four Examiners to be elected in October for Classics, The Acts, and Paley: The Moderators of the next but one preceding year to be Examiners in Mathematics.

223 New alterations were made.

1838. May 16. "Placeat vobis ut Ds Procancellarius, Dr French, Dr Graham, Prof. Peacock, Prof. Miller, Mr Whewell, Mr Hymers, Mr Hopkins, Mr Philpott, Mr Thurtell, Mr Phillips, Mr Steventon, Mr Mills, Syndici vestri constituantur qui consilium ineant et deliberent utrum expediat aliquid immutare in modo Quæstionistas examinandi qui honores Academicos ambiunt:" to report before division.

May 30. Their Report confirmed: A Sixth day added: the Examinations to commence on the Monday preceding the first Monday in Lent Term: the previous Classes to be discontinued: the same questions to be proposed "to all whom the Moderators shall judge, from the public exercises in the Schools, to be qualified for examination as Candidates for Mathematical Honours."

The same rules as before are enjoined respecting the easier subjects on the earlier days, and the number of questions in each paper. The result to be published on the Friday; and if any doubt exists, re-examination to take place.

224 The Examinations have since been administered as thus constituted. But still, some dissatisfaction arose in the University respecting the Elementary part of the examination. It was conceived that the portions of Mathematics which have in England commonly been called "Natural Philosophy," were too much superseded by now the more favourite analysis. Hence the following Grace was passed.

1840. Mar. 18. The former Syndicate re-appointed "quo consilium ineant utrum expediat leges accuratiores præscribere de parte examinationis elementariâ et præsertim de numero et naturâ questionum e partibus Philosophiæ Naturalis simplicioribus selingendarum:" — to report by May 16.

This Syndicate did not report by May 16. On May 20, a Grace was proposed for extending the time to June 1, but was refused in the Caput, on the ground that the Syndicate was extinct.

225 It will be seen, that from 1827 to 1838, these acts of the University made a series of changes, all in the same direction. The previous Classes, which had been framed merely upon the performances of the Disputants in the Schools, and which were subject to different examinations, were gradually abolished. In 1827, these Classes were reduced from six to four; and the examiners were enabled, when they thought fit, to give the same examination to all. In 1832, the examination for the first four days was ordered to be the same for all, and the Classes were divided only on the fifth day. In 1838 the Classes were discontinued, and the same questions were to be proposed to all the candidates.

226 A great ground of the disposition to abolish these Classes was the difficulty which was experienced in doing justice to the different Classes, in comparison with one another. The Examiners, in giving different questions to different Classes, endeavoured to proportion the difficulty of the questions to the attainments of

the Class; and again, to proportion the credit to the difficulty, in judging the answer. The credit was generally estimated in *marks*, and a certain scale of marks allowed to each class. If the questions proposed to the lower Classes were proportionably too easy, the members of those Classes obtained more marks than those who, being in the higher Classes, had probably read higher parts of mathematics than they had. And undoubtedly it must always be difficult to combine, into one arrangement, the result of different examinations. An examination such as that which was finally established, in which the same questions were proposed to all the candidates, has, in that respect a very great advantage, as a means of forming a just list of merit.

227 Another series of changes which took place was, that the length of the examination was gradually increased. In 1779, as we have seen, a fourth day was added to the examinations. In 1808, a fifth. In 1827, two days more were added; making the days for the Mathematical Examinations the Friday, Saturday, Monday, and Tuesday preceding the final Friday, on which the Brackets were to appear. In 1832, five days, instead of four, were appointed for the Mathematical Examination; and in 1838, a sixth day was added to this part of the examination; and so stands the law and the practice at the present time. The length of the examination, however, on each day was diminished in the course of the changes.

228 While more time was assigned to the Candidates to write, more time was also required for the Examiners to read what was written. From 1808 to 1827, when the examinees were set to write during Monday, Tuesday and Wednesday, on an average for six hours a day; and the Examiners had, besides attending at the times of examination, to read and judge the whole mass of answers, so as to bring out the Brackets on Friday morning, their labour was very

severe, and could rarely be gone through without devoting to it many hours of the night. Since that period, the beginning of the Examination has been shifted earlier and earlier; and is now (in practice) sixteen days previous to the final Friday, in the case of candidates for mathematical honours.

229 There is another series of changes noticeable in the Graces which I have quoted. The additional time assigned to the Examination is almost entirely appropriated to "Questions from Books," to the exclusion of "Problems." In 1827, five hours were added to the time employed in answering Questions from Books, while the time for Problems remained unaltered. In 1832, four hours were added to the time for Questions, half an hour for Problems. Up to 1827, there had been given by each class about ten hours to Questions and eight hours to Problems (for those who were willing to take so much.) At present, in an examination of six days, and of $5\frac{1}{2}$ hours each day, only $8\frac{1}{2}$ hours are given to Problems, and the remaining $24\frac{1}{2}$ to Questions from Books.

230 We may further remark, as running through all those acts of legislation, a solicitude which we have already noticed as existing in the governors of the University; namely, that the more elementary portions of mathematics should not be neglected in the attention given to the higher portions. The Grace of 1827 refers to the Grace of 1779, which is to this effect; and directs that the Examination on the first two days shall exclude the higher and more difficult parts of mathematics. On the first day, the Differential Calculus is altogether excluded; on the second day, its simpler applications only are to be admitted. The same direction is given in 1832. And the same disposition, I believe, prompted the Grace of 1840, which, as we have seen, led to no result.

I believe the same wish to avoid recondite and dif-

ficult parts of mathematics led the Syndicates to appropriate the time which they added to the Examination to Questions from Books, rather than Problems. It was supposed that the former were more likely to test the Candidates' knowledge of the Principles of the Subjects of Examination. Perhaps this is not universally the case. A person may answer by rote a Question from a Book: in order to solve a Problem by means of a Principle, he must see the Principle with some degree of clearness.

231 One cause of the difficulty of securing due attention to the Elementary portion of Mathematics is the want of books upon those subjects recognized among us as the standards of our course of study. It appears to have been thought that the establishment of such standards might be left to the general tacit understanding and tradition of Examiners and Tutors. The Syndicate of 1827 expresses its hope, that by the adoption of its scheme, the questions (hitherto delivered *vivâ voce*, but thenceforth printed) might be more generally known, the students might be better directed in their reading, the studies of the University might become more fixed and definite, and an opportunity might be afforded of seeing that all the subjects were duly introduced. The *vivâ voce* Examination, as it had till then been called, was to include only "propositions contained in the mathematical works commonly in use in the University, or simple explanations and examples of such propositions." Moreover in order to discourage the examinees from picking out, in each Examination paper, the higher and passing over the Elementary parts, each Paper of Questions was not to contain a greater number of questions than could be properly answered in the assigned time. The same rules were repeated in the Grace of 1838, the last of those which regulate our Examinations. Notwithstanding these provisions, the Grace of 1840 instituted

an enquiry "whether it be expedient to lay down more exact rules respecting the Elementary part of the Examination, and especially the selection of the simpler parts of Natural Philosophy." This implies, what we know to have been the case, in the opinion of several members of the University, that the Studies of the University had not become fixed and definite; that the questions were not such as the students anticipated; nor all the subjects duly introduced. The language of this Grace appears to imply a suggestion of an authoritative selection of the simpler parts of Natural Philosophy. There had already been an example of such a selection on the part of the University. The Grace of 1837, modifying the Examinations for Ordinary Degrees, gave a Syllabus of the Elementary Parts of Mechanics and Hydrostatics, which became from that time the authoritative guide of a portion of the University Examinations*.

232 It is believed, by many persons in the University, that the defects which have been referred to still exist; that the want of fixity and definiteness in the studies of the University, and the frequent frustration of the anticipations of the candidates as to the questions which will be asked, are still felt, in a sufficient degree to make it worth while to consider whether some remedy cannot be found. It is probable, too, that these defects prevent the mathematical knowledge

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* I believe this mode of defining the portion of Mechanics and Hydrostatics required for the common degrees has been found satisfactory. Such a system may lead to the examinee giving propositions by rote, but not more than the Examination in Euclid may do so. The effectual remedy for this would be a few questions *vivâ voce* in each subject. It is said that the Algebra which is required in this Examination is very imperfectly given. I believe it will continue to be so, as long as young men come from classical schools destitute, as they commonly are, of all familiarity with Arithmetic.

of our students from being sound and coherent; for their attention during their studies is directed, not to overcome the real difficulties of the subject, but to seize some such portion of it, or to put it in some such form, as may fall in with the turn that the Examination may take.

These evils are included among those which I have pointed out, as likely to result from a System of mere paper Examinations, especially if the distinction of Permanent and Progressive Educational Studies be neglected, and if the branches of Mathematics be treated in an Analytical manner. And I must now say a few words respecting the remedies for these evils, as they are suggested by the train of considerations in which we have already been engaged.

Sect. 2. *Suggestions of Improvements in the Educational System of Cambridge.*

233 We have already seen that it is important, in an Educational course, to attend to the Permanent, before proceeding to the Progressive portions of Mathematics: that these Permanent Mathematical Studies ought to be laid before the student in standard works: and that such works must be geometrical rather than analytical in their treatment of the subject. I shall proceed to follow out these remarks into further detail, in their application to the present state of the studies at Cambridge.

234 A Standard System of the more Elementary portions of Mathematics which constitute our Permanent Studies in that department, has been always, in some degree, assumed in the University legislation on this subject. Nor does it appear likely that we shall avoid the evils which have been and are complained of, till such a Standard is in some way established.

I shall offer a few remarks containing views which seem to me fitted to direct those who may be entrusted by the University with the office of selecting a course of standard works, and thus fixing the Permanent Mathematical Studies of the University.

235 I have already shewn that the use of analytical methods has rendered the branches of Elementary Mathematics less suited for Permanent Educational Studies; taking in order Geometry, Trigonometry, Conic Sections, Statics, Dynamics, and Astronomy (46—51). This might be illustrated still further by instances of the changes which have taken place in the books in common use in the University of Cambridge. For instance, by adopting books which employ the analytical method of establishing the properties of the Parabola, Ellipse, and Hyperbola, the subject of Conic Sections has lost all its value, both as an example of geometrical reasoning extended into a new region, as an historical province of mathematics, and as an introduction to the reading of Newton's *Principia*. Looking particularly at the matter in the latter point of view, we may venture to say that a student who knows no other methods of drawing tangents and circles of curvature to the Conic Sections, than are given in the analytical treatises, as now current among us, is not likely to see the meaning of Newton's reasonings concerning the Conic Sections, and curves in general, in the first book of the *Principia*. If, in our standard mode of treating the subject, we draw tangents and circles of curvature by the Method of Limits, or some equivalent geometrical reasoning, the reference in Newton's proofs to the properties so established, is consistent and intelligible. But if we acquire our knowledge of the properties of Conic Sections by general analytical formulæ, the introduction of a few geometrical steps of Newton's reasoning, as a sequel to such formulæ, is incongruous; and must appear to the student a mere

arbitrary convention. If Geometry is to be expelled from Conic Sections, it must be expelled from Cosmical Dynamics also; and Newton must be replaced by Analytical Mechanics. But we are to recollect that, when this is done, besides the regret which we should feel in thrusting out Newton from our course of mathematics, what we have got in the place of our former system, is of little or no value as an instrument of Education. If Newton's Propositions are not worth proving in his own way, in our Educational Course, they are not worth proving in any way. If Conics is not worth retaining in a geometrical form, it is not worth retaining at all. It is true there are difficulties in Newton's reasonings; but it is by understanding these difficulties, and their solutions, that the reasoning of Newton becomes instructive. It is true, that the special properties of Conic Sections, in the geometrical method, require special reasonings; but these reasonings constitute what the mathematical world has always understood by Conics, as a province of mathematics. A person who is acquainted only with analytical treatises, knows nothing of Conics, in the sense in which the word has always heen used by all mathematicians.

236 I should, therefore, recommend that in our standard course of studies, the properties of the Conic Sections should be established by special geometrical reasonings; at least, so far as concerns the properties of the tangents, those of the circles of curvature, and the properties of oblique ordinates, which connect the other two sets of properties. The remaining properties, those regarding the asymptotes of the Hyperbola and the intercepts of its chords, for instance, may be proved by Algebra; for these algebraical proofs are instructive in themselves; and these properties are not directly connected with the others.

I shall, in the subsequent part of this volume, give a scheme of a standard course of Mathematical Studies;

and shall there endeavour to point out how Conics, among other subjects, may be read.

237 Again: that the subject of Mechanics has been rendered less valuable as a part of our Education, by the analytical character which has been given to its Elementary portions, I cannot but believe; although I fear I have had some share in bringing about the change. Dr Wood's Treatise on the subject might be considered as the standard work in the University, at the beginning of the present century. Among the peculiarities of this work, as we may now call them, were Newton's proof of the Composition of Forces, which goes upon the supposed identity of Statical and Dynamical Action; the Laws of the Collision of Bodies, also proved according to Newton; the Laws of Falling Bodies, Cycloidal Pendulums, and Projectiles, proved as Cotes had proved them, by elegant geometrical methods. The rest of the book, the properties of the Mechanical Powers and of the Centre of Gravity, had long had their places in elementary works on Mechanics. In this compilation, brief and simple as it was, there was no part which had not both a historical value and a geometrical rigour of proof. I do not think that any of the parts of the subject which I have mentioned deserved to be rejected out of our system, although it might be very proper to introduce other modes of dealing with these mechanical problems, as comments upon the standard proofs, and as preparations for the higher mathematical studies. The newer modes of treating mechanical questions employed in rival works, were more instructive when compared with those older and simpler reasonings; and it is to be regretted that Dr Wood's *Mechanics* has been allowed to vanish from among the books current in the University*.

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* I am aware that a Volume was published in 1841, calling

238 I seem to be justified in speaking of my own book on *Mechanics*, as the successful rival of Dr Wood's, by the number of editions which it has gone through*; and by the so-entitled "New Edition" of Dr Wood's having adopted all the peculiarities in which it differed from Dr Wood's. The main features of difference, the distinction of Statics from Dynamics, and the statical proof of the Composition of Forces; features which give a new form to the subject of Elementary Mechanics, may, I think, be considered as having been fully accepted by the University. In the last edition of the work (the sixth) I endeavoured to make it approach more nearly than before to what a standard work ought to be; namely, as I there stated, "that it should consist of the principal, or *classical* propositions of the science, and of the other propositions which the proof of these renders indispensable." In one respect I fear that I have carried this principle too far; namely, by excluding "the Mechanical Powers" from the book, as being not an indispensable part of the subject, but mere examples;

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itself a New Edition of Dr Wood's *Mechanics*; but this publication does not at all diminish the force of what I have said. There is, in this "New Edition" scarcely a vestige, either of Dr Wood's general arrangement, or of his treatment of particular questions; for the modes of teaching every subject appear to me to be taken from the rival works which had been published in the seventeen years elapsed since the last edition (the seventh) of Dr Wood's *Mechanics*. For instance, every one of the peculiarities of the work which I have above noticed in the text is obliterated: the Division of Statics and Dynamics, the statical proof of the Composition of Forces, the analytical investigation of the Resultant of Forces, and, I think, every noticeable feature in which Dr Wood's rivals differ from Dr Wood, are adopted. It is still to be hoped that some member of Dr Wood's College will give the Cambridge world a new Edition of his *Mechanics*.

* The work has also been extensively used in Educational Institutions in other parts of the British Empire and in America.

and further, as being examples not scientifically classified, but received by blind tradition from the later Greek mathematicians. On these grounds, I excluded the Mechanical Powers from the Elementary Treatise on Mechanics, giving them in a more complete form in the "Mechanics of Engineering." But I might more properly have said that these "Mechanical Powers" have so constantly had a place in Treatises of Mechanics that they are to be deemed Classical Propositions in the subject; and though they are not a complete classification of the simplest Mechanics, they serve very well to point out the mode of dealing with most statical problems. With the exception of the Toothed Wheel, the Wedge and the Screw, indeed, the Mechanical Powers are included in the University list of Propositions for the *Polloi;* but I should propose still to make them part of the standard Elementary Treatise of Mechanics, as they stood in the fifth edition of my own work.

239 There is one part of Dr Wood's *Mechanics* which it would be desirable to retain, namely, the doctrine of the Oscillations of Pendulums. This subject is so important, both historically, and in its application, that it should be made a portion of our standard Elementary Mechanics. The student of that science ought not to remain in ignorance of the laws of such Oscillations, till he falls in with them, if it so happens, as examples of the Differential Calculus. In all the Editions of my *Mechanics*, I proceeded upon this conviction, and proved the properties of Cycloidal Oscillations by the Method of Limits; modifying, however, Cotes's demonstration. But in the last edition I have, I think, rendered the proof more simple by restoring it nearly to the form in which Dr Wood gave it.

In the scheme of Mathematical Studies which I shall afterwards offer, I shall guide myself by the considerations now stated.

240 With regard to Newton's *Principia*, the text itself of the work is, of course, our standard; and our students ought to be able, not only to give Newton's proofs, but to show, by their explanation of the various steps, that they have fully entered into the train of reasoning of the great author. Several members of the University (myself among the rest*) have published books containing the Propositions of several Sections of the *Principia*, and especially the First Three Sections. But those books ought only to be considered as comments on the original. In the standard course of the University, Newton's Text should be the work adopted. Such books as I have mentioned would enable the student to understand, explain, and, when it is necessary, fill up the steps of Newton's proofs.

241 I have said that a portion of the *Principia* may be included in our Permanent Mathematical Studies; although the greater part of the book can be read only by our higher Mathematical Students. I think that both the general practice of the University, and the character of the subject itself, would direct us to take the First Three Sections as this Permanent Portion, to be studied by all candidates for our mathematical honours. The remainder of the work may employ, along with other capital mathematical works which I have mentioned, the labours of our more advanced students.

242 In the subject of Hydrostatics, Mr Vince's *Hydrostatics* might formerly be considered as the standard work in the University, though never very well suited to such a place. Mr Webster's *Principles of Hydrostatics*, from its form and mode of treating the subject, appears to me very fit to be adopted as our Standard Treatise on this subject.

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* First separately in 1832, and afterwards in *The Doctrine of Limits* in 1838.

243 Dr Wood's *Elements of Optics* is a work, excellent, for the most part, in the selection and demonstrations of its propositions, and deserves to be retained as our standard work on this subject. More recently, this subject has been treated analytically. So far as the analytical method has superseded the geometrical, I am obliged to say (though I believe that I myself, by College Lectures, may have formerly contributed to bring about such a change), the result has been very unfortunate; for in this subject especially, the geometrical method of tracing the course of reflected and refracted rays is highly instructive to the student in the earlier stages of his progress. I do not think the University ought to hesitate to made Dr Wood's *Optics* the standard work to be studied by candidates for honours, as an introduction to all other modes of treating the subject.

244 On the subject of Astronomy, the Treatise of Dr Hymers may, I presume, be looked upon as the one at present established in the University; and the work appears to me to be well fitted for this purpose. Perhaps the subject is too extensive to allow us to require a knowledge of the whole of it from every candidate for our honours; and both on this and on other accounts, it may be best to include only a portion of it in our Permanent Studies; and the same may be said on the subject of Optics.

245 The above works do not require a knowledge of the Differential and Integral Calculus; or if that Calculus be referred to in some places (as in some astronomical Problems), those are not essential parts of the subject. It may therefore be a question whether we are to admit the Differential Calculus into the list of Permanent Subjects to be required from all Candidates for Honours. But the fundamental principles of this Calculus are so instructive, and its elementary portions have now become so familiar to all mathema-

ticians, that they should, I think, be a part of our permanent course. I would however confine this distinction to the parts which are strictly elementary; and these I shall afterwards attempt to point out.

246 I may now recur to the objection which we have mentioned already (54), as sometimes alleged against the appointment of a standard course of study; namely, that the demonstrations of which it consists may be learned by rote; and to the answer which we made to this objection (55), that the student who had the demonstration in his memory only, and not in his understanding, might be detected by a few questions. This, however, cannot be done in any way so decisively as by a *vivâ voce* examination; and here we are brought again to the question, respecting a *vivâ voce* examination; the balance of its great advantages, and its great difficulties, especially as regards the length of time which it occupies.

247 I believe the advantages of a standard course of study accompanied by a *vivâ voce* examination to be so great, that it would be well worthy of the expenditure of time which it would require. The time, indeed, which the Moderator would need to expend in this employment, would not be so great as they always did expend, till within a few years, upon the disputations in the schools; and would have the same advantages which that practice had, of bringing both Moderators and the Questionists before an academical public. It would suffice if each Questionist were examined *vivâ voce* for an hour: two, three, or more, might be examined separately each day, or classes of three or four might be examined together for several hours; and the examinations, continued through the Michaelmas Term, might be extended to the usual number of Mathematical Honours which have been given of late years. But in order that these examinations might retain their interest and efficacy, they must have an influence in their

result upon the Questionist's place in the list of Honours. The Moderator must take the *vivâ voce* performance into his account, in arranging the classes. I do not conceive that this would be attended with any difficulty, if the Moderators were freely and carefully to use their judgment. At least, the oral examination might be taken into account in determining the Junior Optimes, with regard to whom I should mainly propose to employ it; as I shall have to explain.

248 With regard to the nature of the *vivâ voce* Examination thus proposed, it may consist, as a College Examination in Euclid generally consists, in requiring the oral proof of a proposition, and afterwards propounding questions respecting the connexion of the steps of the proof: or it may consist in the examiner propounding difficulties which he requires the examinee to solve; either such difficulties as the Opponents in former times used to bring against the Respondent, or such difficulties as the history of science supplies; those, for instance, which at first prevented the acceptance of Galileo's or Newton's discoveries. Or the *vivâ voce* examination may be combined with a paper examination (their combination, indeed, is on all accounts to be recommended); and this being done, the examinee may be required to explain, *vivâ voce*, steps of proofs which he has already written down. All these kinds of examination would be, I believe, very decisive as to the talents and attainments of the candidates, and very instructive to the bystanders who were looking forwards to a similar trial. Nor do I think they would be at all difficult to conduct, by Moderators who were good mathematicians, and who had reconsidered their mathematical knowledge, with a view to such examinations.

249 I will only observe further, that the *vivâ voce* examination would be worse than useless if it were not conducted with vigour and spirit. If a *vivâ voce* examination were to be established, and were to be

allowed to be, or to become, a mere matter of form, like the disputations at the Schools in their later days, it would answer no purpose; and would probably be soon abolished on account of the weariness and disgust it would excite in those who were compelled to undergo it.

250 I may remark, as some compensation for the trouble and time which the *vivâ voce* examination would demand, that it might be made to abridge very materially the paper part of the Examination. Questions from books might be answered more expeditiously by each candidate, orally than on paper; and the answers would, as we have seen, be, or at least might be made, more decisive as to his merit. Hence the Questions from Books to be answered on paper might be greatly reduced in amount. The Problems, which must of course be proposed and answered on paper, would thus bear a larger proportion to the Questions; as they did before the practical discontinuance of the Disputations.

251 I should recommend, then, that the University should institute, for the Candidates for Mathematical Honours, an Examination in a Standard Course of Elementary Mathematics, consisting of a combination of paper Examinations with public *vivâ voce* Examinations, to be continued through the Michaelmas term. But in order to attain another object, of which I have spoken, namely, an attention to the Elementary Subjects in those who are Candidates for the highest honours, I should recommend that this Examination take place *previously* to the Examination for the highest honours, and that its result should affect the access to the higher honours. In order to make my meaning clear, I may say, that I would make this an Examination to determine who should be *Junior Optimes;* and that none but those who had been pronounced Junior Optimes, after such an Examination, should be allowed

to compete for the honours of *Senior Optimes* and *Wranglers*.

252 I conceive that by this arrangement, and only by some such arrangement as this, should we effectually guard against the danger of candidates trying to make lucky hits in the higher subjects, without an adequate knowledge of the lower. If the two kinds of subjects are mingled together in the same examination, many candidates will always prefer to try their sagacity and good fortune in picking out parts of the higher, rather than encounter any labour of thought in mastering the lower, so as to be able to explain and apply them. If the two portions of the examination are separated, this game can no longer be played. And when this is prevented, we may hope to get rid of the ignorance and confusion of mind which may sometimes be found in those who obtain high honours in an examination, indiscriminate in its subjects, and conducted entirely upon paper.

253 When this Junior Optime Examination has thus been detached from the Examination for the Higher Honours, there will be much less difficulty in conducting the latter in a satisfactory manner. I have already said that I conceive it would be an advantage, if those Treatises on the various branches of Mathematics which are the subjects of study of the candidates for these Honours, were determined by authority. I shall not attempt to point out, further than I have already done, the books which ought to be selected to constitute the University Course of the Higher Mathematics. I conceive that such a selection might with advantage be committed to a body appointed by the University for this purpose;—a *Board of Studies*. This Body should be so constituted as to give permanency and fixity to the University Course, and at the same time, to admit into it gradually those changes which the real progress of Mathematical Science might

require. The Board of Studies should therefore consist partly of permanent and partly of changing elements; it should represent both the past Teaching and the present Examinations. I should conceive that such a Board might be very fitly composed of the Mathematical Professors of the University, along with about an equal number of recent Moderators. A Course of the Higher Mathematics, drawn up by a Board, and modified from time to time, would be a fit guide both for Studies and for Examinations; and might, I think, without much difficulty, have its due influence secured to it.

254 In the plan which I have proposed, the Examination for the Higher Honours might perhaps be conducted entirely on paper; although I do not see why verbal explanations of written papers should not be admitted. In order that the examination might be instructive to those who had afterwards to undergo the like, it ought to be public; and to be effectually so, as I conceive, not only should the Questions be made public (as at present they are) but also the Answers which are made to the questions, or at least some sufficient specimens of such answers. I do not mean that such answers should be printed; but that the answers in general, or at least those of the candidates who obtained the highest places, should be made accessible to the students and the University in general. Such a publication would make the examinations really public, and would make the performances of each race of successful students useful in the education of their successors. It would also, probably, improve the form which our most active mathematical students would give to their answers; for with the prospect of this publicity to be given to their performances, they would hardly be content to present their knowledge in a rude, obscure, conventional form; but would, it may be supposed, aim at the clearness, fulness and symmetry

which would commend their papers to the judgments of mathematicians in general.

255 I will make one more remark on the subject of our Examinations. If the prevalence of mere paper examinations be, as I have endeavoured to show that it is, a source of great evil in an educational system, the University of Cambridge is called upon to seek some remedy for the evil, not only by her duty to herself, but also by her duty to several other institutions. For the practice of paper examinations, as one of the main modes of action of educational bodies, has become very general in this country and its dependencies, mainly, I think, through the influence of Cambridge. The impartiality and purity which have of late years been universally acknowledged as the constant attributes of our examinations, have produced a general confidence in examinations constituted on their plan. Cambridge men have gone into every part of the empire as professors, teachers, and officers of various kinds in educational bodies; and they have carried with them their conviction in favour of paper examinations, and their habit of conducting such examinations. In this manner paper examinations have been very extensively adopted in other Universities, Colleges, and Schools; and appear to be still extending themselves, and threatening to supersede all other modes of educational action. If there be, as I have endeavoured to show, a great evil in the preponderance of this one mode of dealing with young persons in their education, it becomes us, who have set the example of the errour, to lead the way to the remedy. If we have gone wrong in allowing oral examinations to fall into decline, we should, for the sake of others as well as for our own sake, attempt to restore oral examinations. We should aim at familiarizing our students with *vivâ voce* examinations, and public lectures, for the sake of those whom they may hereafter have to teach or to

influence. We should recollect that we have in our hands, mediately and immediately, no small proportion of the education of the British empire; and that if mere paper examinations by themselves be a very poor and insufficient mode of conducting this education, the University ought not to countenance and practise that mode alone. It is rather her business to discover and establish that combination of oral with paper examinations, and of lectures with both, which are best suited to carry on the work of a Liberal Education, so far as the University is concerned; and by her own practice, to exhibit a model of an educational system which, under due modifications, may be followed in other places with safety and advantage.

256 Having explained the arrangements which would, as I conceive, help to remedy the defects of our Mathematical Education, so far as they exist, I shall proceed to consider measures which have for their object another important point; the combination of Classical and Mathematical Education.

The Chancellor's Medals, given to the best proficients in Classical learning among the commencing Bachelors, are restricted to those who have obtained Senior Optimes at least. This limitation manifestly implies that it was considered desirable that Classical should be combined with Mathematical proficiency. That the Mathematical student should be acquainted with Classics was not, at that time, provided by any University regulation; being assumed, as I conceive, to be sufficiently secured by the general course of School and College education. Afterwards, in 1822, the University passed Laws establishing a *Classical Tripos;* that is, three Classes of Honours, to be conferred, for Classical merit, upon those who, on taking their Bachelor of Art's Degree, were found to excel in Classical Literature. In this Law, the course of the provisions respecting the Classical Medals was so far

followed, that no persons were admitted as competitors who had not obtained Junior Optimes at least. The University, in this year, likewise required that those who did not obtain Mathematical Honours should, on taking their degree, undergo an Examination in the *Iliad* and the *Æneid;* and that all persons should, in their second year of residence, pass a *Previous Examination* in certain classical subjects selected for the purpose.

257 This Previous Examination was, I believe, assented to by many members of the Senate, on the ground, that it would secure a certain degree of attention to Classical Studies in the first year and a half of the residence of pupils at the University; and would remedy deficiencies in the system of those Colleges which did not, by their internal administration, provide for this amount of scholarship in their students. But this Law did not extend in its requisitions, and has not extended in practice, to any proficiency beyond that which all students ought to possess on leaving School, and entering the University.

This Examination has, I believe, in a great measure answered its purpose, with regard to those who come to College ill-instructed in Classical learning; but it has given a great check to all good schemes of College Education, and to all larger and more progressive plans of University Education. It has also interfered, it would seem, with spontaneous study in other branches of knowledge. It was remarked that on the institution of this Previous Examination, the lecture-rooms of some of the Professors, which used to be filled with voluntary students, (those of Modern History and Chemistry, for instance,) were immediately thinned. Still, the establishment of this Examination was a step to which the University was naturally led, in its wish to remove evils at the time loudly complained of. But it appears to be at present well worth considering, whe-

ther our Education would not be improved by placing the Previous Examination at the commencement of the Student's residence, and giving a progressive character, both to the College and the University studies of his academical career (187).

258 If such an Examination were placed at the beginning of the pupil's residence, it might be made to answer the valuable purpose of securing the means of a progressive education by a system of which School-teaching, College-teaching, and University Examinations, should form coherent and successive parts. The University may very reasonably require to be satisfied that the pupil brings from School, or from other Teaching, a correct and familiar acquaintance with Latin, and a power of construing ordinary Greek: and along with this, as I have also said, a familiar acquaintance with Arithmetical working. When students possess such a knowledge as this, College Lectures and Examinations, may, by a proper selection of Classical Subjects, as well as of Mathematical, (to which the Progressive Sciences ought also to be added,) be made to carry on a system of Education, which, at the end of three years and a half, shall leave all the students with their minds more cultivated, more expanded, and more instructed, than they were when they entered upon their residence. But if there are many of the students who do not, on commencing their residence, possess the above described amount of knowledge, their labours, and those of their tutors, must be employed, in a great measure, in repairing the defects of their School education, and all attempts at a good combined education at College, will be interrupted and frustrated. If the University were to institute such an *Initial Examination* as I have suggested, the Colleges, having to deal with better and more consistent materials, would be encouraged to improve their systems of instruction. Moreover if there be anything with which the Uni-

versity has reason to be dissatisfied, in the state of instruction in which pupils are sent to College by Grammar Schools and early teachers; such an Examination, steadily enforced, offers an effectual means of producing the requisite improvement: for it cannot be supposed that the Schools would long be content to turn out their scholars in a state of instruction in which they should be rejected by the University.

259 The Examination for Classical Honours, the Classical Tripos, as it is termed, must also be the subject of some remarks here. For reasons already stated (162, &c.), it seems desirable that a portion of this examination should be *vivâ voce*. Such an examination, to be effectual, must occupy a considerable time. But we should, no doubt, if the University were to order such an examination to take place, find able and zealous Examiners to conduct it, as our friends at Oxford do.

260 It may be a question whether our system, of comprizing in the Examinations for Classical Honours the whole body of the best Greek and Latin authors, or the Oxford system, of examining in a few selected works, is likely to make the better scholars. Perhaps, ours tends to make the candidates better acquainted with the Languages; theirs, with the Books. A general examination in the whole body of Greek and Latin literature appears, in the idea, better suited for a *final* examination. But an examination in defined authors, long prepared for, will be likely to make the candidate better versed in those Authors, with reference to their general matter and objects, as well as their more remarkable passages.

261 I will remark on another point;—the provision in our laws that no person shall be a candidate for a place on the Classical Tripos who is not already placed on the Mathematical Tripos. This rule appears to put an inequality between the two lines of study;

for we do not, necessarily, make Classical honours requisite in order to Mathematical. But this apparent inequality of encouragement is really quite necessary, as a means of restoring the balance between the two lines of study which is commonly so utterly deranged in our Classical Schools. In those, the student, if he have tolerable talent and industry, acquires a knowledge of Greek and Latin Literature, which enables him to pursue it with ease and pleasure; while of Mathematics, he generally acquires only enough to learn to dislike the study, without deriving from his acquirements any help to his future progress. If, therefore, there were a road to Classical Honours at the University for those whose mathematical attainments were very slight, it may be expected that this would be the path generally taken by the more gifted and ambitious of the scholars from our Classical Schools. Hence, in this case, Mathematical Studies would be comparatively neglected among us; and the general proportions of the elements of our Education would be destroyed. It is, in fact, an intellectual benefit to the candidate for Classical Honours, to require of him a knowledge of the parts of Mathematics to which we give our honours. If he cannot, or will not, master these, either he has no power or no disposition to think steadily on any but his favourite subjects. His reason is not cultivated in any proportion to his literary enthusiasm. The University does well, not to encourage students to make such a frame of intellect their model of excellence.

262 If it be said that the mathematical attainments by which our lower mathematical honours are reached, are of such a nature as not really to cultivate the reason, or to imply any valuable instruction; that is certainly a very strong ground for improving the character of that portion of our Mathematical system. Accordingly, I have attempted to shew how such an improvement may be effected, by separating the ex-

amination for Junior Optimes from the examination for Higher Mathematical Honours, and making the former take place, and have its result decided, before the latter is entered upon.

263 It appears to me that this plan might also be made to remove an inconvenience sometimes complained of, that the classical candidate cannot know beforehand whether he will be admitted to be a competitor or not, since he may fail in his attempts to obtain the requisite mathematical honour. If the plan were adopted which I have suggested, this inconvenience would be removed or alleviated. The Examination for Junior Optimes might terminate at the end of the Michaelmas term, and its result be declared by the 16th of December. The Examination for the Classical Tripos begins on the fifth Monday in Lent Term; and therefore the interval would be above two months; and for those who were not candidates for Mathematical Honours, a time entirely uninterrupted by University requirements. This would be as long a time as ought to be given to the mere preparation for an examination; which is an employment, as we have already said, not altogether beneficial to the mind (149).

264 The plan, therefore, of an Examination for Junior Optimes, ending with the end of the Michaelmas term, and extending, as to the *vivâ voce* part of it, through that term, appears to have many recommendations. I do not think it would be difficult to put it in such a shape as to make it entirely consistent with the Statutes of the University and the other parts of the University System; and, when it is recollected how recently it has ceased to be the business of the Moderators to preside over *vivâ voce* exercises during the greater part of the year, it cannot be considered a startling innovation to wish to revive this during one term in each year.

Sect. 3. *Of Private Tuition at Cambridge.*

265 The prevalence of Private Tuition, in a manner which interferes with the Public Tuition of Colleges, has already been noticed as one of the evils resulting from a system of mere examinations (154). When there is a tendency to such a state of things, so that its inconveniences become manifest, it is natural that those who are the guardians of the constitution of the University and of its Colleges, should endeavour to repress the practice which thus interferes with the beneficial influences of the established system. With this object, the University may prohibit candidates for honours from reading with a Private Tutor during the latter part of their studies; and may thus teach them that their stores of knowledge, however accumulated at first, are to be appropriated by their own proper acts of thought, before they are fit to be offered as claims for honours. Such measures have been adopted by the University of Cambridge, as we shall see.

266 Or again; Colleges may impose restrictions upon the reading of their pupils with Private Tutors, which shall disarm such reading of its evils. Private Tuition, employed in harmony with, and in subordination to a course of progressive literature and science, of which the scheme is determined by Public Lectures and Examinations which the pupil has to attend, may be a valuable element in our Educational system; and, under such conditions, is to be encouraged in many instances, as I have already intimated (124). On the other hand, Private Tuition not duly limited may, as we have seen, tend to supersede the operations of Colleges altogether. It may, for instance, grow up into a regular and permanent scheme, occupying the vacations of College Lectures; and in such a scheme, it might become a practice of the students, to prepare themselves for the Examinations in the periods of

vacation, and to pass in social amusements the periods assigned to College Lectures. The tendency to such a state of things requires to be guarded against in the administration of the Colleges.

267 But all measures having for their object the repression of Private Tuition should be devised and carried into effect with great caution and tenderness; since they must, more or less, make the University, or the College, appear to look with an unfriendly aspect upon a body of able, learned, and estimable men; for such, the persons most sought as Private Tutors will usually be. Moreover, such measures seem as if they tended to repress the zeal for study, and the love of distinction, which impel pupils to seek for this assistance; and hence, they are likely to fail in obtaining that general sympathy without which laws can hardly be effectually enforced.

268 The excessive prevalence of Private Tuition is, as we have seen, not the source, but the symptom of the evil. In a system entirely governed by examinations, men are naturally led to rest their main dependance on Private Tutors;—still more, if these are mere paper examinations, the answers being unpublished (156);—still more, if the examiners be a rapidly changing body (157):—and still more, if the same persons can, within a short interval of time, discharge the office of Private Tutors and Examiners. And the remedies which I have to propose for the evil, are contained in what I have already said. They are, a definite and progressive System of Studies in the Colleges, occupying the earlier part of the Student's University residence;—a Standard Course of Permanent Studies for the Lower University Honours, and of Progressive Studies for the Higher Honours; each of these courses to be drawn up and revised from time to time by a body having in it permanent as well as rapidly mutable elements;—a *vivâ voce* examination

making part of the examination for the Lower Honours; and the publication (I do not mean the printing, but the public exposition) of some of the best answers. I think that these measures would tend to limit the practice of reading with Private Tutors, so far as it is desirable that the practice should be limited. I think too that the same measures would, as I have already attempted to show, tend to restore to our educational system some of its beneficial influences which have of late been impaired.

[268] In thus urging that a greater publicity should be given to our examinations, I shall not, I trust, be by any person so entirely misunderstood, as to be supposed to imply that there is in them at present any want of fairness and impartiality. I can repeat with pleasure what I formerly said*. "The University of Cambridge is proud, and with much justice, of the acknowledged purity of her examinations. They are free from all taint of sinister practices; above partiality and the suspicion of partiality." The change which I suggest, is recommended as a matter, not of justice, but of improved polity;—not as an improvement in the administration, but in the system. And in this view, I believe such changes would produce the beneficial effects I pointed to; and among the rest would remove, if not the dependance upon Private Tutors, at least that blind and universal dependance which impairs the value of our University Education.

269 I have intimated that the University has already legislated with a view to the suppression of evils produced by Private Tuition. At one time, this appears to have been done on the ground of its being necessary that the examinations should be above suspicion. The fact of Moderators examining their own pupils, might readily give rise to partiality, real or

* *University Education*, p. 56.

supposed. The first Grace on this subject, so far as I am aware, is the following; and its penalties are directed against Tutors who, when they are about to be Moderators, take Private Pupils who are about to be candidates.

1777. Jun. 21. "Cum Academiæ maximè intersit in examinationibus publicis Sophistarum æqui justique rationem tum haberi diligentissimê, tum habitam liquido patere;

"Placeat vobis Ne cui unquam qui hisce examinationibus præfuerit post diem primum sequentis Termini, in Tutelam suam privatam liceat ad docendum recipere Juvenem ullum, qui proximis sit Comitiis Gradum Baccalaurei in Artibus suscepturus; Quod si quis contra hoc Decretum peccaverit ab officio suo prorsus amoveatur."

270 Notwithstanding this Grace, it would appear that the practice gained ground in the University; for the next Grace speaks of it as almost universal among the *Soph*s.

1781. Jan. 25. "Cum mos nuper in Academiâ invaluerit ut unusquisque fere Sophistarum aliquem sibi auxilii causâ inter studia quæ ad Gradum Baccalaureatûs in Artibus spectant sub privati Tutoris nomine asciscat, non sine Academiæ Infamiâ et gravissimis eorum expensis qui summo labore suo et curâ studiosos alunt:

"Placeat vobis ut si quis in posterum Scholaris intra biennium gradum suscepturus, inter studia quæ ad Gradum Baccalaureatûs in Artibus spectant prosequenda, cujuslibet usus fuerit auxilio intra Academiam directè vel indirectè, stipendio aut mercede conducti, sive privati Tutoris, seu alio quocunque sub nomine hujusmodi, omnem sibi aditum ad senioritatem baccalaureis reservatam præclusum intelligat."

271 This latter Grace, was, I believe, for a time effectual; inasmuch as it expressed the opinion of the governing part of the University; and placed a person who was a candidate for honours after having read with a Private Tutor during any part of the last two years, in the condition of a competitor who takes a forbidden advantage. But in order to make this legis-

lation entirely and permanently effective, it would have been proper that the Moderators, before assigning to any candidate an honour, should require a *certificate* that he had not offended against the Grace. Such a certificate might be given by a Prælector of each College, "to the best of his belief," and signed by the Head of the College; and such would, as I conceive, have been a mode of carrying into effect the above Law, conformable to the practice of the University in analogous cases.

272 The practice of reading with Private Tutors continued to prevail, and the objections to it also continued to be entertained, though not perhaps to the same extent. I conceive that, in the period of which I now speak, the objections were, the tendency to destroy independent study and intellectual vigour; for the prohibition is no longer directed against Tutors examining *their own* pupils. The time at the end of the student's career during which reading with a Private Tutor was prohibited, was gradually diminished. By a Grace, 1807, April 9, it was reduced to a year and a half: by another Grace, 1815, July 3, to one year.

273 The last Grace upon this subject is, I believe, the following:

1824. Maii 19. "Cum gratia à vobis Jan. 25, 1781 concessa sit, 'Ut si quis in posterum scholaris, &c.' (as above) et gratia à vobis 9 Apr. 1807 concessa sit, 'Ut spatium biennii in gratiâ Jan. 25, 1781 concessâ definitum ad spatium unius anni et semissis reducatur:'

"Placeat vobis ut gratiæ duæ prædictæ abrogentur: atque ut si quis in posterum scholaris intra *sex menses* ex Calendarii computo ad respondendum quæstioni admittendus, inter studia quæ ad Gradum Baccalaureatûs in Artibus spectant prosequenda, cujuslibet usus fuerit auxilio, intra Academiam, directè vel indirectè, sive Privati Tutoris seu alio quocunque sub nomine hujusmodi, omnem sibi aditum ad senioritatem Baccalaureis reservatam præclusum intelligat."

274 This Grace is, as I conceive, still in force. Perhaps the omission of the Grace of 1815, in the notice of those rescinded, shows how little these Graces had really been habitually referred to in University proceedings: and as I have said, the course which was pointed out by the analogy of our practice, as the proper mode of carrying the Law into effect, was not taken. But the Law, as it now stands unrepealed, is, as seems to me, a very judicious Law. It tends to prevent the dependance upon Private Tutors, and the absence of independent thought, from continuing to the end of the student's career; and provides an interval, during which he is expected to digest and assimilate the materials which he has acquired during his previous course of study. I should conceive Moderators and Examiners to be following the course which the Law of the University prescribes, if they were to require from every candidate for honours, a certificate that "in pursuing the studies which belong to the degree of Bachelor of Arts, he has not, within the University, used the assistance of any one, directly or indirectly, either as Private Tutor or in any like capacity." By whom this certificate should be given, whether by the candidate himself, or by the officers of his College, is a matter to be determined by the Governors of the University.

275 The Grace of 1824 is, in one respect, more sweeping than the previous ones, inasmuch as it omits the condition "stipendio aut mercede conducti," which they had contained. Perhaps it was conceived that with this clause, the law might be too easily evaded; for the gratuitous Private Tuition of the last six months might easily come to be considered a customary appendage to the previous stipendiary Tuition of one or two years.

The Grace appears at first sight too sweeping to be practically acted upon; as the words "*cujuslibet* usus

fuerit auxilio," appear to prohibit the assistance of Public as well as of Private Tutors; but I conceive that not only does the general scheme of the constitution of the University and of its Colleges exclude this application, but that the words which follow, "sive Privati Tutoris seu alio quodcumque sub nomine *hujusmodi*," sufficiently indicate the class of assistance which is prohibited by this Grace.

276 This Grace is, as I have said, still in force. Yet its existence is, I believe, not generally known in the University; and it has certainly been, of late years, habitually disregarded. The same is the case, as we have already seen, with the Grace of directing that the *Polloi* should be arranged in four alphabetical classes. Perhaps we may be allowed to say, that these facts suggest the propriety of some course being adopted in the administration of the University, by which the Laws passed for its direction shall be kept permanently before the notice of its members.

277 If the prohibition of Private Tutors within the University during the student's last six months were carried into effect; if the University Examinations were rendered public, as to the performances of the candidates, and were made to include a considerable portion of *vivâ voce* examination; I believe that we might look for a material improvement in the general condition of the University, and in the effect of our Education. The College Examinations could then be more nearly assimilated to the University Examinations. This result, which all members of the Univerversity, probably, will think a desirable one, would be much facilitated by the authorized adoption of Standard Works or Standard Syllabuses, both of the lower, and of the higher subjects; and by enforcing the often expressed desire of the University, that a knowledge of the lower subjects shall be a necessary condition of obtaining honours in the higher ones. The subjects of

the examinations being known, the order of study maintained, and the standard of excellence evident to all, the College Lectures would retain their superior importance as the best preparations for examinations conducted in a great measure *vivâ voce;* and Private Tuition would retain its value as a means of progress for those who were too slow to keep pace with the rest without such help; or whose aims were too high to be reached by common aids only. Co-operating in the University System under such conditions, and in cordial good understanding with the College Teachers, the class of Private Tutors may be expected to contain, as it has long done, a large portion of the intellectual wealth, scholarship and beneficial influences of the University.

SECT. 4. *Of Establishing the Progressive Sciences in the University System.*

278 It will be observed by the reader that I have proposed that the access to University Honours among us should consist of two steps; in the first of which a person is declared a *Junior Optime;* while in the second, he is admitted as a candidate for the Higher Classes of the Mathematical Tripos; and that the student should, instead of this course, or along with it, be also allowed to be a candidate for the Honours of the Classical Tripos. I have now further to observe that there would be no difficulty in the way of the University, by its legislature, putting other subjects on the same footing on which classical teaching was put by the Grace which established the Classical Tripos. We might have a *Tripos*, or appointed form of Classes of Honour, for any other subjects, for Botany, or Natural History in general, Geology or Ethnography; to which sciences, as I have already said, it would be desirable to give an authorized value in the University, as roads to distinction; or, which would perhaps be

best, we might have a *General Tripos*, including the Inductive Sciences, or those which it was thought right by the University to group together for such a purpose.

279 Such a Tripos, if established, would be a means, and as seems to me, one of the best we could take, of removing the alleged neglect of the Inductive Sciences in the University, without any great disturbance of our existing system. The Sciences, thus encouraged by the University would, of course, be those of which there are Professors in the University, not connected with examinations for degrees; namely, Anatomy, Botany, Chemistry, Geology, Mineralogy. These Professors should be the Examiners, or should form a prominent part of the Examining Board. This arrangement would tend, it may be supposed, to remedy the neglect of the Lectures of some of those Professors which is often complained of. It would tend also to encourage the study of science in the University. Many persons might prefer the study of Botany, or Chemistry, or Mineralogy, or Geology, either to the pursuit of the higher parts of mathematics, or to the continued cultivation of classical learning; especially when those subjects offered a road to University Honours, as well as these. And such a Scientific Tripos would fall in with some of the existing regulations of the University, respecting the duties of the Professors in the University. For some of the Professors of the above sciences are already authorized and required to examine candidates for the degree of M. B., sometime in the fifth year of their residence. If this examination were extended to all who chose to offer themselves, and made to lead to an arrangement of the successful candidates in Classes of Honours, the Professors being formed into a Board of joint Examination, it would probably, in time, draw to it many candidates besides Medical students. For this pur-

pose, it might be desirable to remove it out of the fifth into the fourth year, that it might come about the same period as the Classical Tripos; but on such details of this scheme I shall not now enter.

280 If it were thought advisable, attendance at the Lectures of some or other of the above Professors might very reasonably be required of those who were not Candidates either for Classical or Mathematical Honours; and in this manner the general education of the University would be materially improved. I believe that in Oxford, in some at least of the colleges, a rule of this kind is acted upon.

281 In order further to assimilate the General Tripos to the Mathematical and the Classical Tripos, two Medals for General Science might be established, to be given to the first and second prizemen. I will venture to say that if such a General Tripos as I have described were established, funds for providing one or two such medals would be found, without burthening the University chest. And I think it very likely that, in such case, the merits of candidates shown in this General Tripos would be taken into account, as well as their places in the Mathematical and Classical Tripos, in electing Fellows, and in other appointments both within and without the University.

282 It may perhaps be suggested that the encouragement afforded, by such a scheme, to the cultivation of the progressive sciences in the University would be more complete, if we were to establish a General Scientific Tripos without making it a condition that the Candidates for its Honours should previously be declared Junior Optimes. But in order to estimate the value of this suggestion, we are to recollect what was formerly said, of the necessity of Elementary Mathematics, as a permanent element of a Liberal Education. The sciences which we have mentioned could not for this purpose supply the place of the Mathema-

tical part of our University Studies. Moreover, the sciences themselves would be more fully understood, in consequence of the steadiness of thought and clearness of conception which the study of Mathematics promotes. A student who should distinguish himself in the examination in Science, after obtaining a Junior Optime's place, would be unlikely to have acquired his knowledge of science in a superficial manner, or as a matter of memory merely. And in order to see how little discouraging the requirement of the previous step would be, we are to recollect that we are supposing the qualifications of a Junior Optime to be clearly defined and limited, so as no longer to demand an indefinite and doubtful course of reading. The mathematical studies which such a step would require, would leave time, throughout the student's career, for attending the lectures of the Professors of the Sciences, and for cultivating in other ways the knowledge which the General Scientific Tripos would call into play.

283 How the examination should be arranged with regard to the union or separation of the different sciences, would be a matter for deliberation, if the general design of establishing such an examination were once taken into consideration with a view to its adoption. The main purpose of the present volume being directed to other parts of the University system, I touch briefly upon this; being only desirous of showing in what manner some of the evils often complained of as existing in the University may, perhaps, be remedied.

284 Besides the physical sciences, there are other branches of human knowledge which naturally offer themselves to our consideration, as belonging to the Higher Education of men in our time; other languages and other histories, both ancient and modern, besides those of Rome and Greece; and Comparative Philology, which I have already mentioned; and also those which are sometimes described as the Moral and Intellectual

Sciences; or as provinces of Philosophy; for instance, the Philosophy of the Human Mind, Moral and Political Philosophy, the Philosophy of Science, the Philosophy of History, the Philosophy of Language, and the like. These are subjects which ought to be actively cultivated at Universities; and it is to be hoped that there will always be at the English Universities persons who will make these and the like branches of knowledge the subjects of the labours of many studious years. It is desirable that our Students also should have their attention drawn to some parts of these subjects; but in what manner this is to be done, so that their minds may be led to think steadily, clearly, and rightly on such matters, is a more difficult question even than the like inquiry with regard to the kinds of knowledge already spoken of. Our Universities should furnish lectures in these branches of philosophy, as well as in those other departments of knowledge; but in them as in those others, lectures, even if delivered by highly-gifted men, may find scanty audiences, especially in an atmosphere saturated with examinations. In these subjects too, as in those others, the influence of examinations may be tried; and this may be done with no inconsiderable success, as I can testify from my own experience. But in these subjects, still more than in those others, examinations are a very ineffective machinery for evoking philosophical thought; and the relation which examinations must bear to lectures, so that the effect may be salutary to the mind, is a problem of no ordinary difficulty.

Chapter IV.

PLAN OF A STANDARD CAMBRIDGE COURSE OF MATHEMATICS.

Sect. 1. *Permanent Mathematical Subjects (for Junior Optimes.)*

[Since the first edition of this Work was published, the University has established a standard scheme of the more elementary portions of Mathematics, namely, those portions which are required of Junior Optimes. See Part II. Sect. 5 of this book. Also Mr Harvey Goodwin has published *An Elementary Course of Mathematics*, the design of which is to include such portions of the science as belong to this scheme. Of this book I have spoken in the Second Part. I have moreover myself published *Conic Sections, their principal properties proved geometrically*. I have also published a new edition of my *Elementary Treatise on Mechanics*. I have in Part II. explained the reasons why I consider the course which this Work follows, more suitable to an Elementary Treatise than Mr Goodwin's. I have also published Newton's *Principia*, Book I. Sections I. II. III. in the original Latin, with explanatory Notes and References. As I published these works in order to embody the plan of a standard Course of Elementary Mathematical Subjects which I proposed in the former edition of this work, it will not be considered strange or presumptuous that I should introduce them here. 2nd Ed. Part I.]

(1) ARITHMETIC.

Mr Hind's *Arithmetic*, in the later editions, appears to me to be drawn up in such a manner as to be suited

for use in Schools for those who are intended to go to the University. It includes the use of Logarithms, and the Mensuration of various figures (Triangles, Circles, &c.), which I have spoken of as desirable appendages to the parts of Arithmetic usually learnt at school.

(2) ALGEBRA.

Dr Wood's *Algebra* may still be considered as marking the extent to which this subject should be read by the common student. In reading the First Part of the work the student will probably at first need additional explanations and examples, which he may obtain from many works in common use. In the Second and succeeding Parts the subject admits of developements much more extensive than Dr Wood has given; but still this work may be considered as the Standard of our Algebra, excluding its recent progress*.

(3) PLANE TRIGONOMETRY.

The work most worthy of being made our Standard work on this subject appears to me to be Legendre's *Géométrie*, which includes Trigonometry, both Plane and Spherical, and contains a few Notes which may be looked upon as *classical* in mathematical literature. There is an inconvenience, however, in his exclusive reference to the French graduation of the circle. The

* Mr Lund, in his last edition of Dr Wood's *Algebra* (1845), has very properly kept his additions distinct from the original text by a difference of type. He has omitted the *Second Part* of the Treatise altogether, which I cannot but regret; for that portion of Dr Wood's book represented very well the General Doctrine of Equations as a long established part of Mathematics; whereas Dr Hymers' Treatise, to which Mr Lund refers as replacing this Part, belongs to the Progressive Mathematical Studies of the University.

work has heen translated by Sir David Brewster. The book contains also a few *classical* propositions of Solid Geometry.

(4) CONIC SECTIONS.

[Dr Whewell's *Conic Sections*, or the *Conic Sections* in Mr Goodwin's Course.]

(5) MECHANICS.

[Dr Whewell's *Elementary Treatise on Mechanics.* 7th Edition. 1847.]

(6) NEWTON'S PRINCIPIA.

[Dr Whewell's Newton's *Principia* in the original Latin. 1846.]

I have already stated (240) that the standard book in the study of the *Principia* is Newton's text; and that other modes of presenting the subject are to be considered only as Commentaries upon that text. I have given such a Commentary in the *Doctrine of Limits.* The Doctrine of Limits, or in Newton's language, the Method of Prime and Ultimate Ratios, is the subject of the First Section of the *Principia*, and is the basis of all the succeeding portions of the work.

There are several Propositions concerning the Mensuration of the simplest figures, which are so familiarly assumed as known by Mathematicians, that it is not convenient to make them depend upon the Differential Calculus. Such are the Propositions which Archimedes proved concerning the Sphere and Cylinder. These Propositions may be conveniently proved by the reasoning of Limits. I will here state them.

(7) FAMILIAR RESULTS OF THE METHOD OF LIMITS.

[Though this is not recognized as a distinct subject in the University Schedule, I retain it here, as being very instructive from the light which it throws both upon the Doctrine of Limits as upon the Principles of the Differential Calculus.]

1. To find the circumference of a circle, of given radius.

2. - - - the area of a circle.

3. - - - the surface of a cylinder.

4. - - - the solid content of a cylinder.

5. - - - the surface of a cone.

6. The solid content of a cone is $\frac{1}{3}$ the circumscribing cylinder.

7. The solid content of a sphere is $\frac{2}{3}$ the circumscribing cylinder.

8. The surface of a spherical zone is equal the surface of the corresponding zone of the circumscribing cylinder.

9. The area of the parabola is $\frac{2}{3}$ the circumscribing parallelogram.

10. The solid content of the parabolic conoid is $\frac{1}{2}$ the circumscribing cylinder.

I have proved these propositions in the *Doctrine of Limits**.

(8) DIFFERENTIAL CALCULUS.

[In the former edition I had inserted a Syllabus of those steps which appeared to me to be essential parts of a standard system of the Differential and Integral Calculus confined to the mere Elementary processes of

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* In this as well as in some other parts of the *Doctrine of Limits* were some material errours of the press, which were corrected by cancelling the pages.

the subject. But in drawing up the Schedule which contains the University standard, it was conceived, probably wisely, that the simplest way of limiting the scheme to Elementary Mathematics was to exclude the Differential Calculus altogether. I shall therefore omit the Syllabus of the subject.]

(9) INTEGRAL CALCULUS.

[This is of course excluded along with the Differential Calculus.]

(10) HYDROSTATICS.

As I have already stated (242), Mr Webster's *Principles of Hydrostatics* appears to me fitted for this part of our list. Of course when Hydrostatics is to be studied as a part of Progressive Mathematics, works which teach the subject by the aid of the Differential Calculus must be taken. [See also the "Hydrostatics" in Mr Goodwin's *Course*.]

(11) OPTICS.

I have stated in the last Chapter that I do not think the University can adopt any mode of presenting the Elements of Optics as a permanent subject better than is contained in the work of Dr Wood. Perhaps the calculation of the Aberration of Refracted Rays might be omitted at this stage of study. [See also the "Optics" in Mr Goodwin's *Course*.]

(12) ASTRONOMY.

I have already said that Dr Hymers' *Astronomy* appears to me fitted for general use in the University. But Astronomy in its methods of observing and calculating is a progressive science; and perhaps it might suffice to take, as the permanent part of it with which I am here concerned, Dr Hymers' First Chapter. [See also the "Astronomy" in Mr Goodwin's *Course*.]

SECT. 2. *Progressive Mathematical Subjects (for Wranglers and Senior Optimes).*

The subjects of study which are to lead to the Higher Mathematical Honours ought to be the various branches of mathematics in their best form. The Systematic Treatises in which they are thus presented will necessarily vary from time to time; although it is desirable that the Treatises which we employ in our course should not be rapidly exchanged for others (79). I have already stated how, as seems to me, the selection of such Treatises might be made by the University. The Student's business would then be to master, in the form thus prescribed, a larger or smaller part of the subjects already mentioned; namely, Algebra, the Differential and Integral Calculus, with the solution of Differential Equations, Finite Integrals, the Calculus of Finite Differences, the Calculus of Variations; the properties of Curves and of Curve Surfaces, Analytical Mechanics and Hydrostatics; the Higher parts of Optics, both Formal and Physical, and Astronomy.

I have already mentioned certain works which may be considered as peculiarly the proper employment of our Highest Mathematical Students; namely, Newton's *Principia*, Lacroix's larger *Traité;* the Cambridge *Examples* to the Differential and Integral Calculus; Professor Airy's *Tracts;* and I add, as a Commentary on the Eleventh Section of the First Book of the *Principia* and on the Third Book, his *Gravitation;* Lagrange's *Théorie des Fonctions* and *Mécanique Analytique;* Monge's *Application de l'Algebre à la Géométrie;* Laplace's *Mécanique Céleste;* to which I have added, on account of their practical application joined to their mathematical merit, M. Poncelet's *Mécanique Industrielle*, Professor Willis's *Principles of Mechanism*, and Count de Pambour's *Theory of the Steam Engine.*

Sect. 3. *Other Progressive Sciences.*

If the University were to carry into effect the suggestion which I have offered, and were to institute examinations in the Physical Sciences and Natural History, assigning honours and rewards to those who should distinguish themselves in such examinations, it would be proper, in some degree, to prescribe and define in each science the course of study which the examinations should require. If, as I have proposed, the Professors of the subjects included in these Examinations were to be the Examiners (the Professors of Chemistry, Anatomy, Botany, Geology, Mineralogy), these Professors would be the proper persons to mark out a University course of study in the progressive sciences; and might be invested with authority to draw up and prescribe such a course. In drawing up such a University course of study, the Lectures of the University Professors would naturally and properly be reckoned as necessary and important sources of knowledge. Attendance at those lectures, and the study of standard books in each science pointed out by the Professor, would constitute the University course of study in this department.

Among the subjects which, as I have mentioned in (284) are considered branches of the Higher Education, in addition to the Physical Sciences, there are several of which the University of Cambridge possesses Professorships, namely, Modern History and Languages, Moral Philosophy, and Political Economy, besides the Professorships belonging to the *Faculties* of Divinity, Laws, and Medicine, and the Professorships of Hebrew and Arabic. And on all these subjects Lectures are habitually given by the Professors. If it were thought right to give further weight to those studies, means might be devised for doing so, of the same kind as

those which have been suggested with regard to the Physical Sciences.

I have already (284) spoken of the difficulty of conducting examinations, and of establishing a salutary relation between examinations and lectures, in such subjects. These, however, are questions which might require a treatise for themselves alone; and I will not begin to discuss them at the end of a book which is directed mainly to other parts of the great subject of Education, and which has already extended, it may seem, to a sufficient length with reference to its purpose.

END OF PART I.

OF

A LIBERAL EDUCATION

IN GENERAL;

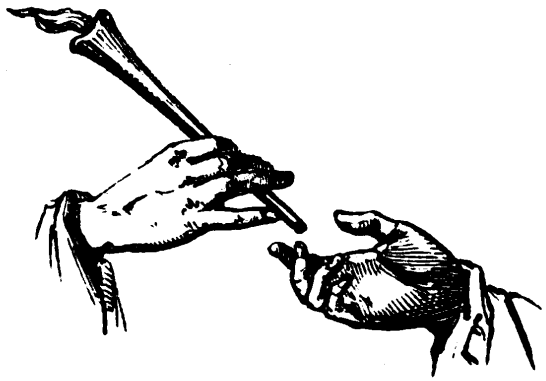
AND WITH ESPECIAL REFERENCE TO THE UNIVERSITY OF CAMBRIDGE.

PART II.

DISCUSSIONS AND CHANGES

1840–1850.

BY WILLIAM WHEWELL, D.D.,
MASTER OF TRINITY COLLEGE.



Λαμπάδια ἔχοντες διαδώσουσιν ἀλλήλοις.

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PREFACE.

THE title of this book may seem to be too large for the matter of it, so far as it has yet appeared; since there are important portions of a Liberal Education, and of Cambridge Education, of which I have not treated; such is, for instance, the instruction in Theology which is given in the University, and which was made much more effective by the measures voted in 1841 *.

I have here offered to my readers my opinions on those points only on which I have special remarks to make, bearing upon discussions recently or at present going on in the University; reserving for future occasions anything which I may have to say on other subjects.

For the benefit of those readers who are not Cambridge men, I may here explain, that in the following pages I have used the word *Tripos*, as it is used in the University, even in official documents, to denote a list of the names of those to whom the University assigns honourable distinction after a public trial. The following account of the manner in which the word came to have this meaning, though in some points conjectural, may serve to make the term seem less strange.

The names of the Bachelors who were highest in the list (Wranglers and Senior Optimes, *Baccalaurei quibus sua reservatur senioritas Comitiis prioribus*, and Junior

* See the Report on the state of Theological Instruction in the University, and the Rules establishing New Theological Examinations, in Article XI. of the *Appendix* to this volume.

Optimes *Comitiis posterioribus,*) were written on slips of paper; and on the back of these papers, probably with a view of making them less fugitive and more entertaining, was given a copy of Latin verses. These verses were written by one of the new Bachelors; and the exuberant spirits and enlarged freedom arising from the termination of Undergraduate restrictions often gave to these effusions a character of buffoonery and satire. The writer was termed *Terræ Filius* or *Tripos*, probably from some circumstance in the mode of his making his appearance and delivering his verses; and took considerable liberties. On some occasions we find that these went so far as to incur the censure of the authorities. Even now, the Tripos verses often aim at satire and humour. The writer does not now appear in person; but the Tripos paper, the list of honours with its verses, still comes forth at its due season; and the list itself has now taken the name of the *Tripos*. This being the case with the list of Mathematical honours, the same name has been extended to the list of Classical honours, though unaccompanied by its Classical verses. The extension of the name of the two new Triposes followed as a matter of course.

Trinity Lodge,
January 19, 1850.

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Sect. 6. *The Great Classical Schools.*

Sect. 7. *The Stability of the University System.*

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OF

A LIBERAL EDUCATION, &c.

PART II.

DISCUSSIONS AND CHANGES

1840–1850.

SECT. 1. *Recent Changes.*

285* FOUR years ago, I published a book concerning a Liberal Education in general, and with particular reference to the University of Cambridge. In that book, besides discussions respecting the subjects and the manner of reading belonging to a Liberal Education, I gave a history of the changes which took place in the studies of Cambridge from 1772, up to the time when I wrote: and I offered several suggestions of additional changes, for which I gave reasons. Since then, several changes have been made in the Cambridge Scheme of Studies and Examinations, by the Senate of the University. I will, in a subsequent part of the present publication, give the Graces of the Senate decreeing these changes: but I will, in the first place, state briefly their import and their relation to the suggestions which I had offered.

286 In what I then wrote I expressed sentiments which were not entertained by myself alone, but which had long been working, in a greater or less

* The Articles are numbered in continuation of those in the first Part; and the references are made throughout to the Number of those Articles.

degree, in the minds of many members of our University who gave their thoughts to the subject of our Educational System. If, therefore, I have now to remark that many of the suggestions which were then made have since been carried into effect, more or less modified, I trust I shall not be held guilty of the presumption of supposing that my arguments were a main cause of the changes. I endeavoured to see what was requisite for the improvement of our system, and I came to nearly the same results as many other persons who made the like endeavour, though I publicly expressed my conclusions and they did not express theirs. And in like manner, in what I shall now write, I believe I may venture to say that, on several points, there are many members of the University, whose opinions would carry great weight with them, and who think with me. This however may perhaps become more clear when the opinions have been publicly brought before the University, as is my present purpose.

I now proceed, as I have said, to notice recent changes made in the University System.

287 I had (234) mentioned as very desirable the establishment of a Standard System of the more Elementary portions of Mathematics; and had offered some remarks which, I thought, were fitted to direct those who might be entrusted with the office of fixing such a standard. By the Grace of May 23, 1846, such a standard was established, and the Examinations for Mathematical Honours were ordered to be regulated by it, beginning in 1848. The subjects thus included as Elementary are Euclid, Arithmetic, Algebra, Plane Trigonometry, Conic Sections, Mechanics, (Statics and Dynamics,) Hydrostatics, Optics and Astronomy; the elementary parts only of these latter sciences being admitted.

The scheme according to which this standard was constructed was such as to conform very closely to the

plan which I had proposed: but upon the parts of this scheme in detail I may have to offer some further remarks in a subsequent page.

288 I had also recommended (251) that the Examination in the Elementary Parts of Mathematics (defined in the way just mentioned) should be separated from the Examination in the Higher Mathematical Subjects; and that a good knowledge of these Elementary Subjects should be made a condition of access to High Honours: for instance, it was suggested that there might be a Preliminary Examination in the Elementary Subjects, to determine who should be *Junior Optimes;* and that those only who had satisfied the Examiners in this Examination, should be allowed to compete for the honours of *Senior Optimes* and *Wranglers.*

A plan of this kind is now established by the Grace just quoted. The Candidates for Mathematical Honours are examined for three days in the Elementary Subjects; after these three days there is an interval in the Examination, and those only are admitted to the subsequent portion of it, (which of course includes the higher parts of mathematics,) who are declared by the Examiners to have acquitted themselves satisfactorily in those lower subjects.

I had recommended (211) that the *Polloi* should not be arranged in an (ostensible) order of merit, which had been the practice, though contrary to the law of the University. By the Grace of May 1846, the *Polloi* were directed to be arranged in four Classes, but alphabetically in each.

289 I had also urged (253) the establishment of *a Board of Mathematical Studies;*—a body which might determine with a certain amount of authority the portion of Mathematics which should be included in the Examination for the Higher Honours: with a view both to a general fixity and permanency in the

University Course of reading, and to such a gradual progress as the state of science might require: and I suggested that this Board might consist of permanent and variable elements combined: the Mathematical Professors supplying the former element and the recent Moderators the latter. Such a Board was established by a Grace of the Senate Oct. 31, 1848, and was directed to draw up and publish every year a Report on the actual state of Mathematical Studies in the University. The Board constituted by the above Grace published, in May last, a Report which I will place in the Appendix, and on which I may have to make some remarks.

290 I had recommended (278) the establishment of a *General Tripos*, or scheme of assigning Honours according to the result of an examination in a general collection of sciences, to be grouped together by the University for that purpose.

Such a scheme was made law for the University by the important vote of the Senate of October 31, 1848; and in a form much better than that which I proposed. By that vote, there were established two new Triposes, or Honour lists; a *Moral Sciences Tripos*, including for the subjects of examination, Moral Philosophy, Political Economy, Modern History, General Jurisprudence, and the Laws of England; and a *Natural Sciences Tripos*, including in the same manner, Human and Comparative Anatomy, Physiology, Chemistry, Botany, Geology, and (afterwards added) the unmathematical part of Mineralogy. These groups of Sciences, as subjects of lectures and examinations, and the mode of making the new University arrangements effective for the introduction of an enlarged kind of education, and for the promotion of science, will be made the subject of some further remarks.

291 I must now notice some points in which the

University has taken a course different from that which I had recommended in the first part of this book: and on these points also I may hereafter be led into some further discussion.

I had recommended (282) that the attainment of a Mathematical Honour (*Junior Optime* at least) should be made a condition of admission to the competition for the new Science Triposes, as it is made for the Classical Tripos. But in the scheme as voted by the Senate, the new Honours are made accessible to all who have passed the *Ordinary* examination for the degree of B.A., that is, to the *Polloi* (204). I conceive that the reason for not requiring a Mathematical Honour as a condition for the new Tripos was, the wish to encourage, by all reasonable facilities, the competition for the Honours in the Moral and Natural Sciences; since there does not exist for them, as yet, the encouragement which arises from knowing that they are the doors to station and emolument in Colleges, as the Mathematical and Classical Honours are. Their connection with such advantages, may, at a future period, become very close and effective; but at present, it is a distant and doubtful speculation. And even with the facility which the scheme, as now established, offers, it may be doubted whether the new Honours will, for a time at least, attract so many competitors as might be desired. This, however, is a matter which we shall have further to consider in these pages.

292 The admission of competitors to the new Triposes without the condition of Mathematical Honours was the principal argument for the relaxation of that condition with regard to the Classical Tripos, which was recommended by a portion of a Syndicate and voted by a Grace Oct. 31, 1849. This also is a point which will be further discussed hereafter.

293 In the former part, it was suggested (258)

that the *Previous Examination* which now takes place in the course of the second year of the student's residence, might be transferred to the beginning of residence and made an *Initial Examination*; and that this change would have certain advantages. This suggestion has not been put in any more definite form; nor am I disposed to urge it at present. But the question of the establishment of an Initial Examination without disturbing the Previous Examination has been brought before the University; and it was decided by the vote of February 15, 1848, that the University disapproves of such a plan as was then proposed. On this subject I will insert, in the Appendix*, a paper which was circulated at the time among the Members of the Senate, and of which the arguments appear to me well worthy of consideration.

294 Some alterations intended to remedy defects to which, I believe, I had not specially referred in my former publication, were made by confirming the Report of a Syndicate appointed for that purpose, which was done by Grace of the Senate, on the 23rd of March 1849. The point in these alterations which principally affects the general course of Cambridge studies as here discussed, was the introduction into the Previous Examination of a small quantity of Mathematics. It was decreed that the first two Books of Euclid and a certain amount of Arithmetic should be introduced among the subjects of examination. By this regulation, it was conceived that the students would be prevented from delaying their Mathematical reading till near the time of their final examination, which it was supposed persons averse to Mathematics often did.

295 I may mention also, that I had recommended (246 and 259) that an Examination *viva voce* should be

* App. Art. XIII.

introduced into the Examinations both for Mathematical and Classical Honours; but that this recommendation does not appear, as yet, to have met with any response on the part of those who turn their thoughts to the improvement of our University system.

I had recommended (254) that some of the best of the answers to Mathematical questions, given on paper, should be made publicly accessible to Members of the University. This suggestion has been adopted (with regard to the answers in general, not the best only,) in the regulations respecting the new Triposes.

I will now make a few remarks on some of the subjects which are thus undergoing alteration.

Sect. 2. *The Classical Tripos.*

296 In the previous part of this book, I have (218 and 256) stated that the Classical Tripos was established in 1822; and that the access to the Honours of this List was restricted to those who had obtained the Mathematical Honour of Junior Optime at least; just as the two Medals given by the Chancellor to the best proficients in Classical learning among the commencing Bachelors had already been restricted to Senior Optimes. This limitation of the Honours of the Classical Tripos to those who have already obtained Mathematical Honours was, for several years, generally approved of as reasonable and wise. More recently, however, it has been objected to, as imposing unreasonable burthens upon those who aim at Classical Honours; and lately, the asserted analogy of the new Triposes being added to the previous arguments for a relaxation of this condition, the First Class of the *Polloi*, as well as the Wranglers and Senior and Junior Optimes, are hereafter to be admitted to compete for the Classical Tripos Honours, as I have already said.

As the discussion upon this subject is probably by

no means at an end in the University, and as it is one of very great importance, I will proceed to offer some remarks upon it.

297 The subject is of very great importance, and the discussion of it involves such questions as these:—Whether a Liberal Education ought to include Mathematical Knowledge as well as Classical Literature:—Whether the Schools at which boys are taught, ought to regulate the conditions on which the University shall grant its Honours:—Whether the University shall have for its aim to teach its students something which they had not learned as boys, or merely to reward their proficiency acquired by other teaching.

298 On the question whether a Liberal Education ought to include Mathematical Knowledge as well as Classical Learning, I have already repeatedly declared my opinion. A knowledge of Mathematics is requisite in order to familiarize students with exact Reasoning, as an acquaintance with the Classics is requisite in order to familiarize them with standard examples of the power and effect of Language. As I have already said (115), "No education can be considered as liberal which does not cultivate both the Faculty of Reason and the Faculty of Language; one of which is cultivated by the study of Mathematics, and the other by the study of Classics. To allow the student to omit one of these is to leave him half educated. If a person cannot receive such culture, he remains, in the one case, irrational, in the other, illiterate." Such an imperfect education, I conceive, the University ought not to give; and undoubtedly, it has been the aim of all those who have hitherto endeavoured to preserve or to promote the beneficial character of our University Education to show that they have taken this large view of its objects. It will be a novelty, and I believe, a very disastrous one, if, in our discussions respecting the rules by which University Honours are to be

assigned, our arguments come to turn, not upon the point, What is a good and Liberal Education; but upon such points as this, Whether it be not hard upon a particular class of men, specially Classical Students, for example, to require them to read Mathematics, which they dislike.

299 But though this would, as I think, be a very narrow and unworthy mode of arguing respecting our University Education, there are certain influences which tend to give such arguments currency among us. The persons who come to the University have been, for the most part, educated at schools at which the Classics form, we may almost say, the sole study. I have the highest opinion of many of the excellent men who are at the head of our several great Schools: and so far as I am acquainted with the present state of those institutions, I admire greatly both the improvements of system and the elevation of their general spirit and character which have taken place in many of them of late years. But still, they may be regarded as exclusively Classical schools. No other subject than Classical studies attains, comparatively, any hold upon the minds of the scholars. In particular, the Mathematics are not, at most of these schools, taught generally and effectually, as part of the business of the school. How it happens, I do not pretend to say; but at several of the great schools the attempts to teach Mathematics to the boys, as a preparation for their University studies, have in a majority of cases failed. Young men highly intelligent and well instructed in the Classics, come to the University most of them knowing little of the Mathematics; many, nothing. Not only so, but such persons have often acquired a repugnance to Mathematics, from the aspect under which they have seen the subject at school; and I believe would, in many cases, study it with more advantage if they were to begin it afresh

when they arrive at the University, provided time enough could be given to it. I do not say this with any purpose of blaming those who conduct the education of those schools. I know that in several of them, men of great talents and acquirements have laboured assiduously to bring about a different state of things. But they appear to me to have succeeded very partially; and I am obliged to state this point distinctly, in order to bring before my readers the most weighty of the arguments which bear upon the question now under consideration.

300 Our great schools, then, from which the greater part of our University students come, are in the main, merely schools of the Classics. The persons who are sent to us from those schools have been instructed in Greek and Latin for several years,—for the whole period of their boyhood; and they know Greek and Latin, often well, but rarely anything else:—of course, I mean of studies which can be called grave or severe. Of these boys, no small number have a skill which is truly remarkable, in rendering Greek and Latin into English, and in writing in Greek and Latin. Such accomplishments, when once acquired, are retained and improved with ease, and exercised with pleasure. To compete for prizes and honours which are to be won by the display of such attainments, adds, to the gratification of taste, the stimulation of contest and the chance of distinction; while to enter upon a new study, or to pursue a study in which the very elements have been imperfectly learnt, is comparatively a hard and humiliating task; and this is still more the case, if the new study be one which requires close attention and steady thought. The accomplished scholars, then, who resort hither from the Great Schools, will naturally desire, as a matter of self-gratification, that they shall be allowed to employ their time here in competitions for classical prizes, without submitting to

any mathematical or other examination, as a condition of the arena. If this is granted them, the University is, for them, a place where they reap the harvest of their schoolboy labours, rather than labour to make any new acquisitions of knowledge: the University stands there for the purpose of crowning them and rewarding them, not for the purpose of teaching them and directing their studies.

301 This would be what accomplished schoolboys would wish, if they thought merely of their own ease and gratification: but it may be thought not very likely that the University will consent to be placed in such a position;—that she will agree to resign the function of Educator and accept that of Awarder of Prizes. I trust that this is so;—and that the University will reject all measures which tend to make this change in her position and office. But yet there are influences of no small strength which tend to produce such a result. For the schoolboys of whom I have spoken, who come to the University, grow in a very few years to be themselves a large part of the University. They become Fellows of Colleges, Tutors, Examiners, Members of the Senate. They have a great share, they may have a dominant share, in the government of the University. If they retain, as governours of the University, the same feelings which they had when fresh from school, they may try now to get rid of what they disliked then. If they thought it hard that they could not compete for Classical Honours, which they would have rejoiced to do, without reading a certain quantity of Mathematics, which they abhorred, they may now endeavour to spare others the hardship. They may try to abolish all conditions for classical honours, except classical excellence; and may still call upon the University to make it her business to assign Classical Honours as one of the main features of her education.

302 It is to be observed that I am not saying

that this is the wish of any considerable number of persons in the University; I am only pointing out that it would naturally be so, if the members of the University were to consult only their personal likings and personal ease, and were to disregard the office of the University as the Guardian of the conditions of a Liberal Education. I trust that the members of the University will continue to look at such questions, as I believe they have hitherto always looked at them, in the spirit of legislators who have to determine on what conditions University Honours, regarded as the stamp of a Liberal Education eminently, should be bestowed. But in considering this question, it will be useful to us to recollect the tendency which there might be in the inclinations of some persons, to disregard this proper and general view. Bearing this in mind, we shall see that it is not superfluous to refer to arguments which might appear too obvious: since, however obvious, they may be put out of sight by the pressure of early tastes and habits. It may not be superfluous to remind the University that she is a University, in order that she may not allow herself to become a mere appendage to the Classical Schools.

303 But some of my readers will perhaps say that on these points there is no question;—that no one has proposed to open the Classical Tripos to all students without any Mathematical conditions;—That at present it is open only to the First Class of the *Polloi*:—That even if the Classical Tripos were opened to *all* who take the B.A. degree, still the Mathematical subjects which are required of the *Polloi* would remain as a condition:—and this, they might add, is not a small portion of Mathematics, since the changes made in recent years.

These are all reasonable pleas, and deserve to be deliberately considered: but I must observe, nevertheless, that in questions of innovation, the measure proposed by any party is not nearly so important as the

arguments by which the innovation is supported: since, if the present demand do not go as far as the argument goes, we are tolerably certain that present concession will only be a step to additional demands. It is therefore necessary for me to consider the arguments which were urged in support of the change recently made, by which the Classical Tripos was thrown open to the First Class of the *Polloi*.

304 I do not think it can have escaped the notice of any one who attended to the discussions which took place on the subject, that the feeling which I have above noticed, as likely to operate upon men in virtue of the tastes and habits produced by mere classical schools, did prompt a great deal of the eagerness which was manifested on that side. The argument which was urged more frequently than any other, was the hardship upon Classical men, of making them read Mathematics. In the mood in which this was argued, the duty of retaining to the University the character of a guardian of the Liberal Education of the Country, who cannot with propriety give her Honours to persons incapable of steady attention or connected reasoning, was quite put aside and forgotten. The question was, in such cases, considered as a kind of personal claim of the Classical Students to the Honours which the University has to bestow: and those who opposed this claim were looked upon, not as doing their best to prevent the University from being made insignificant or inconsistent in the work of Education, but as resisting the rights of the Classical Students, and unduly favouring some rival claims. The greater part of the University however took, I hope, and will always take, higher and truer views of the grounds on which University questions are to be discussed*.

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* In the Preface to the former Part of this book, I had stated that if any Member of the Senate offered suggestions

305 One of the arguments which was often used in reference to this question must be considered as assenting to this renunciation, by the University, of the office of Educator; or at least as admitting the fact that she had, with regard to one class of students, ceased to fulfil such an office. It was said that no harm could be done by ceasing to require the Junior Optime condition of Classical honours, since the Mathematical acquirements of those who read Mathematics merely with a view to Classical Honours were worthless. If our doctrine be true, that the University ought to require some knowledge of Mathematics, as well as a knowledge of Classics, in those to whom she gives a Degree with an Honour, this fact, if it were so, was a reason for improving the examination for the Junior Optime, rather than for abolishing the condition. And, accordingly, those who wished to improve the University Course as a system of Liberal Education, had already turned their attention to the alleged worthlessness of the Junior Optime knowledge, and had tried to remedy it; and there is every reason to believe, with very considerable success. In the new scheme of Examination established by Grace May 13, 1846, the examination for the Junior Optime Honour was detached from the rest, limited to the simplest parts and least technical reasonings of each subject, and clearly defined: and by the labour of an

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different from my own with regard to improvement in the University system I should give them a respectful attention. I added, "I trust however that such proposals, if any are offered, will be conceived with a view to the general promotion of good Education in the University, and not with a view to any supposed interests of particular sections of the students." I have seen no published argument in favour of the recent measure respecting the Classical Tripos; the feeling to which I refer in the text is very much of the nature of that which I had thus deprecated.

individual, following up this direction of the University, the whole of the Mathematics requisite to be studied for the purpose of obtaining a Junior Optime place has been clearly and fully expounded in one moderate octavo volume. It was conceived, I think most reasonably, that the requisite portion of Mathematical reading being thus put in a form in which it could be studied without doubt or difficulty, those who had occasion to apply to the study, could, if they really gave their minds to it, go through the subjects, or a great part of them, in no very long time, in such a manner that they should understand them; except they were afflicted with such weakness of power of attention, or such confusion of intellect, as ought to be a disqualification for University Honours. It was conceived that by this step, the Mathematical condition imposed upon the Classical scholar was made both more easy and more instructive. Whether this would or would not have been the case, was not fairly tried. The examination had only been allowed to take place on this improved plan in January 1848 and 1849, when the Grace of October 1849 arrested the experiment. And I do not see how those who complained of the worthlessness of the Junior Optime Mathematics under the old system, were consistent in urging the argument under a new system, established for the purpose of remedying that and other evils: when the new system had not had time for a full trial, and was never, so far as I heard, alleged to have failed. Those who urged this argument in October 1849 must (it would seem) have been resolved to reject the Junior Optime condition, whatever were the effect of the Mathematical reading which it demanded, though they made the nature of that effect the basis of their argument. I cannot but lament that an attempt to improve the effect of our Mathematical studies as a mental discipline which appeared to me to be judicious and hopeful has not

been allowed to produce its effect upon a large number of our students.

306 But, it may be said, there is still a Mathematical condition required for the Classical Tripos; namely, the amount of Mathematics which is demanded of the *Polloi*, and this, it may be added, is not small. It now includes, not only Euclid, Arithmetic, and Algebra, but a portion of Mechanics and Hydrostatics, and by a recent regulation, problems and questions of the application of principles, as well as mere questions from books. This, it may be said, is as large a portion of Mathematics as the University need require as a condition of its Honours; and the University itself, it may be said, implies as much; for it confers its Degrees upon students without requiring of them any larger portion of Mathematical knowledge.

Now it may be allowed, I think, that if the above subjects were really mastered, they would form such an amount of Mathematical attainment as the University might be satisfied with, (though no part of Astronomy or of Newton's *Principia* is included). And I suppose that a person who had really mastered these subjects would not fail in obtaining a *Junior Optime's* place according to the scale of recent examinations. But an examination held in order to confer Honours, and an examination held in order to exclude ignorance, are conducted in very different ways. In an examination of the latter kind, (a "pass examination") the smallest amount of proficiency which is allowed to pass is commonly something which is very unworthy of being in any way combined with honour; and can hardly fail to be of this character. Moreover, the Examiners who decide what a person's place shall be, are persons of a different character in the eyes of the University in the two cases. I have no wish to speak in any other than the most respectful way of the gentlemen who have commonly discharged the laborious and important office

of examining the *Polloi*; and many of them have been considerable Mathematicians: but the Moderators and Examiners for Mathematical Honours are chosen with different views from these. They are always some of the most eminent Mathematicians in the University, who have themselves obtained high Honours, and on whom the University confidently relies for keeping up the value of the Honours which she bestows. To transfer the holding of the door of access to the Classical Tripos from these to the Examiners for the *Polloi*, cannot but be looked upon as a very serious change.

307 But why, it may be said, require more Mathematics from a candidate because he aspires to a Classical Honour? If Elementary Mathematics would suffice to give him his Degree, why ask more of him because he is not content with a Degree merely, but with an honourable ambition aspires to distinction? And to this I reply, that I would do so, because the ambition which leads him to aim at an honour, shews that he is one of those persons through whom the University operates upon the intellectual habits of men, and really affects the mental character of the nation. He is one of those through whom the University really educates the nation in the best way. With regard to the *Polloi*, or at least those at the lower extremity of the list, they are persons whom the University cannot make much of. A certain degree of attention, of industry, of literature, of knowledge, it may be ascertained that they possess. But they are persons either dull of intellect, or idle and inert in study, and are not likely to produce much effect on the intellectual culture of others, nor to make any great figure in the general intellectual culture of the nation. But with regard to those who are candidates for Prizes, the case is different—they have ambition, mental activity, industry, literary habits. They are the intellectual aristocracy of the land. They will influence the intellectual culture of

many others in various ways. The characteristic education of the nation is *their* education. Their education ought to be the *type* of a liberal English education. For them, then, we must legislate, with this view; and since we deem an education incomplete without a knowledge of the elementary parts at least of Mathematics, we must require such a knowledge of them, though we will not refuse to many more dull, more feeble, or worse prepared in their boyhood, that recognition, which a Degree of B.A. conveys, of their having passed without disgrace through their University career.

To this it may he added, that we may demand a larger portion of Mathematics from one who is a Candidate for Honours, than from one who is not, because in general he is more easily capable of giving us what we demand. The man of active mind, who aims at Prizes, can easily master what a duller man cannot; —or would generally be found able to do so, if the aversion to Mathematics were not fostered by indulgence and schoolboy fashion. If there be cases in which a person's mind is so constituted that he cannot understand or retain Elementary Mathematical reasonings, though he give time and attention to the study, it does not appear unreasonable that the University should refuse to confer on him those Honours which mark him as eminent among those who had received a liberal, that is, an enlarged and general education.

308 But it may be said that those who pass the Examination as *Polloi* need not necessarily be men of inert and inactive minds, nor even devoid of ambition; since the successful candidates are arranged in four classes according to their degrees of merit; and many of the examinees exert themselves much to attain as high a place as they can in this list. And this is true, and ought to be taken into consideration as far as it goes. It is a reason for much preferring the scheme voted in

October last, by which the *First Class* only of the *Polloi* are allowed to obtain Classical Honours, to a scheme in which *all* the *Polloi* should have access to those distinctions. If in the *Polloi* Examinations, the Mathematical and Classical parts of the Examination were separated, and if the First Class in the Mathematical List only were allowed to have Classical Honours, the value of the University Honours would still be in some measure guarded; though even then, what has been said with regard to the bearing of the change of the Examiners would still be true.

309 But, it may be urged, (and this is a very favourite, and undoubtedly a very specious argument on that side) the University does not require Classical Honours as a condition for Mathematical; why then should she require Mathematical Honours as a condition of Classical? There is, in such a procedure, no recognition of that equal necessity of the two elements which you profess to maintain. A man may be Senior Wrangler without passing any Classical examination for his Degree: why then should he not obtain the highest Classical Honours without a mathematical condition? Or sometimes the inference is drawn, that the candidates for Mathematical Honours ought to satisfy some condition of classical proficiency.

Now the remark that a man may take the highest Mathematical Honours without shewing any knowledge of the Classics is not true, since the establishment of the Previous Examination. Every one who takes his Degree must have passed that Examination, Wranglers as well as others. I do not think it would be well to cumber the studies of those who aim at high Mathematical Honours with any examination in Classics, near to the time of their final competition in Mathematics. And in like manner with regard to Classical competitors, I see no objection to placing the Mathematical Examinations to which they should be sub-

ject, at a period anterior to their final competition for Classical Honours, so as to leave their latter months free for their favourite studies. I had proposed such a separation of the Mathematical Elementary Examination for the final Examination of Honours in the former part of this book (251). I made the same proposal in a Syndicate; but it was rejected by those who acted as the advocates of the classical competitors; on the ground, I believe, that such competitors did not wish to be deprived of the liberty of putting off their mathematical reading to the last possible moment.

310 I do not think, then, that there exists the alleged inequality in the mode in which Classical and Mathematical attainments are treated at the University. But I must make a general remark, bearing upon all the differences which, in some of our University plans and regulations, may seem to be made between Classics and other subjects; a remark which is really the kernel of this whole controversy. And the remark is this:—Classical reading has, with the great body of our students, obtained such an immense preponderance by a whole boyhood of exclusively classical training, that any other subject, presented at the University upon equal terms with the classical, has a very small chance indeed of producing any effect upon our students. The balance is so completely destroyed at school, that it would be a mere delusion to attempt to hold the scales even at the University. In order to obtain any hold for other subjects on the minds of students, these must be presented in such a manner as to be likely to exercise some influence upon minds preoccupied with the result of from six to twelve years of exclusive classical teaching. The great body of the boys from our classical schools, and especially the better scholars among them, would, I am persuaded, continue to give their attention to classics alone at the University, if by so doing they could obtain high

University Honours. They would be impelled to such a course by the natural disposition which I have already noticed, to exercise accomplishments already acquired, rather than to enter upon new and laborious studies; and by the general sympathy and fashion which bind together the pupils of the great schools, after they become students at the University. These influences operate powerfully at present, in deterring our students from mathematical study, as something not only laborious and dry, but at variance with literary elegance, good taste, youthful vivacity and liberty of choice. If these influences be reinforced by the creation of a large body of University-prizemen, who are almost entirely ignorant of mathematics, I do not see how we can help anticipating a great decline in the study of mathematics at Cambridge; and with that event, a great diminution of the national benefits derived from the University.

311 I have hitherto only spoken of the ascendancy which classical pursuits possess, in virtue of their being the subject (almost the exclusive subject) of teaching at our great schools, and thus, being much more fashionable at the University than any other studies. But besides the effects of general opinion and mutual applause, among those who have been boys at the classical schools, we must, in estimating the superior attractiveness which classical studies possess over others in virtue of the English habits of education, and which we must balance to some extent at the University, if we would obtain attention to any other studies, take into account the advantages of a more solid kind which classical studies bring:—the prizes which the world offers, as well as those which the University offers. Supposing the Fellowships and other emoluments of the University to be equally divided between Classical and Mathematical merit (though I think the former receive the greater share) there are, as rewards for

known Classical proficiency, all the situations of Head Masters and Under Masters in all the Classical Schools in England, great and small; and in which I have no doubt that there are at least ten Classical Masters for one Mathematical one. There are also all the cases in which tutors receive pupils into their houses, before or after they are at the public schools, or when such an education is preferred to that of a public school; and in these cases the proportion of Classical and Mathematical teachers is, I conceive, much the same. Add to them those who are private tutors in opulent families, who are also, in the great majority of cases, chosen for their classical attainments; and it will be seen what a vast preponderance of encouragement to classical reading the condition of English culture offers; and how important it is for those who know that mere classical reading is a narrow and enfeebling education, to resist any attempts to add to this preponderance by diminishing the encouragement which the University gives to studies of a larger or more vigorous kind.

312 I am obliged to say that I think the change made by the Grace of October last, is a retrograde step in the course of improvement in which the University was proceeding. By the institution of the two new Triposes, for the Moral Sciences and the Natural Sciences, the University aimed, as I conceive, at making its education more comprehensive and truly liberal. It was intended that our students should aspire to something more than the attainments of schoolboys. By this Grace they are told, on the other hand, that they may obtain the highest University Honours while they still remain within the circle of their schoolboy studies. As I have already said, I fear that this permission will *set* the habits of a large portion of University students. So far as it does this, it will undo what the establishment of the new Triposes was to do. It will contract to the dimensions of

the school, the prevalent circle of Cambridge studies, which we had tried to expand so as to be worthy of a University. If it produces this effect, it will cause the failure of the new Triposes; for they must be considered as having failed, if when they have existed for several years, they attract very few competitors. This is a question of future events, which we cannot decide till they happen. I have given my reasons for my fears of the result, and shall be much rejoiced to find them erroneous.

313 But it will be said the Grace to which I refer will tend to promote the success of the new Triposes, by enabling many of the competitors for the Classical Tripos to compete also for the new Triposes; which they could not do if they had also to prepare themselves in Mathematics so as to obtain a Mathematical Honour; as, before the alteration, they were required to do. It may be expected, it will be urged, that many of our most eminent scholars will be led to pursue the studies of the Moral Sciences Tripos especially; and by obtaining Honours in that, as well as the Classical Sciences Tripos, to shew that their culture is comprehensive and real,—a knowledge of things as well as of words. History, Morality, Polity, Jurisprudence have so close a bearing upon Classical Literature that the Classical student will naturally extend his studies to those subjects when he is encouraged by the University to do so; and thus the education of the Country will really be improved. And again, it may easily happen that a Classical student may also have a turn for the Natural Sciences, though he is averse to Mathematics: such a person may aim at Honours on the Tripos of those Sciences, and in this manner also the education of some of our classical scholars will be enlarged.

I wish to treat this argument with great respect; for it is the really hopeful view of the subject. If we

could cherish this hope, we should find nothing to regret in the alteration recently made. If the event should turn out so, the establishment of the new Triposes, and the other measures connected therewith, will be crowned with a success beneficial in an eminent degree to the national education. Let us consider, then, upon what causes it depends which result shall take place:—whether our Classical students, being no longer compelled to labour at Mathematics in order to obtain their Classical Honours, will add to their Classical lore some larger Philosophy; or whether it will become, more decidedly than it is, their practice to attend to nothing but Classical Literature.

314 It may help us to form an opinion on this subject to consider how far our Classical scholars have already shewn any tendency to combine comprehensive philosophical views, and the study of cognate provinces of literature, with the study of Classical Authors.

That this has been done to a great extent by some of our best Classical scholars, in their individual studies, there can be no doubt. I am well aware that Aristotle and Plato have been, by such persons, subjected to a critical and philosophical survey; that the Roman Law has been studied with the advantage of all the light that has recently been thrown upon it;—that the philosophy of language, the relation of languages, the history of the Greek and Latin language, have been the subject of many profound and acute researches;—that the histories of ancient times, and the parallelisms of ancient and modern histories, have been investigated with much thought, as well as learning. This has been done by many of our best scholars. Some of them have given to the world the results of their labours in published books: others are known to have acquired an admirable mastery of such speculations, though they have only communicated their views to narrower circles.

315 But have these philosophical views and com-

prehensive studies produced much effect, hitherto, upon the general body of our Classical students? Do such studies enter much into the occupations of our competitors for Classical Honours? Or do these competitors, on the other hand, confine themselves within the schoolboy circle of construing Greek and Latin, and writing Latin and Greek; the language, or rather the art of translating and writing the language, being their principal object, and not the matter or the thought?

In order to form an opinion on the point before us, which is to us a very important one, I am obliged to ask this question. For the same purpose, I am obliged also to answer it. So far as my acquaintance with the habits of our Classical scholars entitles me to give any answer, I should say that the latter kind of classical knowledge preponderates vastly in the studies of our students; that in most, translation and imitation are the prominent, essential, and almost exclusive elements of their attainments; matter, thought, and philosophy being only occasionally, and in a few cases, the subjects of a transient and subordinate regard.

316 But I will not leave this question to rest upon my own judgment. I am able to give upon this subject, the testimony of a person who himself recently obtained the highest Classical Honours bestowed by the University, and who, on reading the first Part of this book, wrote to me, confirming, from his own knowledge, the account which I had given of evils attendant upon the state of Cambridge studies and Examinations. "I am well assured," he says, "that the chief fault of the Cambridge Classical system in my time was what you have adverted to in Art. 110;" (where I have spoken of the habit prevalent among our Classical students of ridiculing all information respecting philology, antiquities, &c. as *Cramming*;) "but which I think is hardly put so prominently for-

ward in the book as it might deserve: viz. the total absence of all demand in the *University* Examinations, for *any* scientific and well grounded *knowledge* on any Classical subject whatever, not excluding language. For what was required, and of course what was produced, was not knowledge, but skill. At best it was a sort of empirical knowledge, wholly confined to the languages of Greek and Latin. No scientific knowledge of ancient history, philosophy, antiquities, or philology was of the least importance. If a few questions appeared on such matters, they were wholly overbalanced and made insignificant by the preponderance of *skill* in writing the three languages, in all possible combinations: and it is a fact that any one might get anything, up to the Chancellor's Medal, without even a tolerable knowledge on such subjects: for I did it. It was not called for, and I never troubled myself about any such works as you mention in Art. 94 (capital books on Classical History and Antiquities). All I did, for seven or eight years, with a view to Cambridge Honours, was to read all the Classics through, and to write Greek, Latin, and English incessantly. But I never cared whether I even remembered the letter of what I read, let alone the spirit of it, or had any idea of acquiring a philosophical knowledge of antiquity: satisfied with acquiring a perfect mastery of the language, like a tool or plaything."

317 My correspondent's remarks on the intellectual effect of this kind of training appear to me very judicious. "In so far as such a course has positive effects, they are extremely good. It tends to give one both a refined taste and a command of very powerful instruments for acquiring knowledge, together with a most enduring delight in what one has acquired and all connected with it. Nor need these be sacrificed. But I conceive that its negative effects on the mental constitution are most pernicious. It tends to give,

not perhaps a distaste, but an incapacity for all continuous thought, all intellectual labour, all systematic arrangement of knowledge, and all useful exertion of the memory in matters speculative. This I judge from my own experience, though it is very possible that if the system had been different, I should not have been found so well fitted to succeed in it."

318 My correspondent refers also to other evils which I had noticed as likely to arise in a system governed by Examinations alone: and as these evils are especially connected with the Classical Tripos, I will quote this part of the letter also. In Art. 151—158 I had remarked that if University Examinations are the main things attended to, they tend to make College Lectures, and all progressive courses of teaching, disregarded; that they tend also to throw the students entirely into the hands of Private Tutors; especially if the Examinations be entirely upon paper, and if the Examiners be a rapid succession of persons of the same class as the Private Tutors. On this the writer remarks, "It is just possible you may not be aware of the great extent to which many of these evils were actually prevalent, at least in my time, and with regard to the Classical studies of the place. The only right I have to speak, is with respect to these studies, and in consequence of my *having* got to the top of the tree in regard to them; which I did after a course which, if the system were in the sound state in which the suggestions of your book would place it, ought not to conduct to that eminence.

"I doubt whether the evil hinted at in Articles 150, 151, 152, &c. could well have been more active than it was in my time. There was a certain fashion, I do not quite know why, of wishing for a first class, at the end of the freshman's year, in the College Examination: probably because the University Honours were rather remote, and the previous year of College

studies were tolerably conducive to those honours. But after the first year one cannot exaggerate the utter contempt into which the College Examinations, and I must add to a great extent the Lectures also, fell, in the minds of ambitious young gentlemen: especially of one like me, who was *dandled* and allowed to do much as I liked. I remember perfectly well that my feeling was, that all I had to do was to take a good shot at the University Honours, in the way I liked best: and there was very little doubt what that was."

319 As my concern at present is principally with the character of the existing state of Classical study in Cambridge as given in Article 315, I shall not here pursue the subject of the last Article. But I would ask, assuming, as I fear we must do, the description there given to be still to a great extent true, is it likely that our Classical scholars will use their extended liberation from other studies, so as to take the opportunity of combining Moral and Political Philosophy, Jurisprudence, History and the like with their Classical reading; or is it not to be feared that they will rather confine themselves more than ever to Classical reading of the kind that leads to Classical Honours in the University Examinations? And if the latter be the result, must not this change be deemed, after the account which I have given on such good authority what kind of reading that is, be considered a very serious retrograde step in our system of education?

320 But it may be said, that this condition of the Classical knowledge which is encouraged by our University Examinations ought to be amended, and that there is a disposition to amend it. I must again say that I should receive such a reply with great attention and respect; for it presents the really hopeful side of the matter. If such an improvement can be effected in the prevalent Classical studies of Cambridge, that they shall be pursued in a comprehensive and philoso-

phical spirit, and shall generate and promote habits of study, attention, and sound reasoning, much of the evil which results from a great number of our most intelligent and active-minded students confining themselves to these studies will be remedied. And if this can be done, it will no doubt become much more likely that a considerable number of our good classical scholars will seek to obtain the Honours of the Moral Sciences Tripos. Let us consider then what is the prospect of such an improvement, and in what way it may be effected.

321 It is certainly true, that there has often been talk of making the Classical Examinations of the University more comprehensive and philosophical than they have lately been. It is conceived by those well acquainted with the subject, that the tendency to mere language-skill in the Examinations was produced by a re-action against an opposite extreme which prevailed at a previous period, when great encyclopædical papers of questions were proposed. Those who think that we have thus gone from one extreme to the other, are disposed to seek a more moderate and balanced course. And we have lately had some proposals for a better practice put in a more definite shape. On a recent occasion those who proposed to admit not the First Class alone, but all the Classes of the *Polloi* as candidates for the Classical Tripos, did not deny that the Examination for the Classical Tripos, as it is now conducted, is too narrow to be accepted as the main element of a good University education. They proposed to enlarge its scheme by adding to it an Examination in the matter, as well as the language, of certain Classical authors. Such reformers would make the Examinations embrace Moral and Political Philosophy, as it is found, for instance, in the great works of Plato and Aristotle; they would make Ancient History not a mere subordinate but a prominent part of the subjects; they

would turn attention to the philosophy of language in general, as well as to its exemplification in Greek and Latin construing. And they would maintain that an acquaintance with such subjects would be a better intellectual discipline than the kind of Mathematical reading which obtains a Junior Optime place as a mere condition for the Classical Tripos. They would perhaps propose such an Examination to be held previously to the Examination of the Classical Tripos as now held: and they would make a certain degree of proficiency in this examination as to the matter of certain Classical authors and the related subjects become the condition of competition for the Classical Tripos, instead of any Mathematical condition beyond the mere *Polloi* test.

322 If any further proposal is made to extend the admissibility of persons to the Classical Tripos, I presume that of course it will be accompanied with some such condition as this. If not, the attempt of the Grammar School to obtain a complete ascendancy over the University will be so glaring, that I should hope it can have no chance of success. I should be sorry to have soon to discuss such a proposal, whatever condition were annexed to it. I think that our changes of this kind ought, for a time, to have an end; since in education, of all things, a moderate degree, at least, of stability is desirable; and it is impossible to judge of the value of our changes, if, as we have been doing lately, we interrupt one experiment by another, before we can know anything of the operation of the former.

323 I may add, also, that this addition of an examination in the *matter*, to an examination in the *language* of Classical authors, is, I presume, conceived to be a good thing in itself, and not merely a condition to be offered in order to obtain further privileges. It ought therefore, by those who think it good, to be proposed as an independent improvement; and after what has passed, it would be natural that we should see such

a proposal made. If it is made by persons of authority and reputation in Classical matters, it will of course obtain respectful attention, and I should think, will deserve a trial. And when the trial is thus made to give to our Classical Examination a more substantial character,—and to make inquiries into the matter as well as language of great authors—every well wisher of the University will bid 'God speed' to the undertaking, and will look with the most lively hope for a successful result. We may trust that some of our eminent Classical scholars will take up this design without delay, and consider of the best way of shaping their plan and connecting it with the existing practice. Of course, some years must elapse before such a scheme, if established, can produce its due effect; but its effect, if it be anything considerable, can hardly fail to be at every step beneficial.

324 As a first step in the introduction of a *substantial* element into the Classical Tripos Examination, we may regard the Rule in the new Regulations which directs (Appendix VIII. Par. 3) that "on the morning of the sixth day a paper of questions shall be given in Ancient History;" in which paper (Par. 4) "the questions shall be fixed upon by the four Examiners in common," at their general meeting. Much will depend upon the manner in which this Rule is carried into effect; for instance, how far the questions are such as to ascertain whether the candidates have read the Ancient Historians with an eye steadily fixed upon the history, as well as upon the language; and, above all, much will depend upon the amount of weight which the answers in this part of the examination are allowed to have in deciding places in the Classes; for as we have seen, the habit of the Examination has hitherto been supposed to be, that though historical and other general questions are asked, the knowledge or ignorance shown in the answers has produced little

effect in giving the candidates high or low places, in comparison with language-skill.

325 If what has thus been done for Ancient History should be extended to such other subjects as we have mentioned, as philosophy, and the like, I should look with great interest and hope upon the experiment. But if a plan of this kind were spoken of as something which had already a definite form in the minds of its proposers and in the general understanding of the University, and which might therefore be offered as an equivalent for any existing condition imposed upon Classical students, I should be obliged to say that the nature of this new element is not yet definite enough for us to consider it as the equivalent of anything already known to us and existing in our system. If we are told that our eminent classical scholars wish to institute an Examination, not in the language of Plato and Aristotle merely, but in the moral and political and intellectual philosophy which is to be found in their writings, I should say that I think the attempt a laudable one, and will gladly do what depends upon me to favour it. But till it has been in operation for several years; till I have seen several papers of questions proposed in such subjects, and know what kind of answers the Examiners expect and approve; till I know what books are read in order to prepare for this new examination, and what books and lectures are recommended by those who take a leading part in it, I do not know what the examination is about: I do not know what is meant by the philosophy of Plato and Aristotle. And this is so, not because I do not find vast stores of valuable philosophy, of various kinds, in those great authors, but because I do not yet know how far that which I find there is what the Examiners want and will take as satisfactory. Different ages, countries, sects, philosophers, have found very different philosophies in Plato, very different philoso-

phies in Aristotle. I do not mean that we have no power of judging which is the right view in those cases; but I do not know which is the kind of view which the Examiners will take, which I must know in order to estimate the effect of such an Examination as I have spoken of. The mode in which we describe the philosophy which we find in any book, depends upon the philosophy which we ourselves hold. An attempt to give such an account of any system of philosophy as shall be quite uncoloured by our own views will end only in vagueness and ambiguity. Our abstract terms involve theories. Our words include assumptions. And in this there is no harm. Whatever be the view of a modern scholar who expounds an ancient writer, his exposition may be good, and instructive, and a valuable element of education, if it be consistent. I do not want the Examiners in Classical philosophy to be of no sect; but I want them to have some tinge of philosophy. And so they no doubt would, when they had carried on their Examinations for some time: but till then, they might deal with the ancient philosophy so as to make it suggest and encourage no coherent thought in the minds of the Examinees: or at least, (for that is all that I need to say for the purpose of my argument) I do not see any clear certainty that they would make it a discipline of thought and reason.

326 This difficulty would be much lightened or altogether removed if our Classical scholars had recently been in the habit of publishing works upon the philosophy, history, antiquities and philology of Greece and Rome. This has been the case in other countries. In Germany, France, Holland, many dissertations have appeared respecting the works and doctrines of Plato and Aristotle, for instance. I do not know that anything of this kind has appeared among ourselves; at least anything considerable enough to be taken as an

indication of what would be the result if a *substantial* examination in Plato and in Aristotle were established among us. One mode in which scholars have commonly made known their views with regard to the philosophical import and connection of ancient authors has been by translating them, and adding notes or comments; as Schleiermacher and M. Victor Cousin have done with regard to Plato. But I do not know that our English Scholars have recently produced any such work. Mr Sewell's exposition of Plato's philosophy, however interesting, would probably not be considered by us as an adequate guide for our purpose. Aristotle's Ethics, indeed, has long been, at Oxford, the subject of examinations which are intended to relate to the substance, as well as the matter of the work: and this state of things has produced precisely that indication of prevailing interest in the subject which I miss at Cambridge, so far as ancient philosophy is concerned. Various editions and translations and commentaries, and dissertations on special views of the subject, have been published by Oxford scholars. I think it is natural to expect that when our Cambridge scholars have begun to give much thought to the moral, political or intellectual philosophy of the ancients, they will produce similar works. If such works were published, we should know what it is that they offer to us when they propose a *substantial* examination (as for the sake of brevity I may perhaps call an examination in the matter of a book) in Plato, Aristotle, or any other author.

327 That such indications of a prevalent direction of thought in the University should precede any innovation in the Examinations which proceeds on the supposition of the Examiners at least being able to deal with the new subjects, would manifestly be very convenient; and such an order of events would agree with what has already happened on former occasions when

new subjects have been introduced into the University Examinations. Those who, thirty years ago, introduced among us the more analytical modes of treating mathematical subjects, did themselves publish about that time, various books in which they remodelled the usual subjects of study according to what appeared to them the improved views of the best modern writers. On this point I may quote the First Report of the Board of Mathematical Studies, lately published. After reviewing the changes which have taken place in the Mathematical subjects of University Examination they add: "In taking this retrospect it is satisfactory to remark that the more important innovations in the subjects of examination, and in the modes of treating them, receive a kind of sanction by having originated in works written by members of our body whose names are closely connected with the scientific reputation of the country. The responsibility of introducing the alterations rested with the Moderators and Examiners, no regulations having being provided by the University to which they could refer for authority and guidance: and there is reason to say that the uncertainty as to the subjects the examination would embrace, and the want of any due notice of any extension being given to them, have been felt as serious inconveniences by the higher class of students. *Generally, however, the introduction of each subject was preceded by the publication on that subject by a Cambridge mathematician,* in which the Propositions were enunciated and proved in a *manner* suitable to the established system of examination." It would be convenient, as I have said, that the introduction of such subjects as the Platonic or Aristotelian philosophy into our Examinations should be preceded by one or more publications on the subject by Cambridge philosophical scholars; in which the doctrines ascribed to these authors should be presented in a manner so clear and systematic that Examiners

and Examinees might understand each other with respect to them; for that is what is meant by the latter part of the above sentence of the Report.

328 But it may be said, the institution of examinations on new subjects would soon produce publications on those subjects; as has already been seen in other cases; and as indeed has happened in the very cases just spoken of, Oxford Ethics and Cambridge Mathematics. It may be added that there are many works of eminence by foreigners, which might supply materials for such a substantial examination in philosophy as I have spoken of: for instance, the works of Schleiermacher and M. Victor Cousin already referred to.

It may be added that there are many valuable modern works on the History, Antiquities and Philology of Greece and Rome, which have been written by English scholars, as well as many other which have been translated from the German: and out of these, it may be alleged, abundant materials for a comprehensive and substantial examination in such subjects as have been proposed.

329 I reply that I assent to this statement and wish very much to see it acted upon. I have myself proposed (94) that our Classical scholars should be impelled to read the Capital works on Greek and Roman antiquities and history: and I have there mentioned several such works. The same may be said of works on philosophy and other subjects belonging to the substance matter of classical literature. I should much wish to see the attention of our students turned to such works, by means of Examinations, since that appears to be the only effective means at present of commanding their attention. But I may still remark that we want, in dealing with this mass of literature for our purpose, some guidance and direction, which no doubt the examinations themselves would supply in

the course of a few years, but which it would be very desirable to have from the first, and in some form more intelligible than mere series of questions would furnish; questions put forth no one knowing what answers the Examiner wished for, and he having no University authority to make his opinion the standard of right answers on contested questions, because the University had had no means of knowing what his opinion on such questions was. It would be desirable to avoid, in any new case, the inconvenience noticed above in the case of the Mathematical innovations: namely, the students being quite uncertain what was wanted of them. But I mention this, not as a reason against making the proposed addition or change, in the subjects of the Classical Tripos, but as a suggestion with regard to the mode in which it may be made more satisfactorily and effectually.

330 If the Classical Tripos could really be so modified that its Honours should imply those habits of continuous thought, intellectual labour, systematic arrangement, and logical reasoning which, as has already been stated (316) it has recently been conceived rather to weaken than to confirm, it might then claim to be put on a footing of equality with the Mathematical Tripos. There would then be force in the argument, that while the Mathematical student who obtains a place in the Mathematical Tripos can obtain a place in a second Tripos without any additional condition, and the Classical student who obtains a place in the Classical Tripos cannot obtain a place on a second Tripos (that is either of the new ones) without the condition of being upon a third also (the Mathematical one) there is an inequality between the two cases. That there is an inequality we grant: and we hold that the inequality is a necessary feature in our education in order to correct a much greater inequality;—the predominance of the mere language-skill, which

is the principal or sole kind of knowledge promoted by the Examinations as they lately existed: as I have already remarked (309).

331 Whether, the object being to add to our Classical studies elements which might be favourable to systematic intellectual labour, and logical reasoning, Logic itself, as a science and art, might be deserving of consideration as one of these elements, is a question which it might not be superfluous to discuss: but I shall not here enter upon the discussion. If the subject of a substantial Classical Examination is taken up and pursued in the University, it may be worth while to return to this question.

332 Perhaps I may without impropriety refer to my own experience in this matter, of the introduction of Philosophy, Moral, Political, and Intellectual, into Examinations. Such a reference may serve to show that I am not using empty words when I speak of my desire that such Examinations should exist among us. It may show also that an examination, steadily persevered in, does, in the course of years, lead the persons who are to be examined to a course of reading and thinking on new subjects; and it may show further, I think, that it is only in a considerable period of years that this effect is produced in any great degree, even under favourable circumstances. I have now for many years been annually engaged in the examination of candidates for Fellowships in my own College. Long before I held my present position, the Master and Seniors allowed me to propose, as a part of this Examination, a series of questions in Intellectual and Moral Philosophy, or as it has commonly been called among us, *Metaphysics*. This had always been nominally included among the subjects of examination: but it will be easily understood that except one or more of the Examiners take a distinct interest in such a part of the Examination, it will fall into neglect: and this is

likely to happen especially with regard to subjects of general literature, in which our knowledge, except it be kept up by reading and thinking, becomes lifeless and antiquated. With regard to the Greek and Latin languages the case is different. A person who has once well mastered them, knows that no new speculation can in any great degree modify the meaning of the great Classical works; and therefore he can go on year after year examining in these with confidence in himself. But in Philosophy, the prevalent questions, the prominent difficulties and solutions, may become, in a few years, something quite different from what they were; and no one but a person who to a certain extent follows the current of general literature is likely to excite and keep up an interest on the subject in the minds of students. Among persons who have active duties and professional studies of other kinds, only a few are likely to give much attention to Metaphysics, and it need not seem wonderful if that subject be left in the hands mainly of one among several Examiners. The questions which were proposed on the subject in the Trinity College Fellowship Examinations, produced very little effect upon the studies of the candidates for a period of several years; mainly, I think, on account of the difficulty which I have mentioned; the want of any known standard work or body of works where the students might learn to answer the questions. In the course of years the questions themselves gradually pointed out the cardinal works belonging to this department of literature; and there grew up a general understanding as to the direction which the Examination would take. And at present, I believe, that considerable attention is paid to this line of reading by the candidates; and the answers returned influence the decisions of the electors, as, from the knowledge and thought which they display, they often well deserve to do. The result in this case has been very

satisfactory: but the slowness with which it was brought about suggests, I think, the reflection, that if it were attempted to introduce subjects of this kind into the University Examinations, it would be desirable that some standard course of reading relative thereto should be sanctioned by the University and made known to the candidates in general.

But the consideration of such a standard course belongs to the Moral Sciences Tripos, as well as to the Classical Tripos, since it is requisite for modern as well as for ancient Philosophy. I might therefore now proceed to the subject of the Moral Sciences Tripos.

333 But I will venture to go a little further in offering suggestions as to the manner in which such a *substantial* Examination in classical subjects, as I have spoken of, might be combined with the present Examination for the Classical Tripos. I conceive that such an Examination might be made effectual by appointing beforehand certain books (changing from year to year) in which the questions asked, and the answers given, should refer principally to the matter of the books, and to any thing in other books which illustrated this. These books might be either conspicuous works of the ancients upon moral and political subjects, as, for example, portions of Plato's *Dialogues*, his *Republic*, his *Laws*; of Aristotle's *Ethics*, *Rhetoric*, and *Politics*; of Cicero's *Laws*, his *Republic*, and his other *Dialogues*; perhaps the Roman and Greek historians; or they might be modern works upon subjects of ancient history, politics, or manners; as Niebuhr's *Rome*, Müller's *Dorians*, Boekh's *Public Economy of Athens*; and the like. Or perhaps better still, the appointed subjects might include every time a portion of one of these kinds and a portion of the other. The Examination in the Ancient Author would call for such illustrations of the meaning and tendency of the proposed books as either ancient or modern writers have fur-

nished: the Examination in the Modern Critic would require to have the ancient authorities on which his views rest adduced and discussed. I conceive that such an Examination in a prescribed subject, of definite extent and import, has a very beneficial effect upon study, and deserves well to be combined with the other kind of Examination now exclusively employed for the Classical Tripos; namely, an Examination in the language alone of the whole field of Classical Literature, the Examinee being expected to be prepared for any passage taken at random in this field. An Examination in a prescribed subject, on the other hand, is the usual mode of Examination for Classical Honours at Oxford, (except, indeed, that the subjects are selected by the Examinee himself). This method is conceived, justly, I think, to have some peculiar advantages; which, it is to be observed, might be enjoyed here, without at all excluding our present kind of Examination. The Examinee in prescribed definite subjects can, of course, be much more prepared and exact, than in a passage or subject taken at random. The effect of such an Examination upon the studies of candidates is very beneficial. It impels them to continuous and steady thought, and to reading with a definite purpose; adds something solid and critical to the knowledge which a man's general reading of the Classics produces; and in its result, determines how far the candidates are capable of such exertions, and have acquired such knowledge. I conceive that such a special substantial element, added (or perhaps prefixed as a condition,) to the general portion of the Classical Examination which now exists, would greatly improve our studies, considered as the parts of a liberal education; and indeed, no less, considered merely as classical studies.

334 The change of the subjects of the substantial portion of the Classical Examination from year to year is, I think, essential. No subject could be selected, of

those above mentioned, which would deserve to exclude the others; and if there were only one or two subjects, they would soon be exhausted, and the Examination would degenerate into technical conventionalities; (a declension by which Examinations of this kind have already upon former occasions fallen into disrepute at Cambridge.) To have a considerable circle of subjects, such as I have mentioned, would avert this danger; for, being brought into notice, one after another, year after year, they would all be known to those who follow the University studies for a few years. A group of four or five friends, differing each a year from one another, would be acquainted with the whole circle of these subjects: and we know how much the members of such groups impart to each other, in the way of literature and interest in literature. The whole range of the appointed subjects would be generally known to active students, as all the plays of Æschylus, Sophocles, and Euripides are generally known to students, in consequence of one or more of them being every year selected for special study in most of our Colleges. I am fully persuaded, that if such an Examination were instituted, the extension of the knowledge of the great works above mentioned which would take place in the University would be most rapid and striking.

335 But if certain subjects are to be prescribed beforehand as special subjects of Examination for each year, by whom are they to be selected? We have already several instances in which such selection is made by eminent officers of the University: but I must avow, that for this office I should be disposed to institute a new Board, *a Board of Classical Studies*; an institution which would, I think, have other advantages also. I would propose that this Board should be constituted in a manner similar to the Board of Mathematical Studies lately established. There should be, as the permanent element of this Board, the Regius

Professors of Greek, Hebrew and Divinity, and the Public Orator: and as the mutable element, the Examiners of the Classical Tripos for the present and two preceding years. Such a Board would be well fitted to select and announce the portions of the above books or other similar ones, which should form the substantial subjects for the Classical Tripos. The announcement might take place one or two years before the Examination, according to some fixed rule. The Board of Classical Studies might also discharge other offices similar to those of the Board of Mathematical Studies: they might have it for their duty "to consult together from time to time on all matters relating to the actual state of" Classical "Studies and Examinations in the University; and to prepare annually," or occasionally "and lay before the Vice-Chancellor a Report, to be by him published to the University." Such a Report might, for instance, give a sanction to the introduction of new subjects, from time to time, into the circle of subjects included in the substantial Examination. It would be convenient to the University to have some organ by which it could proclaim to the students that from henceforth some new work, ancient or modern, Cicero's *Republic* for instance, or Niebuhr's *Rome*, is to be a special subject of study.

The proposal of such a Board is connected with other suggestions which I have to offer with regard to the study of the Moral Sciences, and to those I will now proceed.

Sect. 3. *The Moral Sciences Tripos.*

336 The subjects included in the Examination for the Moral Sciences Tripos are the following: Moral Philosophy, Political Economy, Modern History, General Jurisprudence, and the Laws of England. The Examiners are the Regius Professor of

Law, the Professor of Moral Philosophy, the Professor of Modern History, the Downing Professor of the Laws of England, the Professor of Political Economy, and an additional Examiner appointed by the Senate. The time of Examination is soon after the Examination for the Degree of B.A., and all persons who pass that Examination are admitted as Candidates; as are also all persons who have passed the Examinations for the Degree of Bachelor of Civil Law or Bachelor of Physic.

The list of sciences included in this Examination was selected rather as comprising subjects already recognized in the University by the existence of Professorships tending to promote their cultivation, than with a view of offering a complete scheme of Moral Sciences. General Jurisprudence was understood to be comprehended in the Lectures and Examinations of the Regius Professor of Laws. Perhaps International Law might have been properly added to the above subjects. It is closely connected with these, forming, as it were, the intermediate step between Morality and History: and it has been, to a considerable extent, habitually treated of in the Lectures on Civil Law.

337 The more precise determination of the nature of the Examination for the Moral Sciences Tripos will be effected by the Examinations of the first few years. The Professors, who are also the Examiners, will, it is to be presumed, explain in their Lectures the course which their Examination will take; and will point out the books which the students must read, in addition to the Lectures, in order to prepare themselves for the Examination. I shall perhaps hereafter endeavour to present a plan of some portion at least of an arrangement of the above subjects, with a view to this purpose.

We have never, in this University, ceased to have

some tradition of a scheme of the Moral Sciences, fitted for general study. Rutherforth's *Institutes of Natural Law* is a work which contains such a scheme; and which is not yet obsolete, inasmuch as it is frequently quoted by writers, and used in other places of education; and is one of the books referred to in the Lectures on Civil Law given here. The substance of this work was originally delivered as Lectures on *Grotius de Jure Belli et Pacis*, in St John's College, Cambridge. It was published in 1754, and used among us much later; and many other works on Morality were published at still later periods, having reference to the pursuit of such studies in Cambridge, till we come to Paley's "Moral and Political Philosophy," which was the book mainly read in recent times; and indeed is still used among us; though of late years Paley's views are rejected by many members of the University. In several Colleges also, Moral and Philosophical Subjects have been retained up to the present time as Subjects of Examinations and Lectures; so that the study of the "Moral Sciences" (if they may be so called) has never been extinguished. It has, however, been so far thrown into the back ground by the predominant attention bestowed upon Classics and Mathematics, that it has formed a very small part, or no part at all, of the occupation of by far the greater portion of our students, and undoubtedly this exclusion of a class of subjects which are so important an element of a really Liberal Education, was a great defect in the system recently prevailing at Cambridge; a defect which the establishment of the Moral Sciences Tripos (along with the accompanying measures,) was needed to remedy. We trust that, in the course of a few years, these measures will bring back the "Moral Sciences" to their due place in our Cambridge Education.

338 A scheme of the Moral Sciences, or at least

of several of them, may be conceived to be implied in the Lectures and Examinations in Civil Law; for these refer not only to the Roman Law and its various applications in ancient and modern times, but also to questions of Morality, of Equity, of International Law, and of English Law; and books are recommended bearing both upon these subjects and upon Modern History. The general scheme of the subjects thus included in the study of the Civil Law at Cambridge is to be found in the *Analysis of the Civil Law*, published in 1779 by Dr Hallifax, the Regius Professor; and again edited with alterations and additions, so as to adapt it to his own Course of Lectures, by his successor Dr Geldart. In this Analysis, various works are named, as those in which the matter is contained by which the outline is to be filled up. On the subject of the Civil Law itself, besides the "*Institutiones*" of Justinian, which of course forms the groundwork, we find Wood's *Institutes of the Civil Law*, Taylor's *Elements of the Civil Law*, the *Elementa Juris Civilis* of Heineccius, as also his *Antiquitates Romanæ* and his *Historia Juris Civilis*, and the *Commentaries* of Hoppius and others. We find also works upon English Law; Blackstone's *Commentaries*, and Burn's *Ecclesiastical Law*. Along with these are introduced works upon what is called "Natural Law," as Grotius *De Jure Belli et Pacis* and Rutherforth's *Institutes of Natural Law*, already mentioned. There are also works of a more historical kind, as Montesquieu's *Esprit des Loix*, Sullivan's *Lectures on the Feudal and English Laws;* and works directly historical, as Robertson's *History of Charles the Fifth*, Lord Lyttelton's *History of Henry the Second.*

339 It will hardly be denied that an effectual study of a body of well selected works of this character would be a very valuable element in a Liberal Education. It is as implying such a class of subjects, that

the study of the Roman Law has, (besides its professional uses,) been long employed in many of the most highly cultured nations, as the main element of the Higher Education. The constant reference to the Roman Law in the course of European history, gives to that history its moral and jural aspect; and in several European countries, all the principal questions of morality, polity, and equity have been discussed in terms of the Roman Law, so as to take the aspect of legal questions. The Roman Law also may be regarded as the basis of International Law, and, consequently, one of the guides of national morality. Hence the Roman Law, studied in its historical, political and moral meaning, is really a valuable part of education; besides the great interest it has from the light which it throws upon Classical authors. We may consider it a fortunate circumstance that this study has continued uninterrupted in our Cambridge system, and forms one of the four "Faculties" in which Degrees are conferred; being, in this respect, coordinate with Theology and Medicine; and it deserves consideration how far we may, in arranging our University Course, treat the study of Law as analogous to the wider and unprofessional Faculty of "Arts," in which the career of our general students commonly lies.

340 If we were called upon to accept Degrees in Law as equivalent to Degrees in Arts, as to their bearing upon University Honours, we should have to require, in the first place, that the circle of studies required for Law Degrees should be of that large and extra-professional kind which has been indicated above; and in the next place, that the studies should be effectually pursued, and a proficiency attained such as may justify us in admitting the candidate to University Honours. In order to satisfy the University on the latter point, perhaps it might be desirable to associate with the Professor of Civil Law, who is now the sole

Examiner for Law Degrees, other Examiners appointed by the University from its general body. If the appointment of such persons were annual, it is probable that in the course of a few years, through the medium of such Examiners and their friends, there would be diffused through the University more knowledge of the nature of the Law studies, and more esteem for them, than at present exists. And it appears to me very necessary that this feeling should be generated, *before* the University is required to admit Law Degrees as a means of access to other Honours; for instance, to those of the Classical Tripos. To allow those who take the degree of B.C.L. to be candidates for the Classical Tripos, without the University being satisfied that such a degree really implies habits of intelligent study and the possession of solid knowledge, would be to open another door to the acquisition of University Honours by the pursuit of mere schoolboy studies;—a course which I have already described as fatally injurious to the dignity and utility of the University. If this door be so guarded that it cannot be passed by those who have mastered schoolboy studies only, the admission by that access may be a highly valuable part of the University scheme. But it is indispensably necessary that we should be well assured of this condition in the first place. An opinion has generally prevailed in the University that a degree of B.C.L. may be attained with less study and less knowledge than a Mathematical Honour, perhaps even than a degree of B.A. without an Honour. This opinion must be satisfactorily confuted before the University can, with any propriety, admit persons to the Classical Tripos in virtue of their having passed the Examination for B.C.L. If the opinion be true, such admission would add to the number of persons who obtain University Honours without receiving any University Education. If the opinion be false, the University has a right to be satisfied of its falseness;

and this may be done, in part at least, by employing other members of the University, as well as the Professor of Civil Law, in the Examination for Law Degrees.

341 I have already deprecated that mode of discussing questions respecting changes in our Educational system, which treats them as questions of the rival claims of different classes of persons in the University; and neglects the consideration of the duty of the University to give its Honours to those only who have had a University Education. This caution may perhaps have a place here. Those who study the Civil Law may think their "Faculty" is hardly used, by not being admitted to the competition of the Classical Tripos, when those who take Degrees in Arts, even without Mathematical Honours are so admitted. But surely no persons are hardly used by being subjected to the condition that the University in order to admit them to Honours must know that their course of study deserves Honour. At present, the Members of the University in general do not know that the study of the Civil Law has any but a Professional value. They do not know that it is a valuable element of a good education. They have a right to know this. They can know it only by observing the course of the Examinations for some years. When they know it, they may then give to those who take Degrees in the Civil Law (or perhaps, rather, to those only who stand in the First Class in the Examinations for that purpose) the access to Classical Tripos Honours. But time is necessary:—at least if our legislation is to be conducted with ordinary prudence. It would be a lamentable thing if, from a childish impatience at a supposed inequality, which, after all, may be only imaginary, the University should still further deprive herself of the means of giving a good education to those on whom she confers her Honours.

342 It is obvious that this question of the improvement of the value of the Law Degree, and of the increase of its estimation in the eyes of the University is clearly connected with other points here discussed; namely, with the Moral Sciences Tripos, and with the introduction of a philosophical or *substantial* Element into the Classical Tripos. For the extended circle of subjects of which we have spoken as the proper Examination for the Law Degree, agrees very nearly with the circle of subjects for the Moral Sciences Tripos. And since the philosophical part of the Classical Tripos Examination, which we have suggested as desirable, includes Morality, Law and Polity as treated by Classical writers, it would also take in some of the subjects of the Law Degree; for instance, the moral reasons of laws, and the illustration of the Classics by means of the Roman Law. At least these three parts of the University System (the Moral Sciences Tripos, the Civil Law Examination, and the Substantial Classical Examination) would have so close a bearing upon each other, that it would be very desirable that the University should habitually consider them as connected in their substance, and should make its arrangements with that view.

343 Perhaps this might be done by establishing a *Board of Moral Studies* (or a *Board of Law Studies*, if that term were preferred) somewhat resembling the Board of Mathematical Studies lately established. Such a Board might consist of all the Professors who are Examiners for the Moral Sciences Tripos, and of the persons, not Professors, who have been Examiners either for the Moral Sciences Tripos or (supposing the above suggestions adopted) for the Law Degree, for the last two or three years. Such a Board might select and appoint, every year, certain books as the special subjects of Examination for the Law Degree, as certain Boards now select the subjects for the Voluntary Theo-

logical Examination, the Previous Examination, and the changeable Classical subjects of the B.A. Examination.

As I have already said, in suggesting a Board of Classical Studies, I believe such an introduction of special books as subjects of study, in addition to the general matter of the subject, to be a very beneficial arrangement. To select certain portions of Grotius, for instance, or of Niebuhr, or of Blackstone, would enable the Examiner to make the Examination in certain definite points more extensive and searching than could otherwise be done, and would test the amount of skill and vigour with which the Candidate could direct his studies to certain predetermined points. I do not think any measure would do so much as this, to connect, with a Law Degree, an exact knowledge of some of the capital works on the subject, and thus, to make the preparation for such a Degree something more than a conventional accumulation of technical propositions.

344 Such a Board of Moral Studies would not have any direct control over the Classical Tripos Studies; but its selection of books, and any notifications which it might have to make, would of course have their influence upon Classical scholars, both those who took the line of Law, and those who aimed at the Moral Sciences Tripos: and this influence would, it may be supposed, extend soon to the substantial part of the Classical Tripos Examination, (of course through the Board of Classical Studies, if such a Board were established). The Board of Moral Studies, would probably include in its list of Law Examination subjects such works as Plato's *Laws*, Aristotle's *Polity*. Cicero's *Laws*, Cicero's *Republic*, Niebuhr's *Rome*, and the like; and these would also certainly (as I have said) form prominent parts of the *substantial* Classical Tripos Examination. And thus, the Faculty of Laws and the Classical Tripos would really be con-

nected; and would be connected by the element which they have in common as parts of a really Liberal Education; the element which does not belong either to the mere schoolboy, or the mere jurist, but to the worthy recipient of University Honours.

345 I formerly stated (281) that if such a new Tripos as I there described were instituted, Prizes, analogous to the Medals and other Prizes now given to the greatest Mathematical and Classical proficiency, might be expected to be offered to the University. This has already been verified, so far as Moral Philosophy is concerned; and probably this kind of encouragement will be hereafter given to other subjects. And when persons who have obtained such distinctions as these come before the Electors for Fellowships, the honours thus won will not fail to operate in their favour; and thus the Moral Sciences, (and in like manner the Natural Sciences,) will be established in the University, and the cultivation of them maintained, by the same means as those by which Mathematical and Classical Studies have been so long upheld in prosperity.

SECT. 4. *The Natural Sciences Tripos.*

346 The Natural Sciences included in this title are the following: Human and Comparative Anatomy, Physiology, Chemistry, Botany, Geology, and Mineralogy excluding the Mathematical part of Crystallography. The Examiners are the Professors of Physic, Anatomy, Chemistry, Botany, Geology, Mineralogy, with an additional Examiner appointed by the Senate, as in the Moral Sciences Tripos. The Examination takes place a little after the Examination for the B.A. Degree.

347 It is evident that to frame such an Examination of four days, including in due proportions all the

above subjects, and to compare the aggregate merits of candidates, taking all the subjects together, must be difficult:—more difficult, perhaps, than in the case of the Moral Sciences. There can be no doubt, however, that the Examiners may, by conference among themselves, make arrangements which may in a great degree overcome this difficulty. And such an attempt to combine the various Natural Sciences into one system will not be without its value for the study of the Sciences themselves.

348 Each Science in this list is capable of being pursued so as to occupy a life, and therefore cannot be exhausted in a few hours of Examination. And in particular, Anatomy is so much a science of detail, that it may at first seem impossible that such a brief Examination in that subject should be of any value. But this objection is greatly removed by considering that the Sciences are here to be taken in connection:—that Human and Comparative Anatomy go together, the one being used to illustrate the other:—and that Comparative Anatomy is to be considered mainly in connection with Geology. Such considerations as these may be used to limit and fix the Examinations which would be conducted in these subjects; and probably will be so applied by the Professors in their Examinations and in their Lectures.

349 There is another difficulty belonging to these Sciences as Subjects of Examination; namely, this; that the Examiners, in order to be really decisive of the knowledge of the competitors, must be answered, not by means of words merely, but by a reference to specimens and experiments. A knowledge of Botany is shown, among other ways, by naming species presented, and practically exhibiting their structure; a knowledge of Geology, by referring given specimens to their place in the series of strata, in virtue, for instance, of the organic fossils which they contain, or of other

characters; a knowledge of Chemistry, by determining the elements of a substance by means of actual tests or analysis: and the same in other sciences. This is, no doubt, a difficulty: but it has been overcome, both in the Examinations which form part of a professional (for instance, a medical) education, and in the general educational systems of other places; overcome at least so far, as to make these Natural Sciences important parts of the education so conducted. I presume therefore that among ourselves, the difficulty may be overcome to at least the same extent.

350 It may appear a defect in the above scheme that Zoology does not enter as one of the Natural Sciences, especially as Botany does: the classification of animals, it may be said, is as instructive and as important as the classification of plants. And no doubt this is a defect in the scheme, considered as a systematic combination of sciences: although to a certain extent, the blank is supplied by Comparative Anatomy. But it is to be recollected that the new scheme of studies was constructed by bringing into a new mode of operation the Professorships already existing in the University; and as we have no Professorship of Zoology, or of any branch of it, that science was necessarily not among those which were named. Nor is the defect a fatal imperfection in our system: for Botany is a good representative of the Classificatory Sciences, which is one view of Zoology; while Comparative Anatomy (and Physiology in some degree) gives the results of another aspect of Zoology. Still, if at any future period there should exist in the University a Professor of Zoology, it would naturally follow that he and his subject ought to enter into the arrangements of the Natural Sciences Tripos.

351 It does not appear necessary at present to propose a Board of Natural Studies, as we proposed a Board of Moral Studies; for there does not exist

any Examination holding the same place with reference to the University Honours, which the Examination for Bachelor of Civil Law does. The Examination for the Degree of Bachelor of Medicine is of a kind not general, but professional; although undoubtedly attendance at the Lectures and Examinations of several of the above Professors of the Natural Sciences are introduced as conditions for that Degree. But there does not appear to be, at present, any necessity for any change in the requirement for Medical Degrees. The professional Education now given at Cambridge to medical students, is a sound and extensive one: and the Degrees are not sought except for professional objects. We do not want at present a Board of Natural Studies which shall connect them with the Medical Faculty. But we may observe that for the purposes of the Examination for the Natural Sciences Tripos, the Professors who conduct the Examination, with the additional Examiner, would constitute a Board of Natural Studies, and would be able to act as such for all needful purposes.

Sect. 5. *The Mathematical Tripos.*

352 I have already stated (286) that the more elementary parts of Mathematics should be defined by means of some standard, and that a satisfactory proficiency in them according to this standard should be made a condition of competition to Higher Mathematical Honours. This arrangement has since been made, and came into operation in January 1848.

The standard of the more Elementary Mathematics, thus established, was in the following terms:

"Euclid, Book I. to VI.; Book XI., Prop. I. to XXI.; Book XII., Prop. I. and II.

"Arithmetic and the Elementary parts of Algebra; namely, the Rules for the fundamental operations upon

Algebraic Symbols, with their proofs, the solution of simple and quadratic Equations, Arithmetical and Geometrical Progression, Permutations and Combinations, the Binomial 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 at 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 Oscillations.

"The 1st, 2nd, and 3rd Sections of Newton's *Principia*, the propositions to be proved in Newton's manner.

"The Elementary parts of Hydrostatics, treated without the Differential Calculus; namely, the Pressure of Elastic Fluid, 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, [treated geometrically,] namely, the laws of Reflection and Refraction of Rays at Plane and Spherical Surfaces, not including Aberrations; the Eye, Telescope, &c.

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

The First Report of the Mathematical Board re-

commended that in the subject of Optics the words "treated geometrically" should be omitted; and a Grace was accordingly passed to that effect.

353 It was to be expected that this Regulation of the Elementary portions of Mathematics by the University would lead to the publication of one or more works combining those portions treated in accordance with the Regulation; so as to provide students with the means of preparing for this part of the Examination. And it was desirable that there should be some one work of this kind which might meet with general approval. If this were the case, we should have not only a standard List of subjects, but a standard Book; a condition under which I conceive that students are able to work with much more benefit to themselves than when they have to search through many books with only the chance of finding what is asked for, or to depend upon the guidance of Private Tutors. I should therefore be most glad to accept a work containing an Elementary Course of Mathematics, conformable to the Grace of the Senate, as the standard for our studies and Examinations.

354 Mr Harvey Goodwin has published a book of this kind: "An Elementary Course of Mathematics;" 1st Edition 1846; 2nd Edition 1847, and has stated that his object in compiling the work was to conform to the Regulations of the University above mentioned. Mr Goodwin made, in his Second Edition, some changes, which were intended to remove some want of full conformity of the work with the University Regulations which I, and perhaps other persons, had conceived to exist in the First Edition. I hope I shall not be deemed unreasonably critical if I point out some passages which still appear to me unsatisfactory. It is to be recollected that we are considering the work as one which we would wish to have fit to be a standard work, permanently used in the University by

all Mathematical students; and permanently used for what I have termed *Permanent* Mathematical studies in opposition to *Progressive*. All the Mathematical improvements of modern times are proper subjects of attention for our students; but they come before us in the Progressive Portion of the subject: the Permanent Portion retaining its original form; as we retain our Geometry, for instance, in the form which Euclid has given to it.

355 I cannot but regret therefore that Mr Goodwin in his mode of presenting Trigonometry, has adopted a mode of defining the Trigonometrical lines and proving their properties, which is a Cambridge novelty of a few years standing only, and familiar to none but Cambridge Mathematicians. I mean that he defines *sines*, *chords*, *tangents*, *&c.*, not as lines, but as ratios. By this means, the meaning of the terms becomes quite obscure, and has no obvious connection with the construction, as in the old and ordinary method it has. If our students learn *this* Trigonometry only, they will be unable to understand any works on the subject except Cambridge works of the last few years; a kind of learning which deprives the study of a great part of its value. To this it may be added, that these definitions of the *sine*, *tangent*, *&c.* are really not applicable when we come to deal with Trigonometry in a form adapted to logarithmic computation: the only form in which Trigonometry is of very extensive use. Mr Goodwin, indeed, afterwards gives the old and ordinary mode of defining the Trigonometrical lines, from whence, as he says, the meaning of their names will be more distinctly seen. But in all his reasonings he takes the new Cambridge definition. Of course I am quite aware that this novelty was introduced in order to get rid of some changes which used to perplex young students in Trigonometry, and which occurred as sines, tangents, &c. were taken "to radius r" or "to

radius 1." But novelties introduced for such purposes should be employed as illustrations of the old form of presenting the subject, and as elucidations of its difficulties, not as substitutes for the old definitions. As I have already repeatedly said, the value of a certain portion of our Mathematics ought to depend upon its permanent form, as for instance, Geometry. I have heard of an Inspector of a School, in which Trigonometry was one of the subjects studied, blaming the managers of the school because they had not got the new Cambridge Trigonometry. It would have been just as wise to blame them because instead of the Euclidean demonstration of the square on the hypothenuse they had not given some one of the many pretty substitutes for it which have been produced since Euclid's time. It is very well that the students should know those novelties; but the way to make them valuable is to have, as a ground work, the old proposition to compare them with. I should be much better satisfied therefore to see, in our standard Course of Elementary Mathematics, Trigonometry presented in the old and *classical* form.

356 I am obliged to make an objection partly of the same kind to Mr Goodwin's mode of treating the subject of Statics. He has first proved the properties of the Composition of Forces at a point, by a method which is ingenious, but not, I think, likely to appear clear or satisfactory to a beginner; and he has then deduced the properties of the Lever from those of the Parallelogram of Forces. Now there is an independent proof of the properties of the Lever which has always been current in elementary works on Mechanics, which is eminently simple and satisfactory; and which is remarkable for being as old as Archimedes, who invented it, and from being thus the first monument of a demonstrative Science of Mechanics. These appear to me to be strong reasons for making it the basis of

Statical reasoning, as it has generally been made. And I much fear that students who see the property of the Lever proved in the complex and indirect way in which Mr Goodwin proves it, will never see what a simple and cardinal truth it is. It is true that Mr Goodwin has given in a note the independent proof of the property of the Lever; but this is far, I fear, from being likely to remove the confusion which is likely to arise from giving to a Science so old, a new form in an Elementary Course. Many of the questions which have usually been discussed in books of Mechanics become unintelligible in this way of treating the subject*.

357 I should be disposed to object, although in a less degree, to the mode in which the subject of Cycloidal Motion is treated. Mr Goodwin has, in a note in the second edition, introduced a method of proving the properties of Cycloidal Oscillations which is conformable to the University Regulation; the method introduced in the text being certainly one which the University could not have contemplated in passing the Grace. I have every temptation to be pleased with Mr Goodwin's adoption of this mode of proof, for it is, in substance, one which I invented, and inserted in my *Mechanics* several years ago. It was invented for the sake of introducing ratios, instead of an arbitrary radius;—the ground, as I have already said, on which our Cambridge Mathematicians made the innovations

* I may remark that my objection to this mode of dealing with the subject of Statics arises from no want of interest in the proofs of the composition of forces at a point. Several such proofs have been devised in recent times, one of which is that which Mr Goodwin gives. I have myself invented one such proof, which was published in a book entitled *Analytical Statics*, in 1833; and which coincides with a proof published about the same time by M. Poisson, though invented quite independently. And I believe I was the first person who published; for the use of Cambridge Students, a Treatise on Mechanics in which the Composition of Forces at a Point was statically demonstrated.

in Trigonometry, of which I have spoken. But I confess I still prefer the older method invented by Cotes, and adopted by Wood; and I think the student would derive from it a clearer notion of the proof; as certainly it has a far better claim to be considered as a classical proposition than mine has.

358 I do not think that I entertain any other objections to Mr Goodwin's book which are so important that I need mention them here. Some parts of his work are well suited to their purpose.

The Conic Sections, as treated by Mr Goodwin, though brief, are sufficiently rigorous. The Newton will not give a very exact notion of Newton's reasoning to those who do not consult the original text: but it is to be hoped that all the more active minded students will do so. The Optics would, I think, have been clearer for elementary students if it had been more Geometrical; but the propositions are very properly illustrated by several good figures, which in a great measure remedy the defect. The Astronomy is such as meets the occasion; and if there be introduced more concerning astronomical instruments than is absolutely needed, this part may serve to turn the attention of the better students to an interesting subject. And the same may be said of the mode of constructing Solar Eclipses, which makes an acceptable addition to the Astronomical part of the Course. I cannot but rejoice that we have the whole of the Elementary Course of Mathematics to which we direct the candidates for Mathematical Honours thus collected in a single moderate octavo volume.

359 The separation of the higher Mathematics from the elementary in the Examination of our candidates for Mathematical Honours was in operation in the Examinations of January 1848, and January 1849; and so far as can yet be judged, has tended much to produce, or to ascertain, the state of things which was

aimed at;—namely, that those who sought Honours as students of the higher Mathematics should also be well grounded in elementary knowledge. This would seem to be now the case; since, as we are told, it was found that those who, in the later part of the Examination, distinguished themselves most in the higher Mathematical subjects, had, for the most part, previously acquitted themselves best in the introductory Examination in the elementary subjects; and that in no case did persons who had been decidedly defective in elementary knowledge reach high Honours by any lucky speculations in the more elevated and difficult part of the Examination.

360 In the Report of the Board of Mathematical Studies notice is taken of a gradual change which has occurred in the Mathematical Examinations, and which I also had noticed (229). They remark that the time allotted to Questions from Books had increased in a much greater proportion than the time allotted to Examples and Problems*. And they state that having examined a considerable series of answers, they find that the number of answers to the examples and deductions has fallen below the amount which it is desirable to secure. They recommend, on this ground, that the papers containing questions from books be shortened, in order to enable the candidates to give more time to Examples and Deductions.

I am of opinion that this recommendation, if acted on, will tend to make our students have a better understanding of their Mathematical principles than they, or at least, many of them, have generally had. For as I have already said, (230) "A person may answer by rote a Question from a Book, but in order to solve a

* By a note to their paper it appears that the time allotted to Questions diminished in the years 1827-1848, from 39-100ths to 27-100ths of the whole time.

Problem by means of a Principle, he must see the Principle with some degree of clearness."

I have spoken so much of the Mathematical part of the University System in the previous part of the work, that I need not now dwell longer upon that subject. But I must still say a few words on the means of promoting the study both of Mathematics and of the Natural Sciences as a part of the general education of the country.

Sect. 6. *The Great Classical Schools.*

361 Any one who has thought at all on the subject of the education of the middle and higher classes in England, must be aware that the Great Classical Schools exercise a very powerful influence upon such education. The flower of our English youth spend at these Schools the years during which the greater part is acquired of all that youths do acquire in the way of learning. It is there that their mental habits in a great measure receive the form which they retain in after life. The tastes there generated, the estimate of different kinds of knowledge there communicated by the contagion of society, are not easily afterwards changed. Even if at the University they are introduced to new subjects of thought, new modes of study, new associates, new motives, still the influence of the School continues to be extremely powerful, and though it may be modified, is never obliterated by subsequent agencies.

362 But the views which have been presented in the preceding pages show us this influence operating still more powerfully in another way. If the scholars who come from the Great Schools to the University are not in any great degree afterwards moulded by the University system:—if they are not engaged upon new subjects and modes of study;—if they obtain University Honours, and College emoluments, merely by con-

tinuing the pursuit of their schoolboy labours;—if, having done this, they become so numerous in the governing body of the University as to be able to control and direct its measures;—if they exercise this power so as to protect the next generation of schoolboys from being constrained to any studies except those of the Schools; then the University is no longer a place of higher education, supplying the deficiencies of the Schools, balancing their partial system, liberalizing their necessarily narrow plan, converting the education of the Grammar School into a University education: the University then is merely an appendage to the Great Schools: rewarding their best scholars, but teaching them nothing; giving prizes, but giving these to proficiency acquired at School; exercising little influence to modify or correct, but much to confirm the impressions made by the mere classical education of boyhood.

363 I will not say that Cambridge has reached this condition; but I conceive that she is in no small danger of it, if she proceeds in the direction of the measure of October last. And there is at least peril enough of this kind in view, to make it worth while for us to consider whether there ought not to be some modification of system in the Great Schools themselves. This, indeed, is a question which it would be well worth while to consider, independently of any danger which we may apprehend to the system hitherto prevailing in our University. For without referring to any such consideration, it is not, I conceive, too much to say that the Great Schools exercise a greater influence than the Universities upon the higher education in England: and that no measures for the improvement of that education will be efficacious if they do not extend their effects to the Schools as well as the Universities. Indeed it appears to me clear, that, so far as Cambridge is concerned, if anything more in the way of

improvement is to be done at present, it must not only extend its effects to the Schools, but must begin at the Schools: and I have the strongest conviction that those who wish to improve English education ought to direct their efforts to those quarters much rather than the Universities, as points on which their action, if successful, will produce a much wider and deeper effect.

364 Of course, when I speak here of the improvement of the system of the Great Schools, I do not mean any improvement in the mode of teaching Greek and Latin, but the improvement of combining, with Classical reading, other elements in the School education. I believe that in the Classical portion of education, and in the general tone and temper of the education of boys, great improvements have in recent years been introduced in most of our Great Schools: and I would beg the eminent scholars who direct the education of these Schools to believe that all which I say is said with the most entire respect for them, and with great admiration of the manner in which they discharge and elevate their office, so far as I am acquainted with the cases. They will, I am sure, see nothing but a fair discussion of an important subject about which we are all deeply interested, in any attempt to consider of what elements the education of a Great School ought to consist, and how these may be introduced into their places. I must treat the subject in a general manner; not only because such is the most proper mode of dealing with it, but because I really have not, in my mind, any reference to one particular place or mode of practice rather than another, amongst those which now exist.

365 After what I have already said, my readers will not be surprised at my again saying that the Mathematics ought to be taught at school, so far as to be a preparation for the Mathematics which are to be studied at the University; nor at my adding that

the present Mathematical teaching at several of our Great Schools fails of satisfying this condition with regard to a great number of their scholars, many of them very well instructed in Classics. Nor shall I here attempt further to illustrate these propositions. That Mathematics is a necessary portion of a Liberal Education, I have endeavoured to show in the first part. But Mathematics cannot be studied to any purpose at the University, except an effectual beginning is made at school. This is true, even of speculative portions of Mathematics, such as Geometry, in which the main point is to be able to understand and to state the proofs of the propositions which belong to the science. It is still more true of practical Sciences, such as Arithmetic, Algebra, and Practical Trigonometry, in which the learner has to apply rules and to perform operations, which it requires considerable time and application to learn to apply and to perform correctly, and still more, to perform both correctly and rapidly. If this is not learnt during the period of boyhood, at least with regard to Arithmetic, it is never learnt; and when this is the case, all real progress in Mathematics is impossible. Yet how imperfectly Arithmetic is generally learnt at our Great Schools, is remarkable to the extent of being curious, besides being, as I conceive it is, a great misfortune to the boys. The sons of great merchants, bankers, and fundholders, when they leave school, are very generally incapable of calculating the discount upon a bill, and often not able to add up the sums of an account. And few indeed of the sons of our great landowners can calculate the area of a field of irregular, or even of regular form, and given dimensions. This appears to be a lamentable state of things on every account:—in its first and lowest bearing, because such ignorance is a great impediment in the practical business of life: in the next place, because Arithmetic is in itself a good discipline

of attention and application of mind, and when pursued into its applications, an admirable exercise of clearness of head and ingenuity:—in the next place, because, as the boys of the Middle Classes at Commercial Schools are commonly taught Arithmetic (and generally Mensuration also) effectively and well, the boys from the Great Schools have, in this respect, an education inferior to that which prevails in a lower stage of society:—and, in the next place, again, because the want of Arithmetic makes it impossible that such young men should receive a good education at the University. On all these accounts, it appears to me in the highest degree desirable that Arithmetic, at least, should hold a fixed and prominent place in the system of our Great Schools. Such facts as I have above stated, show that at present it does not hold this place; and whatever means have hitherto been employed in teaching Arithmetic in the Great Schools, it is plain that they are insufficient with regard to the majority of the scholars: and I should say, plain, that new and better means should be devised and introduced.

366 I do not pretend to be sufficiently well acquainted with the system of Great Schools to be able to suggest how this may best be done: but it is plain, I conceive, that it must be done by making Arithmetic a part of the System of the School; not an appendage to the ordinary work of the school, enjoined it may be, and provided for, but not looked upon with any regard and respect by those who govern the school, and direct the minds of the boys. Arithmetic, and when that has been mastered, Geometry, Mensuration, Algebra, and Trigonometry, in succession, should form a part of the *daily* business of every school which is intended to prepare students for the University. I am aware that it has been said that any substantial attention to such subjects interferes with the Classical teaching; be-

cause the Classes of boys framed according to their knowledge of Greek and Latin will differ from the Classes according to their knowledge of Mathematics. Of course this is a difficulty; but it is a difficulty which should be overcome. It has hitherto been in a great measure overcome in the University and in our Colleges. It is a difficulty which, if we yield to it, and allow it to deter us from the attempt to improve our education, will make it impossible for us to have a Liberal Education; because it will exclude all but one element. At this rate, we shall teach our boys Greek and Latin, and not teach them anything else, for fear it should interfere with Greek and Latin; and this, during the first eighteen or nineteen years of life, when they might learn the elements of all human knowledge, and acquire habits which would lead them into any part of literature or science, according to their intellectual tendencies.

367 It may be said that the University and the Colleges ought to compel the Schools to teach the Elements of Mathematics, by requiring a certain quantity of Mathematics of all their students;—that to a certain extent they do this; and may do it still further, if the present state of things in this respect is not satisfactory. This may be said: and it is true, and will I hope be acted on. I hope that the Colleges, or the University, will require of all students who come to them a real and practical acquaintance with Arithmetic and Geometry. But this will hardly continue to be the case, except something effectual is done to promote the learning of Arithmetic and Geometry at the Great Schools. We know that what is learnt merely in order to pass a single Examination, is always learnt in an imperfect and ineffective manner;—never forms the mental habits, or remains as a permanent possession. Arithmetic learnt for such a purpose, is not a familiar practical art, as, to be of any value, it

should be. Then consider again, what would be the effect, if a rule, that all students should bring with them to the University a good knowledge of Arithmetic and Geometry, were imposed with rigour, while the subject was taught at the schools, as now, reluctantly, and barely as far as was likely to be insisted on. Such consequences as this would ensue:—that some of the best scholars from the best schools, known already to be such by their performances at school, would, in consequence of their Mathematical deficiencies, be turned away from the gates of our Colleges when they presented themselves for admission. Is it likely that this would continue to be done rigorously and steadily?—Done too when the persons who hold the doors of those Colleges are themselves, perhaps, in a large proportion, men from Great Schools, sympathizing with the scholars of those schools:—sympathizing with their taste, their ambition, perhaps their ignorance. The unlikelihood that such a system of rigour will long be persisted in, except the Schools begin by really teaching Arithmetic and Geometry as a part of their system, makes me look to the latter course as the only one which is likely to prevent the further narrowing of our University Education.

368 Geometry, that is, a few Books of Euclid, has hitherto been commonly taught along with Arithmetic, at the Schools from which young men commonly proceed to the University. It is not quite so necessary that Geometry should be well studied at school as it is that Arithmetic should be well taught there: because in Geometry, the learner has only to understand and to remember, whereas in Arithmetic he has to work in virtue of acquired habit. A student at the University, if he had very good mental talents, might perhaps go forwards and acquire a good knowledge of Mathematics, even if he had his Geometry to begin after his arrival. Still it is not very likely that

he would do so. The habits of mental attention and coherence of thought should be cultivated before the age of eighteen, or they will hardly be cultivated to much purpose. It appears to be, in the present state of things, quite necessary that youths who are to come to the University should become masters of some considerable portion of Euclid before they come. Indeed this appears to be the more necessary now, because, so far as I can judge, boys in general are more slow in understanding any portion of Mathematics than they were thirty years ago. It may be that I am mistaken, but so it appears to me: and I do not conceive it to be at all improbable that a long continuance of mere Classical learning, of the kind which I have already attempted to characterize, should have led to that which not I alone think likely to result from such an education; namely (316) an incapacity for all continuous thought and all intellectual labour. I do not think it at all incredible that a long course of indulgence in the pleasures of taste and imagination, without any corresponding exercise of the reason, may have emasculated the intellects of the rising generation, so that they prove feeble in comparison with their fathers, when they are called to any task requiring continuous and systematic thought.

369 I have already said (33) that along with Arithmetic, I think Mensuration, that is, Practical, as distinguished from Speculative Geometry, a subject well adapted to the teaching of schools, and suited to prepare the student for the University, by giving him the possession of the practical art of which Science afterwards explains the speculative reasoning. The relation is in some measure the same as between Arithmetic and Algebra. We may add that the application of Mensuration to special examples and problems gives great occasion to the exercise of ingenuity and clearness of thought, and is not only a good discipline of

the mind, but a very good arena for competition in skill and knowledge among young students.

370 If Arithmetic were already taught effectually at School, I should be disposed to add the Use of Logarithms (I mean the practical use) as an art of great value for abridging laborious Arithmetical operations. But I do not now insist upon this; confining myself to urging that which I do think a most important and essential improvement in English education, —namely, that Arithmetic and a portion of Euclid's Geometry should be taught to all the scholars in our Great Classical Schools: taught so as to be familiarly used and permanently possessed; and with that view, made a part of the daily system of those schools.

371 I will observe, once more, that a great part of the vice of the mode in which such branches of learning are now taught at Classical Schools is this:— that they are taught, not as valuable for their own sakes, but as means of passing our Examinations in the University. And hence it comes that boys are not taught things the most fit for boys, and in the manner most fit (as the practical teaching of Arithmetic is); but are taught, as much as possible, in the manner most resembling the teaching of the University. And undoubtedly the teachers, looking only to the boy's University career in what they teach, think this a great improvement on the system of teaching Mathematical subjects in their schools. This, however, I will take the liberty of saying, is altogether a mistake. Boys should be taught Arithmetic and Geometry, and it may be, Algebra and Trigonometry, in the Great Classical Schools, in the same way in which they are in the best Commercial schools: at any rate, in some way in which the knowledge, and not the passing of examinations, is regarded as the valuable result.

372 I will now quit the subject of Mathematics, once more repeating, that the improvement of the

higher English education is to be effected only by improving the system of the Great Schools: and I will apply this remark to another subject:—a subject already noticed in the preceding pages as one of those in which this University has instituted Examinations and Honours, I mean Natural History, or perhaps I might say, the Natural Sciences at large.

373 I am by no means going to recommend that the Natural Sciences, or even Natural History, should be made a part of the ordinary course of instruction at Great Schools. But it will be generally allowed, I conceive, that knowledge of this kind acquired by young persons in whom there exists an aptitude for it, is an agreeable and often a valuable addition to the fundamentals of a good education; tends to give a more comprehensive character to their mental culture; and may be the beginning of a really scientific and effectual prosecution of those sciences. It is with these views, I conceive, that the University of Cambridge has resolved to encourage the study of the Natural Sciences by her Rules and her Honours. Now with regard to Natural History, especially, it is notorious that where the aptitude for the pursuit exists, it is commonly called into activity by some early event which brings before the boy's mind the objects with which the science deals. Many of our more eminent naturalists can trace the beginning of their scientific career to their having some early friend or relative, who was a collector, or had a collection, or to hearing some lecture on plants or animals, their habits, classification or structure. Such events, if they happen so as to impress the boyish and still plastic mind, may have an effect upon the mental habits, which nothing presented at a later period could produce. I should think that the effect would be likely to be very beneficial, if at certain intervals, the boys of our Great Schools were to hear some lively and intelligent lecturer on some branch

of Natural History, the lecture being of course abundantly illustrated with specimens or drawings. Even the general mass might retain enough of what they heard and saw to make an addition to their ordinary stores of innocent occupation and amusement; and when the naturalist's eye and the naturalist's mind existed in their embryo state in any boy, the developement of those peculiar faculties might begin early, and might, all the more easily on that account, affect the whole life. And if young men came from the Great Schools to the University thus prepared, the Natural Sciences, which are now offered to them as one of the objects of University study, would then stand upon more even ground, and have a fairer chance of attracting a proper share of notice, than they can have when they are presented to persons who for the first eighteen years of their lives have had an education entirely occupied about words; and have never been accustomed, or at least never taught, to look at Nature at all.

374 I should conceive that this suggestion of occasional or periodical Lectures on Natural History, to be given to the scholars of our Great Schools, might be carried into effect without any inconvenience, and might indeed be an arrangement agreeable and interesting alike to the Master and the Scholars, without interfering in any way with the business of the School; since I propose only lectures, without any examinations or lessons in the subject in any other form, except such as the pupils afterwards voluntarily give themselves by applying and extending, if they were led to do so, the knowledge which they had got at the lectures.

375 I repeat once more, that the further improvement of English education must begin in the Great Schools; and the two main steps which I now urge as the most likely to forward this object, are the establish-

ment of Arithmetic, Geometry, (and I would add, Mensuration) as parts of the system of the Schools, so that they shall be constantly, universally and effectually taught; and the introduction of frequent Lectures on Natural History in addition to the business of the School. With such additions, the thorough Classical education which is given to the best pupils of our Great Schools would form the best foundation for a Liberal Education, to be afterwards completed at the University.

I cannot think that there would be any difficulty in finding time for these additions to the occupations of our schoolboys. At present they are employed during the ten or twelve years of life best adapted for learning, in learning Greek and Latin. Some do this very imperfectly indeed; some no doubt, not only learn these languages admirably well, but add also a knowledge of French, German, Italian, or the like. But even with those who do all this, there must be times for such additions as I have mentioned; while, with regard to the less complete Classical scholars, such additions would prevent their education from being so wretchedly poor and narrow, and themselves from being so illiterate and ignorant as they often are.

SECT. 7. *The Stability of the University System.*

376 Probably most persons will allow that a great degree of caution is requisite in legislating on the subject of education; and that our system ought not to be suddenly or hastily changed. In education, more perhaps than in any other subject, the results of our innovations turn out in fact quite different from what they were in design and theory. In education, again, the effect which studies produce upon the mind depends upon their being something permanent and stable, connecting one generation with another. In education,

further, there must be time for the teachers and examiners to learn their parts, as well as the pupils, theirs; therefore no great change can be made, or should be attempted, except in the course of years; and no second change should be attempted till the working of the first has been seen in actual practice, as well as contemplated in prospect.

377 These are simple, and I believe, very sound principles of University legislation. It may be worth our while to consider how far in the legislation of the present time, the University of Cambridge is conforming to them. It cannot be denied that our legislation has, to say the least of it, been very copious in recent years. Taking the interval which has elapsed since 1840, the date to which in the first part of this work I brought up the history of our changes, we have passed the following laws relative to the educational course of our students. And first, with regard to the general (as distinguished from the professional) education, we have had these very important steps of legislation:—

I. 1846, May 13. New Regulations for the Examinations for B.A., both for Honours and *Polloi.*

II. 1848, Oct. 31. Institution of two New Triposes, and of the Professorial Conditions for B.A.

III. 1849, Oct. 31. New Regulations for the Classical Tripos.

IV. 1849, Nov. 23. New Regulations for the Previous Examination.

Besides these, we have passed various laws concerning the Degrees in Medicine: namely

V. 1841, April 1. New Regulations concerning M.D., M.L., and M.B.

VI. 1847, May 5. Modification of the Rule for M.B.

Also in Theology we have not been idle: we established

VII. 1842, May 11. The Voluntary Theological Examination, and the Theological Examination required of the *Polloi;*

Besides making a Professorial Condition with regard to Theology in the Law No. II. We have also had

VIII. 1847, Oct. 23. The institution of the Porson Scholarship.

And within the same period some subsidiary regulations have been made with regard to the publication of the Classical Tripos, and the Examination of Candidates for Honorary Degrees.

378 Now I believe all these steps to have been real, and some of them great improvements; with the exception, perhaps, of No. III.; of which I hesitate to approve, because, as I have said, it disturbed the effect of the promising experiment made by No. I.; and, if not counteracted by improvements in the Great Schools and in the Classical Tripos Examination, is but too likely to prove a retrograde step upon the advance made by No. II. But granting all these to be wise and hopeful measures, they are, it would seem, a sufficient number of new laws upon one class of subjects for the present. Most of these laws will require time to produce their effect, and even to show of what nature their effect will be. Some of them may require co-operating agencies to be exerted elsewhere, before they can produce their full benefit here. We have an example of such a case in No. VII. The Voluntary Theological Examination is, I believe, exercising a very beneficial influence upon the Theological training of our students. But why is this? Because almost all the Bishops require that the persons whom they ordain shall have passed this Examination satisfactorily. It is "voluntary" so far as the University is concerned, but the Bishops make it compulsory on candidates for Holy Orders. In the same way with regard to our

other new Triposes: it is very difficult to foresee what bearings they may have in the course of a few years: impossible to foresee this till they have come into operation, which as yet they have not. Any further legislation then, founded upon the supposed operation of these new Triposes, would be in the highest degree rash and premature. A few years will show whether the admission of the First Class of the *Polloi* to the Classical Tripos, be, as many of us fear, a retrograde step; or whether it tends really to liberalize the education of our Classical students. Let us wait till we see how this turns out. Let us not legislate further, as if that favourable result were certain which appears to me so doubtful, and which I have given, I think, very strong reasons for doubting. And above all, let us not legislate as if such questions were mere points of rival claims between different classes of students in the University, and as if men, acting as Senators of the University, had it not for their first and paramount obligation to take care that the education here given is really worthy of the University:—really a University education, not a distribution of prizes for School proficiency*. If we are to deal with the question as one of rival claims, the rivals are the Grammar Schools and the University.

379 There are some inconveniences attendant upon the mode in which laws are passed by the University. I suppose that most members of the Senate perceive the intolerable inconveniences which would result from having every measure made the theme of

* I do not conceive that the same ground for deprecating change exists with regard to any proposal for improving the Classical Tripos Examination by the introduction of a substantial element (330); provided such a change is made independently and without altering the conditions of competition. Such a change would not interfere with the result of any of our recent laws.

public debate in the Senate-House. There are some inconveniences arising from the absence of any general and regular mode of discussing measures proposed for the acceptance of the University, but these inconveniences may be surmounted. If when measures are proposed, the arguments on one side and on the other are not circulated through the University, in some form, it may happen, even in questions which excite great interest, that two bodies in the Senate may vote on opposite sides, neither of them knowing what are the views and arguments of the other party; and this has, I think, not unfrequently happened. This defect of a regular channel for the discussion of University matters is often remedied by the publication of pamphlets, or by the circulation of printed papers of reasons among the members of the Senate. And such papers are, I conceive, always to be welcomed as tending to make the members of the Senate understand each other's views, and vote with a knowledge of the case. But the proper and constitutional provision, which supplies the means of discussion, while it is consistent with the calmness, caution, and discretion which the conduct of University affairs requires, is the appointment of a Syndicate in order to consider a given question, or to frame measures for a given object. Such Syndicates are commonly so selected, that in them the opinions current in the University are duly represented, advocated, and brought into conflict. In such a Syndicate, a free discussion of the prevalent views, plans, and arguments commonly takes place, and ends in the production of a "Report," usually recommending some Plan, which is afterwards voted upon by the Senate, and confirmed or rejected. The selection of the Syndicate is generally suggested by those who take the chief interest in any proposed change, acting with the approval of the Vice-chancellor, and introducing a due balance of different classes and interests into the com-

position of the Syndicate. Those who have seen much of the working of this process, will agree with me that in almost every case, the Syndicate has been fairly selected, and the discussions at its meetings carried on with great ability, temper, and a sincere zeal for the good of the University. All the more considerable of the measures above referred to (namely, I, II, III, IV, VII.) were the result of repeated and careful deliberations of such Syndicates. Indeed no measure, however slight, should be allowed to pass without careful examination of it in various points of view by several persons in common; for it is impossible in any other way that the University should be secure from committing the grossest incongruities, and producing utter confusion and mischief. Accordingly those of the above measures which were not prepared by a Syndicate, were carefully considered by the Vice-chancellor, along with the Heads of Houses, or other members of the University specially connected with the points in question: and the notice of the Grace for their acceptance being placed upon the Notice-paper issued by the Vice-chancellor, this circumstance was looked upon by the Senate as a guarantee that this care had been exercised in preparing the new Regulations. And this course may suffice for slight and subsidiary Rules and modifications: but when any considerable change is contemplated, or even any change which may seem slight, but about which there are conflicting opinions in the University, there can be no doubt that a Syndicate ought to be appointed, in which the varying opinions may come into contact with one another, and reasons may be answered, and amendments proposed, and means devised of overcoming difficulties, and, in short, the functions of a deliberative body duly exercised, before the Senate proceeds to vote upon the measure*.

* Of course the appointment of a Syndicate is not inconsis-

380 We cannot doubt of the propriety of following the course here described, in any changes which may hereafter be made in the Plan of University Examinations as at present established; whether such changes refer to the matter of the Examination in the Classical, Moral, or Natural Sciences Tripos, or in the conditions of admission to the Honours of these Triposes. With regard to changes in the Examination for the Mathematical Tripos, the Board of Mathematical Studies may, it would seem, stand in the place of a Syndicate, and changes may properly be proposed to the Senate on the recommendation of that Board, as has already been done. But in the other departments, no change ought to be made without being discussed in a Syndicate composed, as those Syndicates were which recommended the Plans recently adopted, of several of the most eminent persons in the University, of acknowledged learning and experience in University matters, and of various standing, position, and views.

381 There exists, however, no express rule, limiting the University to this mode of making and changing its laws. Any Member of the Senate may give notice of a Grace to be proposed at any Congregation: and it is understood that the Grace must be voted upon in the Non-Regent and in the Regent House, except it be stopped in the *Caput*. The Caput, therefore, is the only security which we have against the most rash and inconsistent legislation. Without the power of *Veto* in the Members of the Caput, the Constitution of the Senate of the University of Cambridge would be among the most democratic and unbalanced that have ever

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tent with the publication of the views of other members of the Senate at the same time. A Syndicate must always be desirous of knowing what opinions are entertained in the University on the subject about which it has to deliberate.

existed in the history of legislative assemblies. A Grace proposed by any Member, with only two days' notice, voted without any discussion whatever, only one voting taking place in each house, would become law. With such a constitution, it is difficult to assign a limit to the extravagance and inconsistency to which our legislation might proceed. For few Members of the Senate attend the Senate-House habitually in order to vote: so that a comparative few who attended expressly for the purpose, might carry their measure. And few Members would see all the bearings of a measure, all the arguments for and against it, without discussion with persons of very different views. The conversation of a limited circle of friends on such subjects would be more likely to confirm them in some special and partial view, than to lead them to a wise and comprehensive judgment. Hence, to have important measures proposed without previous discussion in a Syndicate, is a practice highly dangerous, and much to be discouraged: and we may hope that if any change modifying the measures which have recently been adopted with regard to our System of Education were to be proposed by any single Member of the Senate, without being considered in a Syndicate, the Members of the Caput would feel that it was their duty to place their veto upon it: and we may be satisfied that the power of the Caput used in this manner would be regarded with approval and gratitude by the University.

382 The Caput, (*Caput Senatûs*) and the Heads of Colleges, have, by persons out of the University, been confounded, in a manner showing a degree of heedlessness or obtuseness, which is truly marvellous. The Heads of Colleges have no special share in the legislation of the University, except as the advisers of the Vice-chancellor. They may have some influence in their respective Colleges; but this is not great, for nothing is more common than to see the majority of

the Fellows of a College vote against the Master. But the Heads of Colleges are persons who hold a more permanent position in the University than most of the other Members; and hence, in the long run, they may be able to produce or to prevent change; as may, in like manner, any other Member of the Senate, residing long, and striving steadily and industriously for the like objects. In reference to their respective Colleges, the Heads have, of course, peculiar relations, powers, and duties; and from their community of position they may be looked upon as an Order in the University. But the Caput, instead of being, like the Heads, a permanent Order, possessing no definite powers with regard to the University, is a temporary body composed of the representatives of five different Orders, along with the Vice-chancellor, and possessing the most definite powers, namely, an absolute Veto in each Member. The Members of the Caput are, besides the Vice-chancellor, the representatives of Theology, Civil Law, and Physic, and of the Regent and Non-Regent Houses. None of these Members are necessarily Heads of Colleges: though the Vice-chancellor and the Doctor of Divinity always are so in practice. The other four are not so; and these Members of the Caput have no grounds of sympathy or agreement with the Heads, beyond what any other Members of the Senate have. If there be, on any occasion, any opposition of feeling between the Heads in general and the Senate in general, there are four Members of the Caput out of six who are likely to feel with the Senate.

383 The Members of the Caput hold their places for the year only. Measures once rejected by the Caput, may be again proposed, and may pass at a future time. The Caput originates nothing, having only this power of *Veto*. Thus the power of the Caput amounts to this:—that being the only real check against hasty and inconsistent legislation by the Se-

nate, it consists of six Members representatives of six different Orders in the University, each of whom has a *Suspensive Veto*, operating till the end of the Academical year. I conceive that a slighter power of checking rash voting does not occur in any real constitution of a Senate, and is hardly consistent with any degree of stability in our system. But I am not at present concerned with the Constitution of the University, except as it bears upon the business of regulating our System of Education. I will again say that I trust that the Cambridge System as now established, will be allowed to work for some years without further innovation, in order that we may be allowed to see what is the real value of the changes which we have recently made. If any attempt is made to introduce any further change, without the subject being fully discussed and reported on by a Syndicate fairly and judiciously chosen and appointed, it is impossible to conceive a more fit occasion for the exercise of that power of preventing rash change which resides in the Caput, and which, if not exercised on each occasion, will leave the University a prey to childish rashness, and impatience, and will probably end in making it useless as a place of Education.

APPENDIX.

APPENDIX.

I.

REVISED STATEMENT OF PROPOSED ALTERATIONS IN THE QUESTIONISTS' EXAMINATION.

(*Published March* 23, 1846).

I. In the Examination of Candidates for Honours:

In order more completely to secure in all Candidates for Mathematical Honours a knowledge of the more elementary parts of Mathematics; and to determine with a greater degree of certainty the amount of Mathematical knowledge required of such Candidates; it is proposed—

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 XXI. Book XII, Props. I, II.

ARITHMETIC and the elementary parts of ALGEBRA; namely, the Rules for the fundamental Operations upon Algebraical Symbols, with their proofs; the solution of simple and quadratic Equations; Arithmetical and Geometrical Progression, Permutations and Combinations, the Binomial 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 Center.

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 Center 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 Oscillations.

The 1st, 2nd, and 3rd Sections of NEWTON'S PRINCIPIA; the Propositions to be proved in Newton's manner.

The elementary parts of HYDROSTATICS, treated without the Differential 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, treated geometrically: namely, the laws of Reflection and Refraction of Rays at plane and spherical surfaces, not including Aberrations; the Eye; Telescopes.

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

4 In all these subjects, Examples, and Questions arising directly out of the Propositions, shall be introduced into the Examination, in addition to the Propositions themselves.

5 The Examination both for Mathematical Honours and for the Ordinary Degree shall be conducted according to the following Schedule.

6 The Moderators and Examiners shall be authorized to declare Candidates, though they have not deserved Mathematical Honours, to have deserved to pass for an Ordinary Degree, so 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.

The proposed Alterations shall not take effect until January 1848.

SCHEDULE

OF THE ORDER OF DAYS, HOURS, SUBJECTS, AND EXAMINERS, AT THE GENERAL QUESTIONISTS' EXAMINATION.

The first Thursday here mentioned is the first Thursday after the first day of January. The last Tuesday is the Tuesday preceding the general B.A. Admission.

Exam. for	Days.	Hours.	Subjects.	Examiners.
Honours.	Thursday.	9 to 12	Euclid and Conics.	Jun. Mod. & Sen. Exam.
		1½ to 4	Arith. Alg. & Pl. Trig.	Sen. Mod. & Jun. Exam.
Hon.	Friday.	9 to 12	Statics and Dynamics.	Sen. Mod. & Jun. Exam.
		1½ to 4	Hydros. and Optics.	Jun. Mod. & Sen. Exam.
Hon.	Saturday.	9 to 12	Newton and Astron.	Sen. & Jun. Exam.
		1 to 4	Probs. in all the preceding subjects.	Sen. & Jun. Mod.
	Sunday.			
	Monday.			
	Tuesday.			
Ordinary Degree.	Wednesday,			
	1st Div.	9 to 12	Euclid.	
	2nd Div.	12½ to 3½	Arith. and Algebra.	
Ord. deg.	Thursday,			
	1st Div.	9 to 12	Arith. and Algebra.	
	2nd Div.	12½ to 3½	Euclid.	
Ord. deg.	Friday,			
	1st Div.	9 to 12	Mechan. and Hydros.	
	2nd Div.	12½ to 3½	Mechan. and Hydros.	
Ord. deg.	Saturday,			
	1st Div.	9 to 12	Latin Subject.	
	2nd Div.	12½ to 3½	Greek Subject.	
	Sunday.			
Honours.	Monday.	9 to 12	Natural Philosophy.	Sen. Mod. & Sen. Exam.
		1½ to 4	Pure Mathematics.	Jun. Mod. & Jun. Exam.
Hon.	Tuesday.	9 to 12	Easy Problems.	Sen. & Jun. Mod.
		1½ to 4	Natural Philosophy.	Sen. & Jun. Exam.
Hon.	Wednesday.	9 to 12	Problems.	Sen. Moderator.
		1½ to 4	Pure Mathematics.	Sen. & Jun. Exam.
Hon.	Thursday.	9 to 12	Problems.	Jun. Moderator.
		1½ to 4	Pure Math. & Nat. Phil.	Sen. & Jun. Mod.
Hon.	Friday.	9 to 12	Pure Math. & Nat. Phil.	Sen. Mod. & Sen. Exam.
		1½ to 4	Pure Math. & Nat. Phil.	Jun. Mod. & Jun. Exam.
Hon. and Ord. deg.	Saturday,			
	1st Div.	9 to 12	Paley and Eccles. Hist.	
	2nd Div.	12½ to 3½	Acts and Epistles.	
	Sunday.			
Hon. and Ord. deg.	Monday,			
	1st Div.	9 to 12	Acts and Epistles.	
	2nd Div.	12½ to 3½	Paley and Eccles. Hist.	
Ord. deg.	Tuesday,			
	1st Div.	9 to 12	Greek Subject.	
	2nd Div.	12½ to 3½	Latin Subject.	

PROPOSED ALTERATIONS IN THE QUESTIONISTS' EXAMINATION.

II. In the Examination of those who are *not* Candidates for Mathematical Honours:

In order to secure in all Candidates a better knowledge of the Subjects of Examination, it is proposed—

1 That in the Schedule of Mathematical Subjects, there be added, to the clause respecting Arithmetic, this:—

"Together with the proofs of the Rules and the reasons for the processes employed."

2 That there be added, to the clause respecting Algebra, this:—

"10 Easy Equations of a degree not higher than the second, involving one, or two, unknown quantities, and Questions producing such Equations."

3 That the following clause be added to (9), in the description of the Questions to be proposed:—

"And also of such Questions and Applications as arise directly out of the aforementioned Propositions."

4 That the Questionists who are Candidates for an Ordinary Degree only, and not for Honours, and who pass, be arranged by the Examiners into four Classes, namely, a fourth, fifth, sixth, and seventh, according to merit, the names in each Class being arranged alphabetically; and that these Classes be published in the Senate-House on the Friday preceding the general B.A. Admission.

The proposed alterations shall not take effect until January 1848.

Two Graces passed the Senate; one, to confirm the above proposed Alterations in the Questionists' Examination for the Degree of B.A., of those who are Candidates for Mathematical Honours; the other, to confirm the proposed Alterations in the Examination of those who are *not* Candidates for Mathematical

Honours; each Grace also rescinding all previous Graces and Regulations so far as they are inconsistent with the Alterations proposed to be confirmed.

II.

REPORT.

(*Published Oct.* 16, 1848).

THE SYNDICATE appointed to consider whether it is expedient to afford greater encouragement to the pursuit of those studies for the cultivation of which Professorships have been founded in the University, and if so, by what means that object may be best accomplished, beg leave to make the following REPORT:

THE SYNDICATE, admitting the superiority of the study of Mathematics and Classics over all others as the basis of General Education, and acknowledging therefore the wisdom of adhering to our present system in its main features, are nevertheless of opinion that much good would result from affording greater encouragement to the pursuit of various other branches of Science and Learning which are daily acquiring more importance and a higher estimation in the world, and for the teaching of which the University already possesses the necessary means.

In accordance with this view the Syndicate recommend as follows:

A

THAT, at the beginning of each academical year, the Vice-Chancellor shall issue a Programme of the subjects, places, and times, of the several Professors' Lectures for the year then to ensue.

That all Students, who, being Candidates for the Degree of B.A., or for the Honorary Degree of M.A., are not Candidates for Honours, shall, in addition to what is now required of them, have attended, before they be admitted to Examination

for their respective Degrees, the Lectures delivered during one Term at least, by one or more of the following Professors:

Regius Professor of Laws,
Regius Professor of Physic,
Professor of Moral Philosophy,
Professor of Chemistry,
Professor of Anatomy,
Professor of Modern History,
Professor of Botany,
Woodwardian Professor of Geology,
Jacksonian Professor of Natural and Experimental Philosophy,
Downing Professor of the Laws of England,
Downing Professor of Medicine,
Professor of Mineralogy,
Professor of Political Economy;

and shall have obtained a Certificate of having passed an Examination satisfactory to one of the Professors whose Lectures they have chosen to attend.

That all Students, who, being Candidates for the Degree of B.C.L., do not pass the Examinations for the First Class in that Faculty, shall, in addition to what is now required of them, have attended, before they be allowed to keep their Act, the Lectures delivered during one Term at least, by one or more of the following Professors:

Regius Professor of Physic,
Professor of Moral Philosophy,
Professor of Chemistry,
Professor of Anatomy,
Professor of Modern History,
Professor of Botany,
Woodwardian Professor of Geology,
Jacksonian Professor of Natural and Experimental Philosophy,
Downing Professor of Medicine,
Professor of Mineralogy,
Professor of Political Economy;

and shall have obtained a Certificate of having passed an Examination satisfactory to one of the Professors whose Lectures they have chosen to attend.

That this Regulation shall apply to all Students answering the above descriptions who shall commence their Academical Residence in or after the Michaelmas Term of the year 1849.

B

That a New Honour Tripos be established, to be called the *Moral Sciences Tripos*, the places in which shall be determined by an Examination in the following subjects:

Moral Philosophy,
Political Economy,
Modern History,
General Jurisprudence,
The Laws of England.

That the Examiners for the *Modern Sciences Tripos* be the Regius Professor of Laws, the Professor of Moral Philosophy, the Professor of Modern History, the Downing Professor of the Laws of England, the Professor of Political Economy, together with one additional Examiner to be nominated by the Vice-Chancellor and appointed by Grace of the Senate; and in case any of the above-named Professors be prevented from examining in any year, Deputies to examine instead of them shall be nominated by the Vice-Chancellor and appointed by Grace of the Senate.

That the Examination for the *Moral Sciences Tripos* shall commence on the 2nd Monday after the general admission *ad respondendum quæstioni* and shall continue four days.

That all Students who shall have passed the Examinations and kept the Exercises required for the Degree of Bachelor of Civil Law, or of Bachelor of Physic, or who shall have passed the Examinations entitling to admission *ad respondendum quæstioni*, may be Candidates for Honours in the *Moral Sciences Tripos* next succeeding such Examinations.

That the Candidates for Honours in the *Moral Sciences Tripos* whom the Examiners shall deem worthy of an honour

shall be arranged by them in three Classes, the places being determined by estimating the aggregate merits of each Candidate in all the Subjects of the Examination. And that in these Classes, marks of distinction shall be affixed to the names of such of the Candidates as have shown eminent proficiency in particular subjects.

That the first Examination for the *Moral Sciences Tripos*, under the Regulations now proposed, shall take place in the year 1851.

C

That a New Honour Tripos be established, to be called *the Natural Sciences Tripos*, the places in which shall be determined by an Examination in the following subjects:

Anatomy,
Comparative Anatomy,
Physiology,
Chemistry,
Botany,
Geology.

That the Examiners for the *Natural Sciences Tripos* be the Regius Professor of Physic, the Professor of Chemistry, the Professor of Anatomy, the Professor of Botany, the Woodwardian Professor of Geology, together with one additional Examiner to be nominated by the Vice-Chancellor and appointed by Grace of the Senate; and in case any of the abovementioned Professors be prevented from examining in any year, Deputies to examine instead of them shall be nominated by the Vice-Chancellor and appointed by Grace of the Senate.

That the Examination for the *Natural Sciences Tripos* shall commence on the 6th Monday after the general admission *ad respondendum quæstioni* and shall continue four days.

That all Students who shall have passed the Examinations and kept the Exercises required for the Degree of Bachelor of Civil Law, or of Bachelor of Physic, or who shall have passed the Examinations entitling to admission *ad respondendum quæs-*

tioni, may be Candidates for Honours in the *Natural Sciences Tripos* next succeeding such Examinations.

That the Candidates for Honours in the *Natural Sciences Tripos* whom the Examiners shall deem worthy of an honour shall be arranged by them in three Classes, the places being determined by estimating the aggregate merits of each Candidate in all the Subjects of the Examination. And that in these Classes, marks of distinction shall be affixed to the names of such of the Candidates as have shown eminent proficiency in particular subjects.

That the first Examination for the *Natural Sciences Tripos*, under the Regulations now proposed, shall take place in the year 1851.

D

That, with a view to encourage attendance at the Lectures of the Mathematical Professors, and to secure a correspondence between those Lectures and the Mathematical Examinations of the University; and also as a means of communicating to the Students themselves, from a body of experienced Examiners and Lecturers, correct views of the nature and objects of our Mathematical Examinations: The Lucasian Professor of Mathematics, the Plumian Professor of Astronomy, the Lowndean Professor of Geometry and Astronomy, and the Jacksonian Professor of Natural and Experimental Philosophy, together with the Moderators and Examiners for Mathematical Honours for the time being, as well as those of the two years immediately preceding, be constituted a *Board of Mathematical Studies;* whose duty it shall be to consult together from time to time on all matters relating to the actual state of Mathematical Studies and Examinations in the University; and to prepare annually and lay before the Vice-Chancellor a Report, to be by him published to the University in the Lent or Easter Term of each year.

The Syndicate, having respect to the great importance of the Study of Theology, and with the view of giving increased efficiency to the Regulations already established for the promotion of it, further recommend:

E

That all persons who present themselves for Examination at the *Theological Examination*, established by Grace of the Senate, May 11, 1842, be required to produce a certificate of having attended the Lectures delivered during one Term, at least, by two of the three Theological Professors, viz. the Regius Professor of Divinity, the Margaret Professor of Divinity, and the Norrisian Professor of Divinity.

That the Regulation now proposed shall first come into operation at the Theological Examination in the Michaelmas Term of the year 1850.

ROBT. PHELPS, *Vice-Chancellor.*

JOHN GRAHAM.	HENRY G. HAND.
W. WHEWELL.	W. HOPKINS.
H. PHILPOTT.	J. J. SMITH.
ALFRED OLLIVANT.	C. MERIVALE.
HENRY S. MAINE.	J. MILLS.
JOHN HAVILAND.	W. H. THOMPSON.
JAMES CHALLIS.	EDWARD WARTER.

Separate Graces for adopting the Regulations proposed in the parts, A, B, C, D, E, respectively, of the above Report, passed the Senate on *Tuesday* the 31st instant.

III.

(*Published Feb.* 28, 1849.)

THE following STATEMENT addressed to the VICE-CHANCELLOR is communicated to the Members of the University in compliance with the wish of the Professors who have signed it.

Mr Vice-Chancellor, CAMBRIDGE, *Feb.* 15, 1849.

WE the undersigned Professors charged with the execution of the Regulations respecting the Moral Sciences Tripos, the Natural Sciences Tripos, and the Professorial condition for the Ordinary B.A. Degree, adopted by the University in Graces

passed on October 31, 1848, beg leave to assure you of our willingness to use our best exertions in order to carry into effect the intentions of the University as expressed in those Graces.

We shall be prepared to give, when required, such information as may enable the Vice-Chancellor to issue the Programme of Professors' Lectures as there directed.

We shall also be prepared to offer a Scheme of the Order of Examination for the Moral Sciences Tripos and the Natural Sciences Tripos, which we recommend as convenient and conformable to the intentions of the University as expressed in those Graces.

HENRY S. MAINE, *Regius Professor of Civil Law.*
J. HAVILAND, *Regius Professor of Physic.*
W. WHEWELL, *Professor of Moral Philosophy.*
J. CUMMING, *Professor of Chemistry.*
WM. CLARK, *Professor of Anatomy.*
J. S. HENSLOW, *Professor of Botany.*
A. SEDGWICK, *Woodwardian Professor.*
R. WILLIS, *Jacksonian Professor.*
W. W. FISHER, *Downing Professor of Medicine.*
W. H. MILLER, *Professor of Mineralogy.*
GEO. PRYME, *Professor of Political Economy.*

IV.

(*Published June* 6, 1849.)

THE VICE-CHANCELLOR begs leave to publish to the University the following PROGRAMME and REGULATIONS, which have been agreed upon by the Professors charged with carrying into effect the Schemes of the two new Triposes, established by GRACES of the SENATE, *Oct.* 31, 1848.

Programme of Professors' Lectures with Subsidiary Regulations.

THE Professors charged with the execution of the Regulations respecting the Moral Sciences Tripos, the Natural Sciences Tripos, and the Professorial condition for the ordinary degree

of B.A., have, for the purpose of carrying into effect the intentions of the University as expressed in those Regulations, agreed upon the following *Subsidiary Regulations;* which they have drawn up with a careful regard to the existing customs of the University, and with a view of providing for some Uniformity in the number of Lectures, pecuniary terms, and mode of requiring the attendance of Students in the courses of different Professors.

1 That the attendance at any Course of Lectures, required as a condition of a *Professor's Certificate* (according to Grace A) be not less than twenty, and not more than twenty-five Lectures; it being understood that the Professor may make allowance for cases of unavoidable absence.

2 That *Lecture Tickets,* not transferable, be delivered by the Registrary to all Undergraduates who apply for them, directly or through their College Tutors: these Tickets being of two kinds; namely, *Special Tickets,* delivered on payment of three guineas each, and admitting the person thereon named to the Lectures of some one Professor in one or more years; and *General Tickets,* delivered on payment of five guineas each, and admitting the person thereon named to any one or more of the courses of Professors' Lectures, in the same or different years; and that a Professor's Certificate be not given to any Undergraduate who has not provided himself with one or other of such Tickets.

N. B. These regulations refer only to the attendance at Professors' Lectures *required by Grace* A. The attendance at the Lectures of Professors on the part of persons wishing to take a degree in the Faculties of Law or Medicine, will continue to be regulated by Graces already in operation, and by the Professors concerned therewith. The full courses required by Grace for such degrees being fifty Lectures, will generally occupy two terms; and for these two terms, the regulations (as to fees) made for those proceeding in the Faculties may be different from those here stated.

The terms of attendance of persons not requiring Certificates will, as hitherto, be regulated by the Professors severally.

It is understood that the Professors may admit gratuitously

to their Lectures persons recommended by the Tutors, in such cases as have hitherto been customary.

3 The sum raised according to Article 2 shall be distributed in the following manner:—the Registrary shall retain a shilling of every guinea; and, after providing for the expense of the Lecture Tickets, the residue shall be divided (for the present) into sixteen shares; two of these shares each shall be given to the Professors of Anatomy, Chemistry, and the Jacksonian Professor, in consideration of their expenses in apparatus and preparations; and one share to each of the other ten Professors named in Grace A.

4 It is understood that the Graces establishing the Moral Sciences Tripos and the Natural Sciences Tripos, allow the Examiners to arrange the names in each of the three Classes of Honours alphabetically: this arrangement not precluding the Examiners from marking which Candidate is first, second, &c. in any special subject, as directed by the Graces.

5 Each of the certifying Professors shall hold an Examination, before the end of two Terms after each course of Lectures, for the purpose of granting Certificates to those who deserve them: and it shall be provided, by communication among the Professors, that the amount of the difficulties which the Candidate is required to surmount by each Professor be not very different.

6 The answers given in writing by the Candidates (both in the two new Tripos Examinations, and in the ordinary Professors' Examination) shall be kept by the Registrary for at least one year, and shall be accessible to members of the Senate by an order of the Vice-Chancellor.

The Vice-Chancellor being directed by Grace to issue a Programme at the beginning of each academical year, stating the subjects, places, and times of the several Professors' Lectures for the year; the following scheme is drawn up as a basis for the Programme for the year 1849—1850. Attempts will be made to supply any deficiencies which may exist in the present notice, before it is again issued at the beginning of next Michaelmas Term according to the Regulation.

SCHEME OF LECTURES OF PROFESSORS.

Michaelmas Term.	PLACES, DAYS, AND HOURS.	BEGIN 1849.
MORAL SCIENCES.		
Down. Prof. of Laws of Eng.	Down. Coll.—M. T. F. S.—11 A.M.	Oct. 22.
Prof. of Political Economy.	Pitt Press.	
NATURAL SCIENCES.		
Regius Professor of Physic.	Anat. School.—M.W.F.—10 A.M.	Oct. 22.
Professor of Anatomy.	Anat. School.—M.W.F.—1 P.M.	Oct. 22.
Professor of Geology.	Geol. Mus.—M.T.W.Th.F.—12 M.	Oct. 22.
Prof. of Nat. and Exper. Phil.	Bot.Lect.Room.—T.Th.S.—1 P.M.	Oct. 23.
Downing Prof. of Medicine.	Down. Coll.—T. Th. S.—12 M.	Oct. 23.
Lent Term.		1850.
MORAL SCIENCES.		
Regius Professor of Laws.	Law Sch.—M.T.Th.F.S.—11 A.M.	
Prof. of Moral Philosophy.	Trin.Coll.—M.T.W.Th.F.—1 P.M.	Feb. 6.
NATURAL SCIENCES.		
Regius Professor of Physic.	Anat. School.—M.W. F.—10 A.M.	
Professor of Anatomy.	Anat. School.—M.W.F.—1 P.M.	
Professor of Mineralogy.	Mineral. Mus.—T. Th. S.—2 P.M.	
Easter Term.		
MORAL SCIENCES.		
Prof. of Modern History.		
NATURAL SCIENCES.		
Professor of Botany.	Bot.Lec.Rm.—T.W.Th.F.—1P.M.	
Professor of Chemistry.	Ch.Lec.Rm.—M.T.W.Th.F.—12M.	
Downing Prof. of Medicine.	Down. Coll.—T. Th. S.—10 A.M.	

HENRY S. MAINE, *Regius Professor of Laws.*
JOHN HAVILAND, *Regius Professor of Physic.*
W. WHEWELL, *Professor of Moral Philosophy.*
J. CUMMING, *Professor of Chemistry.*
WILLIAM CLARK, *Professor of Anatomy.*
J. S. HENSLOW, *Professor of Botany.*
A. SEDGWICK, *Woodwardian Professor.*
R. WILLIS, *Jacksonian Professor.*
A. AMOS, *Downing Professor of Law.*
W. W. FISHER, *Downing Professor of Medicine.*
W. H. MILLER, *Professor of Mineralogy.*
G. PRYME, *Professor of Political Economy.*

The above Professors have agreed upon the following scheme of Subsidiary Arrangements by which they intend to regulate the Examinations for the New Triposes.

MORAL SCIENCES TRIPOS EXAMINATION.

By the Grace, To commence on the *second* Monday after the general admission *ad respondendum quæstioni,* and to continue four days.

	SUBJECTS.	EXAMINERS.
MON.	Moral Philosophy.	Prof. of Moral Philosophy.
	Political Economy.	Prof. of Political Economy.
TUES.	General Jurisprudence.	Regius Prof. of Laws.
	Laws of England.	Downing Prof. of Laws of England.
WED.	Modern History.	Professor of Modern History.
THURS.	A collection of questions in all the five subjects, about equal portions of each.	

It is intended that the "Additional Examiner," mentioned in the Grace, shall put Questions in the Thursday's Examination, examine all the answers, and vote in deciding places in the Classes.

NATURAL SCIENCES TRIPOS EXAMINATION.

By the Grace, To commence on the *sixth* Monday after the general admission *ad respondendum quæstioni,* and to continue four days.

	SUBJECTS.	EXAMINERS.
MON.	Human and Comp. Anatomy.	Prof. of Anatomy.
	Physiology.	Regius Prof of Physic.
TUES.	Botany.	Prof. of Botany.
	Geology.	Prof. of Geology.
WED.	Mineralogy.	Prof. of Mineralogy.
	Chemistry.	Prof. of Chemistry.
THURS.	A collection of questions in all the six subjects, about equal portions of each: (*Human and Comparative Anatomy* are reckoned as one subject. The examination in Mineralogy is, by the Grace of the Senate, to exclude the mathematical part of Crystallography.)	

It is intended that the "Additional Examiner," mentioned in the Grace, shall put Questions in the Thursday's Examination, examine all the answers, and vote in deciding places in the Classes.

It will probably be thought advisable by each of the Professors who Lecture and Examine, to state, in his Lectures, or by means of a *Syllabus*, the general range and nature of the Examination which he intends to hold, and to point out what books, if any, in addition to his Lectures, will be useful in preparing Students for his Examination.

V.

(*Published October* 11, 1849.)

PROGRAMME of the SUBJECTS, PLACES, and TIMES of the several Professors' LECTURES for the ensuing Academical Year.

Mich. Term. 1849.	SUBJECTS.	PLACES, DAYS AND HOURS.	BEGIN.
Marg. Prof. of Div.	The Liturgy of the Church of Eng.	Pitt Press.—W. F.—1 P.M.	Nov. 9.
Reg. Prof. of Laws.	Civil Law.	Law School.—M. T. F. S.—11 A.M.	Nov. 6.
*Reg. Prof. of Physic.	General Pathology.	Anatom. School.—M. W. F.—10 A.M.	Oct. 22
Reg. Prof. of Heb.	The Psalms.	Pitt Press.—W. S.—11 A.M.	Oct. 24
*Prof. of Anatomy.		Anatom. School.—M. W. F.—1 P.M.	Oct. 22
*Prof. of Geology.		Geol. Mus.—M. T. W. Th. F.—12 M.	Oct. 22.
Lowndean Prof. of Astron. & Geom.	Plane Astronomy.	Divin. Lect. Room.—M. W. F.—12 M.	Oct. 26.
Norris. Prof. of Div.		Divin. Lect. Room.—T. Th. S.—1 P.M.	Oct. 18.
*Jacksonian Prof. of Natural and Exp. Philosophy.		Bot. Lect. Room.—T. Th. S.—1 P.M.	Oct. 23.
*Downing Prof. of Laws of England.	Laws of England.	Down. Coll.—M. T. F. S.—11 A.M.	Oct. 22.
*Downing Prof. of Medicine.	The Preservation of Health.	Down. Coll.—T. Th. S.—12 M.	Oct. 30.
*Prof. of Pol. Econ.		Pitt Press.—M. T. W. Th. F. S.—12 M.	Oct. 29.
Lent Term. 1850.			1850.
Marg. Prof. of Div.	Past. Theol. and an early Father.	Pitt Press.—W. F.—1 P.M.	Jan. 30.
Reg. Prof. of Div.	Thirty-Nine Articles	Pitt Press.—W. S.—1 P.M.	Feb. 6.
*Reg. Prof. of Laws.	History of Roman Jurisprudence.	Law School.—M. T. F. S.—11 A.M.	Feb. 11.
Reg. Prof. of Physic.	Special Pathology.	Anatom. School.—M. W. F.—10 A.M.	Jan. 28.
Reg. Prof. of Heb.	The Psalms.	Pitt Press.—W. S.—11 A.M.	Feb. 6.
Reg. Prof. of Greek.	Sophocles.	Pitt Press.—T. Th. S.—1 P.M.	Feb. 5.
*Prof. of Moral Philosophy.	History of Moral Philosophy.	Trin. Coll.—M. T. W. Th. F.—1 P.M.	Feb. 6.
Prof. of Anatomy.		Anatom. School.—M. W. F.—1 P.M.	
Norris. Prof. of Div.		Divin. Lect. Room.—T. Th. S.—1 P.M.	Jan. 29.
Down. Prof. of Med.	Clinical Medicine.	Hospital.—T. Th. F.—11 A.M.	Jan. 29.
*Prof. of Mineral.	Mineralogy.	Mineral. Mus.—M. T. Th. F. S.—2 P.M.	Feb. 7.
Jacksonian Prof.	Ecclesiastical Architecture.	Bot. Lect. Room.—T. Th. S.	Feb. 23.
East. Term. 1850.			
Reg. Prof. of Laws.	Civil Law.	Law School.—M. T. F. S.—11 A.M.	Apr. 19.
Reg. Prof. of Heb.	The Psalms.	Pitt Press.—W. S.—11 A.M.	Apr. 17.
Prof. of Arabic.	Arabic.	Cath. H.—M. T. W. Th. F. S.—12 M.	Apr. 10.
	Sanskrit.	Cath. H.—M. T. W. Th. F. S.—1 P.M.	Apr. 10.
Lord Almoner's Reader of Arab.	Persian.	Trin. Coll.—T. W. Th.—2 P.M.	Apr. 16.
*Prof. of Chemistry.		Ch. Lec. Rm.—M. T. W. Th. F.—12 M.	Apr. 16.
Plumian Prof. of Astronomy.	Practical Astron.	Div. L. Rm.—M. T. W. Th. F. S.—1 P.M.	Apr. 15.
	Optics, Hydrost. and Pneumatics.	Div. L. Rm.—M. T. W. Th. F. S.—1 P.M.	Apr. 29.
*Prof. of Mod. Hist.		Trin. Hall.—T. Th. S.—1 P.M.	Apr. 16.
*Prof. of Botany.		Bot. Lect. Room.—T. W. Th. F.—1 P.M.	Apr. 16.
Down. Prof. of Med.	Materia Medica & Pharmacy.	Down. Coll.—T. Th. S.—10 A.M.	Apr. 16.

N.B. There will be an Examination in the Subject of each of the courses marked *, with a view to granting the Certificates required by the Regulations adopted Oct. 31, 1848.

All persons who present themselves for examination, after the present year, at the *Theological Examination*, established by Grace of the Senate, May 11, 1842, will be required to produce a Certificate of having attended the Lectures delivered during one Term, at least, by two of the three Theological Professors, viz. the Regius Professor of Divinity, the Margaret Professor of Divinity, and the Norrisian Professor of Divinity.

H. W. COOKSON, *Vice-Chancellor.*

VI.

LECTURE TICKETS.

This GENERAL TICKET for PROFESSORS' LECTURES

Admits _____

of _____ College

to the Lectures of the Professors mentioned in the following List.

Received *£5. 5s.*

_____

Registrary.

Oct. 1849.

University Regulation (1848).

All students who being candidates for the Degree of B.A. or for the Honorary Degree of M.A. are not candidates for Honours, shall, in addition to what is now required of them, have attended, before they be admitted to examination for their respective degrees, the Lectures delivered during one Term at least, by one or more of the following Professors, and shall have obtained a Certificate of having passed an examination satisfactory to one of the Professors whose Lectures they have chosen to attend.

(*See list of Professors*, p. 93.)

This SPECIAL TICKET for PROFESSORS' LECTURES

Admits _____

of _____ College

to the Lectures of the [*some special Professor*]

Received £3. 3*s*.

_____

Registrary.

Oct. 1849.

University Regulation (1848).

All students who being candidates for the Degree of B.A. or for the Honorary Degree of M.A. are not candidates for Honours, shall, in addition to what is now required of them, have attended, before they be admitted to examination for their respective degrees, the Lectures delivered during one Term at least, by one or more of the following Professors, and shall have obtained a Certificate of having passed an examination satisfactory to one of the Professors whose Lectures they have chosen to attend.

(*See list of Professors*, p. 93.)

VII.

(*Published March* 10, 1849.)

THE SYNDICATE appointed Feb. 14, 1849, to consider whether any and what alterations may be made in the PREVIOUS EXAMINATION, beg leave to recommend for the approbation of the SENATE the following

PLAN FOR THE PREVIOUS EXAMINATION.

[N. B. The Parts of the following Plan in which it differs from the Plan of 1837 are printed in italics.]

1 THAT the subjects of the Examination shall be one of the four Gospels in the original Greek, Paley's Evidences of Christianity, the Old Testament History, *as contained in the books from Genesis to Esther both inclusive,* one of the Greek and one of the Latin Classics, *the Elements of Euclid, Books* 1 *and* 2, *and examples in the following rules of Arithmetic, viz.:*

Addition, Subtraction, Multiplication, Division, Reduction, Rule of Three; the same Rules in Vulgar and Decimal Fractions; Practice, Simple and Compound Interest, and Discount.

2 That the appointment of the particular Gospel, and in regard to the classical subjects, the appointment both of the authors and of the portions of their works which it may be expedient to select, shall rest with the Vice-Chancellor for the time being, the three Regii Professors of Divinity, the Civil Law, and Physic, the Regius Professor of Greek, and the Public Orator (provided that not more than two of them are members of the same College); upon this clear understanding, that in the exercise of the powers thus to be vested in them, they shall so limit the Examination, that every one who is to be examined may be reasonably expected to shew a competent knowledge of all the subjects.

3 That in case three or more of those to whom the appointment of the subjects of Examination has been assigned

shall belong to the same college, deputies for any number exceeding two shall be appointed, every year, by a Grace of the Senate.

4 That public notice of these subjects of examination in each year shall be issued in the first week of the Lent Term of the year preceding.

5 *That the Examination in the Evidences of Christianity, the Old Testament History, Euclid, and Arithmetic, shall be conducted entirely by printed Papers.*

6 That, in regard to the Greek Testament and the Classical subjects, every person when examined shall be required (1) to translate some portion of each subject, and (2) to construe and explain passages of the same, *and to answer such plain questions in Grammar, History, and Geography, as may arise immediately out of the subjects.*

7 That previously to the commencement of the Examination, the Examiners shall prepare an alphabetical list of all the persons to be examined, and divide them into *six portions as nearly equal as possible:* and that they shall send a copy of such list to the Prælector of each College, notifying *the days and hours when* each of the persons to be examined belonging to that College shall be required to attend the Examination.

8 That the Examination shall begin on the Monday in the week before the end of the Lent Term in each year.

9 That the days of Examination shall be Monday, Tuesday, Wednesday, Thursday, and Saturday, in the first week, and Monday, Tuesday, Wednesday, and Thursday, in the following week; and the hours of Examination each day from 8 till 11 in the morning, and from 12 till 3 in the afternoon.

10 *That on the first day the subject of Examination shall be the Evidences of Christianity, on the second day the Old Testament History, and on the third day Euclid and Arithmetic; the persons whose names appear in the first three divisions being examined in the morning, and those whose names are in the last three divisions in the afternoon of each day.*

11 *That during the last six days each of the six divisions shall be examined for one day in the remaining subjects, viz., in the Greek and Latin subjects, and in the Greek Testament;* the persons under Examination being employed in translating the passages proposed, and each individual being called upon in turn during the time of Examination to construe and explain passages of the appointed subjects *and to answer questions.*

12 That the Examination of each person *in the Greek and Latin subjects and in the Greek Testament* shall be concluded in one day, and that the result of the whole Examination with regard to him shall be notified to the Prælector of *his* College as soon as conveniently may be *after the end of the Examination of all the Six Divisions.*

13 That every Undergraduate shall be required to attend the Examination in the Lent Term of the year next but one after that in which he has kept his first term.

14 *That in case any person who has been a resident member of either of the Universities of Oxford or Dublin shall become a resident member of this University before the time at which he would have been required, had he been originally of this University, to attend the Previous Examination, such person be required to attend that Previous Examination which he would have been called upon to attend if he had come to reside in this University at the time he actually did commence his residence at Oxford or Dublin.*

15 *That in case any person who has been a resident member of either of the Universities of Oxford or Dublin shall become a resident member of this University after the time at which he would have been required, had he been originally of this University, to attend the Previous Examination, such person be required to attend that Previous Examination which shall take place next after his becoming a resident member of this University.*

16 That two Classes (each of them arranged alphabetically) shall be formed out of those examined—the first consisting of those who have passed their examination with credit—and the second, of those to whom the Examiners have only not refused their certificate of approval.

17 That in case any one shall be prevented by illness, or any other sufficient cause, from attending the proper Examination of his year, a certificate of such illness or other cause shall be submitted by the Tutor of his College to the Vice-Chancellor and Proctors for the time being, for their approbation in writing.

18 That if any one shall absent himself from the proper Examination of his year, without the written approval of the Vice-Chancellor and Proctors, he shall not be allowed the Lent Term of that year.

19 That there shall be a second Examination commencing on the second Monday in the Michaelmas Term of each year, for those who have been absent with the approval of the Vice-Chancellor and Proctors from the preceding Lent Examination, and for those who have not been approved by the Examiners at that Examination; and that such Second Examination shall be in the same subjects *as those of the preceding Lent Examination, shall be conducted* by the same Examiners, *and in a manner similar to that described in the preceding Regulations.*

20 That those who shall not have been approved at either the Lent or October Examination of their year, or who shall have been absent from both those Examinations, shall be required to attend the Lent Examination of the following year, subject to the same conditions as before; and that no degree of B.A., M.B., or LL.B., shall be granted, unless a certificate be presented to the Caput shewing that the candidate for such degree has passed, to the satisfaction of the Examiners, some one of these Examinations.

21 That in every year, at the first Congregation after the 10th day of October, the Senate shall elect *six* Examiners, (who shall be members of the Senate, and nominated by the several Colleges according to the cycle of Proctors, Taxors, and *Scrutators*) to conduct the Lent and October Examinations of the succeeding year, *provided that no one of such Examiners shall also hold the office of Pro-Proctor at the time of the Lent Examination.*

22 *That the Pro-Proctors and four at least of the Exami-*

ners shall attend each portion of the Examination during the first three days; and that all the six Examiners shall attend each portion during the last six days.

23 That each of the Examiners shall receive £20 from the University Chest.

24 *That the four Pro-Proctors' men shall be in attendance upon the Examiners during each of the first three days; and two of the Proctors' men during each of the last six days of Examination.*

25 That the foregoing Regulations shall not interfere with the composition between the University and King's College.

26 *That the first Examination under these Regulations shall take place in the Lent Term of* 1851.

H. W. Cookson, *Vice-Chancellor.*

W. French.	J. G. Mould.
W. Whewell.	A. T. Cory.
H. Philpott.	Barnard Smith.
J. Rowlands.	Francis France.
J. Cooper.	Thos. S. Ackland.
C. Clayton.	C. A. Swainson.

A Grace to confirm the above Report passed the Senate March 23, 1849.

VIII.

(*Published May* 30, 1849.)

The Syndicate appointed April 25, 1849, to consider whether any and what alterations may be made in the Regulations for the Classical Examination after Admission *ad Respondendum Quæstioni*, beg leave to recommend for the approbation of the Senate the following

REGULATIONS.

1 That the Classical Tripos Examination shall commence in each year on the fourth Monday after the general admission

ad respondendum quæstioni, and shall continue during five days and the morning of the sixth day; the hours of attendance being from nine till twelve in the morning, and from one till four in the afternoon.

2 That the following persons only shall be admitted to Examination:

(1) Those who shall have obtained Honours at the Mathematical Examination of the preceding January.

(2) Those who, having been declared by the Moderators and Examiners for Mathematical Honours in the preceding January to have deserved to pass (according to the present standard) for an Ordinary Degree, so far as the Mathematical part of the Examination for such Degree is concerned, shall have afterwards passed in the other subjects of that Examination.

(3) Those whose names shall have been placed (according to the present standard) in the first class in the Examination for an Ordinary Degree in the preceding January.

(4) Those persons, entitled to Noblemen's Degrees, who shall have entered into their eighth Term at least, having previously kept six Terms, exclusive of the Term in which they were admitted, and shall have passed the Examination for an Ordinary Degree in the preceding January; provided, however, that not more than eight Terms shall have passed in the case of any such person after his first Term of residence.

3 That on the Mornings of the first four days Composition shall be required, consisting of Translations from English into Greek and Latin, Prose and Verse; on the Afternoons of the same four days and on the fifth day passages shall be proposed for Translation selected from the *best* Greek and Latin authors, and written answers required to such questions as arise immediately out of such passages; on the Morning of the sixth day a paper of questions shall be given in Ancient History.

4 That to conduct the Examination two Examiners shall be nominated every year by the Colleges whose turn it is to present the Proctors for that year; and the Examiners so nominated shall, if elected by the Senate, and also re-elected

by the Senate in the following year, hold their office for two years. The election shall be made by the Senate at the first Congregation after the 10th of October.

5 That there shall be a general meeting of the Examiners previous to the Examination, when the Papers set by each Examiner shall be submitted to his colleagues for their approval; and that in the paper on History the questions shall be fixed upon by the four Examiners in common.

6 That the Exercises in Composition and the answers to the questions in History shall be examined by each of the four Examiners; the Translations by not less than two.

7 That there shall not be contained in any paper longer passages for Translation, nor more questions than Students well prepared have generally been found able to translate and answer in the time allowed for that paper.

8 That the names of those persons who shall pass the Examination *with credit* shall be placed in three classes, of which the first and second shall be arranged in order of merit, and the third alphabetically.

9 That the classes shall be published by the Examiners in the Senate-House on the fourth Thursday after the end of the Examination.

10 That no person who has degraded shall be allowed to attend the Examination, unless he shall previously have obtained special permission for so doing from the Syndicate appointed to examine into the cases of applicants for permission to become Candidates for Honours after they have degraded.

11 That each of the Examiners shall receive Twenty Pounds from the University Chest.

12 That the foregoing Regulations shall not interfere with the composition between the University and King's College.

13 That the first Examination under these Regulations shall take place in the Lent Term of 1851; it being provided that the two Examiners nominated in 1849 by the Colleges whose turn it was to present the Proctors for that year shall,

if elected by the Senate, take part in conducting the Examination of the Lent Term of 1851, together with the other two Examiners nominated and elected according to the provisions of Rule 4.

H. W. Cookson, *Vice-Chancellor.*

H. Philpott.	R. L. Ellis.
J. Hymers.	Rowland Williams.
W. H. Bateson.	Francis France.
W. H. Thompson.	Hubert Holden.
Edward Warter.	

A Grace to confirm the above Report passed the Senate Oct. 18, 1849.

IX.

(*Published April* 1, 1841.)

Regulations respecting Candidates for a Licence *ad practicandum in Medicina*, and also respecting Candidates for the Degree of Doctor of Physic.

1 That Candidates for a Licence *ad practicandum in Medicina*, being previously Bachelors of Physic, be required to produce to the Regius Professor of Physic Certificates of their having attended on Hospital practice for three years exclusive of the nine Terms which they kept by residence for the Degree of Bachelor of Physic, and of their having attended Lectures on the following subjects; namely;

Practice of Physic and Pathology.
Anatomy and Physiology.
Chemistry.
Botany.
Medical Jurisprudence.
Materia Medica and Pharmacy
Principles of Surgery.
Principles of Midwifery.
Practical Anatomy for two seasons.

2 That Candidates for a Licence *ad practicandum in Medicina*, being previously Masters of Arts, be required to bring satisfactory Evidence to the Regius Professor of Physic of their having been employed in the study of Physic for five years after they became Bachelors of Arts; and to produce to him Certificates of their having attended on Hospital practice for three of the said five years, and of their having attended Lectures on the subjects before mentioned.

3 That every Candidate for a Licence *ad practicandum in Medicina* be required to pass an Examination to the satisfaction of the Regius Professor of Physic, the Professor of Anatomy, the Downing Professor of Medicine, and a Doctor of Physic to be nominated by the Vice-Chancellor and approved by the Senate at the first Congregation after the tenth of October in each year.

4 That in case any of the three Examiners ex officio be prevented by illness or absence from taking part in such Examination, it be competent to him to appoint a Doctor of Physic to examine in his stead, subject to the approbation of the Vice-Chancellor.

5 That there be two such Examinations in every year; one in the week immediately preceding that in which the division of the Michaelmas Term falls; the other in the week immediately preceding that in which the division of the Easter Term falls.

6 That a Candidate for a Licence *ad practicandum in Medicina*, being previously Bachelor of Physic, shall not be examined for the said Licence until the Examination which shall occur next but one after his having passed the Examination required for the Degree of Bachelor of Physic.

7 That every Candidate for the Degree of Doctor of Physic, who has not previously obtained a Licence *ad practicandum in Medicina*, be required to produce to the Regius Professor of Physic the same Certificates and pass the same Examination as are required in the case of Candidates for a Licence *ad practicandum in Medicina*.

8 Provided that the foregoing Regulations shall not take effect, until after the end of the Easter Term 1841; provided also that the seventh Regulation shall not apply to any person who was admitted *ad intrandum in Medicina* before the Lent Term 1836.

X.

On *May* 3, 1847, a Grace was passed

To allow Candidates for the degree of M.B. to offer themselves for Examination by the Professors of Chemistry and Botany after the expiration of three years from their admission.

XI.

REPORT.

(*Published March* 17, 1842.)

THE SYNDICATE, appointed "to consider whether any and what steps should be taken to provide a more efficient system of Theological instruction in the University," beg leave to commence their Report with a brief account of the present state of instruction in that department of study.

IN the Previous Examination and in the Ordinary Examination for the B.A. degree, the University requires an acquaintance with one of the Gospels and the Acts of the Apostles in the original Greek, with Paley's Evidences and Paley's Moral Philosophy.

The other encouragements and aids to Theological studies offered at present by the University (in addition to what is done by Lectures, Examinations, Prizes, &c. in the several Colleges) consist of

The examinations and disputations conducted by the Regius Professor of Divinity in order to Divinity degrees: (see note A.)

The Lectures of the Lady Margaret Professor of Divinity: (see note B.)

The Lectures of the Norrisian Professor of Divinity: (see note C.)

The Lectures of the Knightbridge Professor of Moral Theology: (see note D.)

The Lectures of the Regius Professor of Hebrew:

The three Crosse Theological Scholarships:

The six Tyrwhitt Hebrew Scholarships:

The Prize (occasionally given on the Tyrwhitt bequest) for a Dissertation on some subject connected with Hebrew Literature:

The Prize for the Hulsean Dissertation: (about £100.)

The Prize for the Norrisian Dissertation: (£12.)

Note A.

The superintendence of all Exercises, required for the degrees of Bachelor and Doctor in Divinity, is committed to the Regius Professor of Divinity; who also is much engaged in Examinations more or less connected with Theological studies.

Note B.

Memorandum of the Lectures delivered by the Lady Margaret Professor since his election in 1839.

I. On the *Early Fathers:*

Introductory Lectures shewing, 1st from her express declarations, and 2ndly, from her structure and services, the regard the Church of England pays to early antiquity:

On the Apostolical Fathers; (the Lectures on Ignatius prefaced by an abridgment of Bishop Pearson's Vindiciæ Ignatianæ:) On Justin Martyr; Tatian; Athenagoras; Theophilus; and Irenæus; the last, now in the course of delivery.

The object of these Lectures, is to put the hearers eventually in possession of a knowledge of all the Fathers of the first three centuries: The plan, has been to go through each Father in detail; to give the substance of the author, where more than

this did not seem necessary; to translate at full and explain, where a passage was remarkable; and lastly, to sum up the whole (with references) under several heads, such as, Evidences, Canon of Scripture, Interpretation of Scripture, Sacraments, Ecclesiastical discipline and polity, Points of controversy with Rome, Classical illustrations, &c.

When the Course is completed, it may be adjusted to the period of an undergraduate's residence in the University: meanwhile, parts of it are repeated, and advances made in it, every year.

II. A Course of practical Lectures on *the acquirements, and principal obligations and duties of the Parish-Priest:*

Introductory Lecture, on the ministerial character of St Paul:

On the Reading of the Parish-Priest; (advising, (1), the study of the Scriptures in the original languages, with examples of the advantage of this, and other hints for reading them; (2), the study of the Fathers of the first three centuries, with illustrations of the benefit to be derived from this study; (3), the study of the English Reformation in the documents set forth seriatim by the Reformers; a list of these given, with remarks on each: The whole intended to put the students on applying themselves to original authorities, as the sources of sound knowledge, and to divert them from such as are only secondary and derivative:) On the composition of Sermons: On Schools, Sunday and Daily, the method of establishing, maintaining, and conducting them: On Parochial Ministrations, especially visiting the sick: On ordinary Pastoral Intercourse: On the observance of Rubric and Canons: On the general Rule by which the Parish-Priest should be guided.

The Margaret Professor proposes to deliver this latter series of Lectures, with such alterations or additions as may suggest themselves, every second or third year, so that all students intended for Holy Orders may have an opportunity of hearing them.

Note C.

Outline of the Lectures delivered by the Norrisian Professor since his election in 1838.

I. The provision made by the Church of England for securing in Candidates for Holy Orders

1 Moral fitness.

2 Literary qualifications.

3 Soundness in Doctrine.

Occasion is taken to explain what is implied in subscription to Articles of Religion generally—and in subscription to the Three Propositions contained in the 36th Canon particularly—references being, at the same time, given to Authors who have treated of these several subjects.

II. The course of reading desirable to be pursued by the Candidate for Holy Orders is then considered, as embracing

α. *The Sacred Scriptures* in the original Languages—and under this head is given a detailed account of some of

i. The principal Editions of the Hebrew Bible and Greek Testament.

ii. The Hebrew and Greek Lexicons } to the sacred
..... Concordances } Scriptures.

iii. The commentaries on the Old and New Testament.

iv. Those writers who have treated of the Chronology, Geography, Antiquities, &c. of the Scriptures.

A selection being made in each case, for the biblical Student, of such Books as seem, to the Professor, best adapted for the Student's use and circumstances.

β. *The Prayer-Book.* Under this head are noticed

i. The conformity of the English Liturgy with the Scriptures, and with the best portions of the Liturgies of Antiquity.

ii. The modifications which the Prayer-Book has undergone.

iii. The importance of an accurate acquaintance with
a. The Office for the Administration of Baptism.
b. ..... Holy Communion.
c. The Office for the Ordering of Deacons and Priests.
d. Those of the XXXIX. Articles which treat of the Doctrine of the Sacraments.

In the discussion of these several subjects references are given to such writers as treat of them respectively.

γ. The *Church of England* as respects her
A. *History.* Comprising under this division notices of
i. The Ancient British Church.
ii. The Anglo-Saxon .....
iii. The Anglo-Norman .....
iv. The Reformed .....

The more important eras in each being pointed out, and books mentioned in which information respecting the subject-matter may be obtained.

B. *Polity.* Comprising an inquiry into
i. The Scriptural Authority for a Threefold Ministry.
ii. The validity of the Orders of the English Church.

The principal writers on these subjects being referred to as occasion requires.

C. *Controversies*, With
i. Infidelity.
The bearing and importance of Natural Religion, as connected with Revelation, being pointed out.
ii. Romanism.
Mentioning in detail the chief points in dispute with Romanists, and in the history of the Romish Controversy in this country.
iii. Dissent.
Marking the peculiarities of dissent, and the different forms it has assumed both doctrinally and in its workings.

The writers from whom information on these several topics may be obtained being severally referred to.

D *Ministrations.*

i. Preaching.

Taking occasion under this head to refer to sources from whence instruction may be derived respecting

a. The style and composition of Sermons; and then

b. Giving a List of some Authors whose Sermons may be read with advantage.

ii. Parochial duties.

In connexion with which such Books are referred to, as treat of

a. The spiritual duties and general conduct of a Clergyman.

b. Or relate to the secular affairs of a Parish.

E. *Endowments.* Under this head notice is taken of

i. The general principles involved in Establishments, as contrasted with, what is called,

ii. The Voluntary Principle.

Then is noticed,

a. The origin of our Parochial and Cathedral endowments.

b. Some of the chief points in their history:

References being given to writers on these subjects respectively.

Besides the several topics which have been thus recited, it should be borne in mind that the main outlines of the Evidences and Doctrines of Christianity are discussed in such portions of Pearson on the Creed as are read and commented upon in the Course of the Lectures.

Note D.

The Professorship of "Moral Theology or Casuistry" founded by Dr Knightbridge is considered by the present holder of it as a Professorship of Moral Philosophy. During the last three years, he has delivered three courses of Lectures upon the History of Moral Philosophy, especially its history in England since the Reformation. During the present year he is

delivering a course of Lectures on the difficulties which attend the formation of a System of Morality, and the mode of overcoming them.

Judging from the information received from the Professors and Examiners, the Syndicate consider that the amount of the attendance at the Lectures of the Professors, the number of the competitors for the above-mentioned Scholarships and Prizes, and the proficiency in Theological learning exhibited by those competitors, prove that the existing requirements together with the encouragements and aids above referred to are, to a very considerable extent, efficacious towards the end for which they were designed.

The Syndicate, bearing in mind the Theological knowledge at present required, and the encouragements and aids to Theological studies already afforded both by the University and by the several Colleges, and being anxious that whatever may be adopted, with a view to the farther advancement of Theological learning, amongst the younger students of the University, should be founded on the methods of instruction already established, recommend, *in the first place,* the following plans, marked No. 1, No. 2, No. 3. It will be observed that those three plans have reference to students *before admission ad respondendum quæstioni,* whether such students be intended for Holy Orders, or not. In the *first* of them, an addition is made to the present Previous Examination. In the *second,* will be found some additions to the present Ordinary Examinations for the B.A. degree, together with a few alterations in the same. The object of the *third* is to afford to Questionists, who are Candidates for Honours, an opportunity of shewing that they have paid due attention to Theological studies. In the plans marked No. 1 and No. 2, the Syndicate have inserted in the present Report those paragraphs only of the existing Regulations, for the Previous Examination and for the Ordinary Examination for the B.A. degree, in which any changes are proposed; and all such changes are printed in the *Italic* character.

No. 1.

Plan for the Previous Examination.

1 THAT the Subjects of the Examination shall be one of the four Gospels in the Original Greek, Paley's Evidences of Christianity, *the Old Testament History* and one of the Greek and one of the Latin Classics.

2 and 3 to remain unchanged.

4 That every person when examined shall be required (1) to translate some portion of each of the Subjects appointed as aforesaid, (2) to construe and explain passages of the same, and (3) to answer printed questions relating to the Evidences of Christianity *and the Old Testament History.*

5, 6 and 7 to remain unchanged.

8 That the persons to be examined each day shall be formed into two divisions; that each of these divisions shall be examined in the Greek subject by two of the Examiners, and in the Latin subject by the other two during the morning; and that the Greek Testament, Paley's Evidences *and the Old Testament History* be the Subjects of Examination in the afternoon.

9 to 22 to remain unchanged.

23 *That the first Examination, under the Regulations now proposed, shall take place in the Lent Term of* 1844.

No. 2.

Plan of Examination for Questionists who are *not* Candidates for Honours.

1 THAT the Subjects of the Examination shall be *the first fourteen, or the last fourteen Chapters of* the Acts of the Apostles, *and one of the longer, or two or more of the shorter Epistles of the New Testament,* in the original Greek, one of the Greek and one of the Latin Classics, *three of the six Books of* Paley's Moral Philosophy, *the History of the Christian Church from its Origin to the assembling of the Council of Nice, the History of the*

English Reformation; and such Mathematical Subjects as are prescribed by the Grace of April 19, 1837, at present in force.

2 That in regard to *these* Subjects, the appointment *of the Division of the Acts—of the Epistle or Epistles—of the Books of Paley's Moral Philosophy, and* both of the Classical Authors and of the portions of their Works, which it may be expedient to select, shall be with the persons who appoint the Classical Subjects for the Previous Examination.

3 That public notice of the *subjects so selected* for any year shall be issued in the last week of the Lent Term of the year next but one preceding.

4 and 5 to remain unchanged.

6 That the distribution of the Subjects and Times of Examination shall be according to the following Table:

	Div.	9 to 12	Div.	12½ to 3½
Wednes.	1	Euclid	2	Greek Subject .....
Thurs...	1	Greek Subject	2	Euclid .....
Frid.....	1	Mechanics & Hydrostatics.	2	Latin Subject.....
Sat.....	1	Latin Subject.....	2	Mechanics & Hydrostatics.
Mon.....	1	Paley *& Eccles. Hist.*	2	Acts *& Epist. or Epistles.*
Tues.....	1	Acts *& Epist. or Epistles.*	2	Paley *& Eccles. Hist.* .....
Wednes.	1	Arithmetic & Algebra.....	2	Arithmetic & Algebra.....

7 to remain unchanged.

8 That the Papers in the Classical Subjects and in the Acts *and Epistles* shall consist of passages to be translated, accompanied with such plain Questions in Grammar, History and Geography as arise immediately out of those passages.

9 to 14 to remain unchanged.

15 That two of these Examiners shall confine themselves to the Classical Subjects, and two to Paley's Moral Philosophy, *Ecclesiastical History,* the Acts of the Apostles *and the Epistles.*

16, 17 and 18 to remain unchanged.

19 *That the first Examination, under the Regulations now proposed, shall take place in the Lent Term of* 1846.

No. 3.

Plan of Examination for Questionists who *are* Candidates for Honours.

1 THAT the Questionists who are Candidates for Honours be required to attend, with the other Questionists, the Examination in Paley's Moral Philosophy, the New Testament and Ecclesiastical History, appointed to take place on the 1st Monday in the Lent Term and on the following day.

2 That the Names of all such Questionists, Candidates for Honours, as shall, in the judgment of the Examiners, have passed their Examination in these subjects with credit, be published, in alphabetical order, by the Proctors, in the Senate House, upon the day of the Bachelor of Arts' Commencement.

3 That the first Examination, under the Regulations now proposed, shall take place in the Lent Term of 1846.

On proceeding to direct their attention to a plan of Examination for persons who, having been admitted *ad respondendum quæstioni*, are intended for Holy Orders, the Syndicate found the subject involved in difficulties; but, after mature consideration, they beg leave to recommend, *in the second place*, the following plan to the Senate.

No. 4.

Plan of Theological Examination for Students who shall have been admitted *ad respondendum quæstioni* in conformity with the preceding Regulations.

1 In the first or second week of the Michaelmas Term of each year, there shall be an Examination in the Greek Testament, assigned portions of the Early Fathers, Ecclesiastical History, the Articles of Religion and the Liturgy of the Church of England; which Examination shall be open to all students who, having at any time been admitted *ad respondendum quæstioni* in conformity with the preceding regulations, shall present themselves to be examined.

2 The Examinations shall be conducted by the Regius and

Lady Margaret Professors of Divinity; or, in case of the illness or unavoidable absence of either or both of them, by some Member or Members of the Senate, nominated by either or both of the Professors, and confirmed by Grace of the Senate.

3 The names of those students, who shall have passed their Examination to the satisfaction of the Examiners, shall be published in alphabetical order, and registered in the usual manner.

4 Immediately after each such Examination, a portion of the Hebrew Scriptures shall form the subject of a new Examination, for such students as, having their names published as above mentioned, shall offer themselves to be examined.

5 The Examination in the Hebrew Scriptures shall be conducted by the Regius Professor of Hebrew; or, in case of his illness or absence, by some Member of the Senate, nominated by him, and confirmed by Grace of the Senate.

6 The names of the students, who shall have passed their Examination in the Hebrew Scriptures to the satisfaction of the Examiner, shall be published and registered in the manner already described.

7 Public notice of the days of Examination and also of the portions of the Early Fathers and of the Hebrew Scriptures, assigned for the aforesaid Examinations in the Michaelmas Term of any year, shall be given in the first week of the Lent Term immediately preceding.

8 The first Examination, under the Regulations now proposed, shall take place in the Michaelmas Term of 1846.

The Syndicate recommend that the Examination marked No. 4 should be open to students in the Civil Law, on producing certificates, from the Regius Professor of the Civil Law, or his Deputy, of their having performed the Exercises required for the Degree of Bachelor in that Faculty.

G. ARCHDALL, *Vice-Chancellor.*

W. FRENCH.	J. J. BLUNT.
R. TATHAM.	JAMES WILLIAM GELDART.
W. WHEWELL.	JAMES SCHOLEFIELD.
T. TURTON.	

The Syndicate are authorized to announce to the Senate that, should the Regulations contained in the foregoing Report be adopted, the Regius and Lady Margaret Professors of Divinity and the Regius Professor of Hebrew, in consideration of the length of time which must elapse before the plan marked No. 4 can come into operation, will commence in the Michaelmas Term of 1843, and continue in the corresponding Term of each of the two following years, Examinations somewhat similar to those proposed in that plan.

A Grace to confirm the above Report passed the Senate May 11, 1842.

XII.

(*Published May* 19, 1849.)

THE VICE-CHANCELLOR begs leave to publish to the University the following REPORT, in accordance with the Regulation D. adopted by the SENATE Oct. 31, 1848.

THE BOARD OF MATHEMATICAL STUDIES beg leave to lay before the VICE-CHANCELLOR the following REPORT:

WITH the view of carrying out the intention of the University in appointing a Board of Mathematical Studies, the present Members commenced their duties by making regulations for holding meetings and conducting the discussion of the questions that might require their consideration, and for keeping minutes of their proceedings to serve as an authentic record for future reference. The existing state of the Mathematical Studies of the University has been the subject of mutual communications and discussions, which have resulted in their agreeing upon certain recommendations which will be found in the latter part of this Report.

I. The Board conceive that the objects intended to be secured by an annual Report on the state of our Mathematical

Studies may be promoted, and a basis formed for future suggestions, by bringing under review in this first Report, (1) the changes that have been made from time to time by Graces of the Senate in the regulations for conducting the Mathematical Examinations; (2) the progressive steps by which new modes of treating the subjects of examination, and new subjects, have been introduced into the course of Mathematical Study.

(1) In 1808, the Examination of the candidates for Honours commenced on the first Monday in the Lent Term; three days were devoted to Mathematics; and the candidates having been arranged in *Brackets* according to the result of the examinations on those days, the order of their merit was finally determined by examinations of the Brackets on the following Friday. Each candidate was examined 18 hours in the course of the three days, of which 11 hours were employed in answering questions from books, and the remaining 7 in the solution of Problems. The number of candidates that obtained Honours in that year was 38. In 1828, when the number had increased to 90, the examination commenced on the Friday preceding the first Monday in the Lent Term, and extended over four days, exclusive of the day of examining the Brackets; the total number of hours of examination was 23, and the time assigned to Problems remained the same as in 1808. By regulations which took effect in January 1833, the commencement of the examination was placed a day earlier, the duration was five days, and the hours of examination on each day were $5\frac{1}{2}$. Thus $4\frac{1}{2}$ hours were added to the whole time of examination, 4 of which were appropriated to the answering of questions from books, and the remaining half-hour to the solution of Problems. The successful candidates in that year amounted to 105. In 1835 the number was 117, and the examination, for the convenience of the examiners, began on the Wednesday of the same week, without alteration in other respects. In January 1839 there were six days of examination, beginning on the Monday preceding the first Monday in the Lent Term, and the total number of hours of examination was 33, of which $8\frac{1}{2}$ were given to

Problems. The first day of examination was altered in 1841 to the Wednesday week preceding the first Monday in the Lent Term. The number on the list of Honours in 1840 was 146.

Of the alterations relating to the classification of the candidates and the mode of proposing the questions, the following are those of chief importance. Previous to January 1828, the candidates were divided into six classes, determined by the Exercises in the Schools; different printed Problems and *vivâ voce* questions were proposed to different classes, generally taken two together, and the only questions proposed to all in common were the *Evening* Problems. In the year above named, important regulations, confirmed by Grace of the Senate, Nov. 13, 1827, came into operation. The classes were reduced to four, determined as before by the Exercises in the Schools. On the first two days all the candidates had the same questions proposed to them, inclusive of the Evening Problems; and the examination from books on those days excluded the higher and more difficult parts of mathematics, with the view of securing an object which, in the opinion of the Syndicate on whose recommendation these regulations were adopted, was highly desirable, viz.: "That the Candidates for Honours may not be induced to pursue the more abstruse and profound mathematics to the neglect of more elementary knowledge." Accordingly, on the first day (Friday), the questions from books extended to such parts of pure Mathematics and Natural Philosophy as do not require the Differential Calculus, and on the Saturday were added parts of Natural Philosophy somewhat more advanced, and the simpler applications of the Calculus. On Monday, the first and second classes were examined together, and the third and fourth together, in questions from books and in Problems; and on Tuesday, the second and third were examined together, and the first and fourth separately, in questions from books. The questions which had previously been given out *vivâ voce*, were *printed*, in order to make generally known the questions proposed in each year, and, by thus directing the reading of the students, to produce more fixity and definiteness in the mathematical studies of the University. The printed papers also

afforded the opportunity of ascertaining by inspection that the examination embraced in due proportion all the ordinary subjects of mathematical study. No change was made in the substance of the examination; the questions inserted in the papers being, like those which had been proposed *vivâ voce,* propositions contained in the mathematical works commonly in use in the University, or simple examples and explanations of such propositions. For the purpose of preventing those who had attended to a *part* only of the subjects from having any undue advantage by this mode of conducting the Examination, it was especially recommended that "there be not contained in any paper more questions than students well prepared have been generally found able to answer within the time allowed for such paper." At the same time a discretionary power was given to the Examiners of proposing additional questions *vivâ voce,* if any candidate should before the end of the time have answered all the questions in the paper. This power, however, was not continued in the regulations of 1833, nor in any subsequent regulations. With this exception, the preceding regulations may be said to have determined the principles on which in the main the examinations have been since conducted; and for this reason it has been thought right to insert them at some length in this Report.

By regulations which came into force in January, 1833, the same questions were proposed to all the classes during the first *four* days. The order of difficulty of the questions on the first three days was the same as it had previously been on the first two days; but on the fourth day the examination extended to subjects of greater difficulty, care, however, being taken to insert into the papers some questions suitable to the lower classes. On the fifth day the examination was conducted according to classes.

In January, 1839, the division into classes was discontinued, and the same questions were proposed throughout the examination to all whom the Moderators judged, from the public Exercises in the Schools to be qualified for examination as candidates for Mathematical Honours. The order of difficulty

of the questions was regulated nearly as before, questions selected exclusively from the higher parts of the subjects being proposed only on the sixth day of the examination.

The most recent alterations came into force in January, 1848. As these are of an important character, and the Board may be expected to give some account of their operation in the last two examinations, it will be necessary to state the regulations in some detail. The examination commences on the first Thursday after the first day of January. Questions and Problems are proposed to the candidates on eight days, instead of six as formerly, the first three days being assigned to the elementary, and the last five to the higher parts of mathematics. After the first three days there is an interval of eight days, and on the seventh of these days the Moderators and Examiners declare what persons have so acquitted themselves as to deserve Mathematical Honours. Those who have so acquitted themselves, and no others, are admitted to the examination in the higher parts of mathematics, and after the examination the Moderators and Examiners, taking into account the examination of all the eight days, arrange those who have been declared to deserve Mathematical Honours in the order of merit in the usual manner. The three classes of Wranglers, Senior Optimes, and Junior Optimes, are published on the Friday morning preceding the general B.A. admission, and no provision is made for any further examination corresponding to the examination of the Brackets, which formed part of the previous scheme, but had in practice been discontinued for several years. A principal feature in the new scheme is the limitation by a Schedule of the subjects and parts of subjects of examination in the first three days, and of the manner in which the questions are to be answered. The subjects are, the portions of *Euclid* usually read; *Arithmetic;* parts of *Algebra,* embracing the Binomial Theorem and the Principles of Logarithms; *Plane Trigonometry,* so far as to include the solution of Triangles; *Conic Sections,* treated geometrically; the elementary parts of *Statics* and *Dynamics,* treated without the Differential Calculus; the *First three Sections of Newton,* the

Propositions to be proved in Newton's manner; the elementary parts of *Hydrostatics*, without the Differential Calculus; the simpler propositions of *Optics*, treated geometrically; the parts of *Astronomy* required for the explanation of the more simple phenomena, without calculation. In all these subjects, Examples and Questions arising directly out of the Propositions are introduced into the Papers in addition to the Propositions themselves. Easy Problems in all the subjects are also proposed in a separate Paper. The order of the Examination in the remaining five days differs in no important respect from that of the last five days under the former arrangement. The hours of examination in the first three days amount to 17, inclusive of 3 hours for the Problem Paper, and in the last five days, to 27½, inclusive of 9 hours for the Problem Papers. The number of candidates that obtained Honours in 1848 was 135.

With respect to the general effect of the alterations which have now been enumerated, it may be asserted from present experience, that the discontinuance of classes has facilitated the determination of the relative merits of the candidates; and that the publication of all the questions proposed, has secured the introduction of a due proportion of all the subjects into each year's examination. The Board has had the opportunity of consulting a careful abstract of the number of questions in each subject in the examinations of ten years, from 1833 to 1842, from which it appears that during that interval, the subjects were proposed very nearly in the same proportions, and this practice, they have reason to say, has been adhered to since. It has, however, been found necessary to guard against the effect of proposing the same questions to all the candidates, which was apprehended by the framers of the regulations of Nov. 13, 1827, viz., its holding out an inducement to read the higher, to the neglect of the more elementary subjects; and it was partly with the view of correcting this tendency, that the regulations which came into operation in 1848 were adopted. With reference to this point, the Board has the satisfaction of reporting, on the authority of the Moderators and Examiners of 1848 and 1849, that generally the candidates who acquitted themselves

best on the first three days of examination were also the most successful in the remainder; and that it never happened that those who acquired little credit in the first part of the examination, attained eventually to a high place on the Tripos.

(2) No precise information, excepting so much as may be gathered from the published Problem Papers, can be obtained respecting the questions proposed to the candidates for Honours before 1828, when the practice of printing all the questions commenced. The character of the questions appears to have been determined by a few standard original works, and by the English elementary treatises in common use, which, though admirable as models of sound reasoning, certainly fell behind the progress of mathematics on the Continent. The Principles of Analytical Calculation, published by Professor Woodhouse in 1803, and his Plane and Spherical Trigonometry published in 1809, are the earliest indications of the introduction of more of the *analytical* element into the mathematics of the University; but the most decided impulse in that direction was given by the translation of the Differential and Integral Calculus of Lacroix by Herschel, Peacock, and Babbage, in 1817, followed by Peacock's Examples to the Differential and Integral Calculus, and Herschel's to the Calculus of Finite Differences in 1820. The symbol of differentiation, first used in an Examination Paper in 1817, had already in 1819 superseded the symbol of the Fluxional Calculus. A like impulse as to the extent and character of the questions proposed in Natural Philosophy, was given by the publication of Whewell's Mechanics (1819), Whewell's Dynamics (1823), Coddington's Optics (1823), and Woodhouse's Plane Astronomy (1821-1823). The first edition of Airy's Tracts was published in 1826, containing the Lunar Theory, the figure of the Earth, Precession and Nutation, and the Calculus of Variations. All these subjects soon found their way into the Examination Papers. Woodhouse's Physical Astronomy, and his Treatise on Isoperimetrical Problems had already appeared, but not being composed in a form adapted to the University system of examinations, these works had not made a general impression. Ana-

lytical Geometry, which had only been read in French treatises by the more advanced students, gained a decided footing after the publication of Hamilton's Analytical Geometry (1826), and Hymers' Analytical Geometry of Three Dimensions (1830), and now holds a prominent place in the examinations. Mr Airy, on being appointed Lucasian Professor in 1826, commenced a course of Lectures in Experimental Philosophy, which he continued as Plumian Professor. These Lectures had the effect of raising in a very important degree the standard of *information* among our students, and exciting their interest in classes of phenomena till then litle known in the University. In 1830 Professor Airy began the practice (now fully established) of publishing the questions proposed to the candidates for Dr Smith's Mathematical Prizes. In several instances, new classes of questions introduced for the first time into the Smith's Prize Examination, were shortly after admitted into the examinations of the Candidates for Honours. Peacock's Treatise on Algebra (1830) had the effect of directing the attention of the Students to the Principles of Symbolic Calculation. The second edition of Airy's Tracts was published in 1831, containing, in addition to the matter in that of 1826, the Planetary Theory, and the Undulatory Theory of Light, the latter of which had already been experimentally exemplified in his Lectures. From that time questions in each of those subjects appear in the papers in considerable numbers. About the same time, and more recently, there occur questions in Analytical Hydrodynamics, Definite Integrals, Laplace's Coefficients, and, sparingly, in the Mathematical Theories of Electricity, Magnetism, and Heat. Very little accession of new matter has taken place in the last ten years, during which the character of the examination with respect to the subjects it includes may be asserted to be nearly stationary.

In taking the foregoing retrospect it is satisfactory to remark, that the more important innovations in the subjects of examination, and in the modes of treating them, receive a kind of sanction by having originated in works written by members of our body whose names are closely connected with the scien-

tific reputation of the country. The responsibility of introducing the alterations rested with the Moderators and Examiners, no regulations having been provided by the University to which they could refer for authority or guidance: and there is reason to say that the uncertainty as to the subjects the examinations would embrace, and the want of due notice of any extension being given to them, have been felt as a serious inconvenience by the higher class of students. Generally, however, the introduction of each new subject was preceded by the publication of a treatise on the subject by a Cambridge mathematician, in which the Propositions were enunciated and proved in a manner suitable to the established system of examination. It is unnecessary to enumerate here the various treatises that have now come into use: suffice it to say that on the different branches of Pure Mathematics and Natural Philosophy which constitute the present mathematical course, there is a considerable number of English works which are well adapted to convey exact knowledge of the subjects, and at the same time to facilitate the preparation of the students for the examinations.

II. Respecting the Lectures of the Mathematical Professors, it may be sufficient to state the following particulars. The Lectures begun by Professor Airy twenty-three years ago, embraced Mechanics, Hydrostatics and Pneumatics, Geometrical Optics, and the Theory of Light. Lectures on the last four subjects have been continued by the present Plumian Professor, since 1837, at which time the Lowndean Professor also began courses of Lectures alternately on Astronomy and Geometry. In 1843, the Plumian Professor added Practical Astronomy to his other subjects, the Lowndean Professor having discontinued his Astronomical Lectures. The Lectures of the Plumian Professor have had the disadvantage of being given at a time when increasing activity in Astronomical Science demanded extraordinary attention to the duties of the Observatory. They have, however, been attended by a class varying from twenty to thirty, consisting chiefly of the more

advanced students. Since 1838 the Jacksonian Professor has given annually a course of Lectures on Mechanism, and in the present year he has added to these a series of experimental and illustrative Lectures on Mechanics, more immediately bearing on the reading of the students who are preparing for Honours.

It will appear from the foregoing statement that, in order to give increased efficiency to the Lectures of the Mathematical Professors, it is desirable that the subjects should be more equally distributed among the different Professors. These Lectures cannot, however, be expected under any arrangement to supersede other channels of instruction; and it may be doubted whether Professorial Lectures on Pure Mathematics are ever likely to form an effective part of the general system. The case is different with the branches of Natural Philosophy, the importance of experimental and illustrative lectures on which, as *supplementary* to the other modes of instruction, cannot be too much insisted upon; not only on account of the greater distinctness of conception which is acquired by visible representation of what is read in books, but because such lectures can hardly fail to increase the student's interest in what he reads, and add to his stock of information, and because they afford the opportunity of leading him on to the practical bearings and applications of the subjects of his study. The circumstance of our being able to collect in this University an audience consisting of students who, by previous training, are qualified to understand and appreciate experimental lectures on mathematical subjects, is an advantage by no means to be lost sight of. With respect to any direct means of securing a correspondence between the Lectures of the Professors and the Mathematical Examinations, it is conceived that the publication of a Syllabus, or Outline of the Lectures, accompanied by descriptions of the experimental arrangements, and by mathematical proofs of propositions immediately connected with the facts exemplified, may materially conduce to this end.

III. To the foregoing review of the past and existing state

of the Mathematical Studies of the University, the Board beg leave to add the following recommendations:—

(1) Taking into consideration the great number of subjects which now occupy the attention of the candidates, and the doubt which exists as to the range of subjects from which questions may be proposed, the Board recommend that the Mathematical Theories of Electricity, Magnetism, and Heat, be not admitted as subjects of examination.

(2) It has appeared from statements in the former part of this Report, that while the total number of hours of examination has gradually been increased, the time allotted to the solution of Problems has not been altered in the same proportion*. As this arrangement, which could hardly be avoided on account of the large addition to the number of subjects, had the effect of inducing the candidates to neglect examples and problems, it seemed highly desirable to counteract this tendency. Partly with this view and partly to obtain a surer test of the acquaintance of the candidates with the subjects of their reading, examples and deductions have been attached to many of the propositions from books. The Board, however, having had before them an analysis of the answers to the

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* The following table exhibits in one view the principal changes in the regulations for conducting the examination which have been mentioned in the course of the Report, together with the average proportion in the successive intervals over which the changes extended, of the number of candidates that obtained Honours, to the whole number of Questionists admitted to the B.A. degree.

Interval.	No. of days of Examination.	No. of hours of Examination.	Hours allotted to Propositions from Books (B)	Hours allotted to Problems (P)	$\frac{P}{P+B}$	No. per cent. of Questionists that obtained Honours.
1808—1827	3	18	11	7	·39	27·8
1828—1832	4	23	16	7	·30	28·3
1833—1838	5	27½	20	7½	·27	38·0
1839—1847	6	33	24½	8½	·26	36·9
1848	8	44½	32½	12	·27	40·3

questions proposed in 1846, 1847, 1848, and 1849, find that the number of answers to the examples and deductions has fallen below the amount which it is desirable to secure. They are of opinion that such a result may in a great measure be prevented by diminishing the number of questions, and they have agreed to recommend, that the Papers containing the questions from books be shortened, in order to enable the candidates to give more time to Examples and Deductions.

(3) Some uncertainty having been expressed as to the kind of answers the candidates are allowed to give to questions in Optics on the first three days of examination, the Board feel called upon to state, that they understand the term "geometrically" in the Schedule, to mean in a strictly geometrical manner, such, for instance, as that employed in Wood's Optics. At the same time, taking into consideration that the attention of the candidates to geometrical reasoning is sufficiently secured by other subjects of examination on the first three days, they are of opinion, that with reference to Optics, the restriction "geometrically" may with advantage be omitted, and that the questions should be so framed as not necessarily to require any particular kind of demonstration. They, therefore, suggest that it would be desirable to offer to the Senate a Grace for omitting the words "treated geometrically" in the Schedule.

J. Challis, *Plumian Professor.*
R. Willis, *Jacksonian Professor.*
T. Gaskin.
W. C. Mathison.
H. Goodwin, *Junior Moderator.*
G. G. Stokes.
J. Sykes.
J. C. Adams.
W. B. Hopkins, *Senior Moderator.*
C. Octavus Budd.
S. Parkinson.

May 17, 1849.

A Grace passed the Senate May 23, to omit the words

"treated geometrically" (so far as they relate to Optics) in the Schedule which constitutes the third clause of the Regulations for the Examination of Questionists who are Candidates for Honours, approved by Grace of the Senate, May 13, 1846.

XIII.

SOME REASONS against the expediency of instituting a PUBLIC EXAMINATION OF STUDENTS previous to their Residence in the University.

1 THE duty as well as the privilege of each *College* is to admit such Students as it considers likely to derive benefit from attending its lectures; that of the *University* is to see that the Students are duly qualified at the Examinations previous to conferring its degrees. Some Colleges may, by greater attention bestowed on its Students, or by a different style of lectures, or from the smallness of their numbers, or other reasons, be able to prepare a class of young men for the University Examinations, different from that which another College is able or willing to do. I see no necessity for the standard of admission at all Colleges being the same; in fact, the very difference has its advantages. The mode of lecturing is not likely to be the same at all Colleges, neither is it desirable to have entire uniformity. If any one thinks that in consequence of the want of an admission examination by the University "the standard of the College Lecture-rooms is so low, that a young man going from the top of a public school will be nearly losing his time by attending them," he can have very little acquaintance with the Lectures of some of the larger Colleges. Instances not unfrequently occur, of Students, who having been considered unlikely to profit by the Lectures of one College, have gone to another, and by their own steady application, and the pains bestowed upon them, have eventually obtained a degree with credit.

2 It is said that the plan has been tried at Trinity College

and found to succeed, and that the principle is the same in the case of the University. The plan tried at that College is a *private* examination, conducted by its own officers in conformity with its statutes. "Nemo admittatur nisi a Decano seniore et Lectore Primario examinatus; et si ab his habilis ad lectiones audiendas reperiatur, a Magistro admittatur; sin minus, omnino rejiciatur." And this examination has been made efficient for some years by laying down definite books and subjects of examination. The great advantage obtained is, that it secures a little more knowledge of Latin and Greek in the inferior candidates for admission, but especially an acquaintance with one or two books of Euclid, and Arithmetic, and the first elements of Algebra; which enables the Lecturers to commence systematically their Lectures to a large class, without being obliged to wait for some days (as used to be the case formerly) till all the Students had provided themselves with a Euclid, and looked at the definitions; whereby the whole class would be retarded, or the unprepared left hopelessly behind from the first.

When this Examination was first instituted, the most sanguine approvers of the scheme thought that henceforth Trinity College would have very few, if any, men in the second Class at the Previous Examination, and that a case of a 'not approved' Candidate would be almost unheard of. It will be found on inquiry that these expectations have not been altogether realized, though much advantage and convenience of another kind has ensued. I certainly think that Trinity College would lose by substituting a public for a private examination. Their private examination they can easily alter as they find advisable; a public one would in many respects not give the same satisfaction, nor answer the end proposed.

3 The *details* of any such scheme will be found to be attended with many difficulties. The first is, the very great number of Candidates who would attend the Examination in October; for of late years the Matriculations in that term have exceeded 400. At least four Examiners would be required, and there must be an Examination in every term, possibly two in each term. And though three-fourths of the men would pro-

bably pass with ease, the remainder would require much care and delicate consideration. The Examiners would, I presume, be chosen according to the cycle of Proctors; and I need hardly say that great jealousy between the Tutors of the different Colleges and the Examiners would probably arise, at the rejection of Students, of whom the Tutors, from private information, or personal knowledge, may have had reason to think well. It is also to be remembered, that on the first entrance to the University, many would be much at a loss how to proceed in an examination conducted mainly on paper, and that rejection, even for a time, at a *Public* Examination would be felt to be a very serious concern; so much so, that I think the Examination would shortly become little more than a matter of form, from the odium excited by refusing a certificate of admission.

4 Lastly, when we consider the nature of our University, and that it is the ordinary channel of admission to Holy Orders, great care must be taken not to exclude deserving persons, who, though ill-prepared at first, may probably by diligence and attention sufficiently improve themselves, and so attain an object of great importance, to be debarred from which for a year or two longer might be attended with extreme disadvantage. It is this class of men who would, I fear, be more likely to fail at an entrance examination, than those who come from our public and private schools with very little information and knowledge, though sufficient to pass, and who frequently turn out much less satisfactorily at the Final Examination for the B.A. Degree than the others.

TRINITY COLLEGE,
Dec. 3, 1847.

XIV.

(*Published Dec.* 1, 1849.)

THE VICE-CHANCELLOR begs to inform the Members of the Senate, that he has received the following communication from the MASTER of TRINITY COLLEGE:

'I wish to offer to the University two Prizes of fifteen Pounds 'each to be given every year, so long as I hold my present Pro- 'fessorship, to the two Persons who shall shew the greatest 'proficiency in Moral Philosophy, in the Examination for 'the Moral Sciences Tripos, appointed to commence in 1851, 'provided that, in the judgment of the Examiners, they pos- 'sess sufficient merit.'

(Signed) W. WHEWELL.

Confirmed by Grace of the Senate, Dec. 3, 1849.

XV.

SCHEME OF EXAMINATIONS IN MORAL PHILOSOPHY.

THE following may be given for the present as a list of important works on this subject.

Xenophon's *Memorabilia of Socrates.*
Plato's Moral Dialogues: *Theætetus. Meno. Gorgias. Euthyphro. Charmides. Laches. Protagoras. The Republic,* B. I—X. *The Laws,* B. I—XII.
Aristotle. *Nicomachean Ethics,* B. I—X.
—— *Politics,* B. I—VIII. *Rhetoric,* B. I—III.
Plutarch's Moral Works.
Cicero. *De Officiis. De Finibus Bonorum et Malorum.*
Epictetus. *Enchiridion.* Arrian's *Epictetus.*
Seneca. *De Beneficiis. De Irâ. De Clementiâ. De Vitâ Beatâ.*

S. Augustin. *De Mendacio. Contra Mendacium.*
Grotius. *De Jure Belli et Pacis.*
Hobbes. *Human Nature. Leviathan.*
Sanderson. *De Juramenti Obligatione. De Obligatione Conscientiæ.*
Jeremy Taylor. *Ductor Dubitantium.*
Butler's Sermons I. II. III. V. VI. VIII. IX. XI. XII. (Recently published as Butler's *Three Sermons* and Butler's *Six Sermons*).
Locke. *Essay on the Human Understanding.*
—— *Treatise on Government.*
Cudworth. *Immutable Morality.*
Clarke. *On the Being and Attributes of God.*
Rutherforth. *Institutes of Natural Law.*
Paley. *Moral and Political Philosophy.*
Bentham. *Principles of Morals and Politics.*
Hutcheson. *Inquiry into Beauty and Virtue.*
Hume. *Treatise of Human Nature.*
Reid. *Essays on the Powers of the Human Mind.*
Price. *Review of Questions in Morals.*
Adam Smith. *Theory of Moral Sentiments.*
Dugald Stewart. *Philosophy of the Active and Moral Powers.*
—— *Outlines of Moral Philosophy.*
Brown. *Lectures on Ethics.*
S. T. Coleridge. *Aids to Reflection.*
Mackintosh. *Dissertation on the Progress of Ethical Philosophy.*
Wheaton. *International Law.*
Manning. *Law of Nations.*
Kant. *Kritik der Praktischen Vernunft.*
Fichte. *Sittenlehre.*
Schleiermacher. *Kritik aller bisherigen Sittenlehre.*
Victor Cousin. *Philosophie Morale au* XVIII. *siecle.*
—— *Cours d'Histoire de la Philosophie Moderne.*
Whewell. *Elements of Morality.*
—— *Lectures on Systematic Morality.*

It is proposed to select every year certain works or portions of works from the above List, as special subjects of the examination in Moral Philosophy which belongs to the Moral Sciences Tripos.

For instance, the following Selection might be made.

For the Moral Sciences Tripos Examination 1851.

Plato. *Charmides. Protagoras. Republic,* B. I.
Aristotle. *Nicomachean Ethics.*
Cicero. *De Finibus.*
Grotius. *De Jure Belli et Pacis,* B. I.
Stewart's *Outlines.*
Of Things Allowable.

For the Examination 1852.

Plato. *Meno. Laches. Republic,* B. II. III. IV.
Aristotle. *Rhetoric.*
Cicero. *De Officiis.*
Grotius, B. II.
Cousin. *Philosophie Morale au* XVIII. *siecle.*
The Right of Search.

THE END.

Additional Professors' Regulations respecting the Examinations for the New Triposes. *See* page 98.

At Meetings of the Professors and Examiners for the New Triposes, held October 28, and Nov. 28, 1850, the following Additional Regulations as to the mode of conducting the Examinations for the Triposes in 1851 were agreed upon.

1 That at the time of the general B. A. Commencement, notices shall be issued to the University by some of the Examiners for each Tripos (as is done for the Classical Tripos), stating the place where and time when the Examination will begin, and the limit of time at which persons intending to offer themselves as Candidates for either of these Triposes must give notice of their intention to some one of the Examiners.

2 It was agreed that, for the Moral Sciences Tripos of 1851, such notice to the Examiners must be given not later than Friday, Jan. 31 (the Examination beginning Monday, Feb. 3), and that for the Natural Sciences Tripos of 1851, such notice must be given not later than Feb. 28, (the Examination beginning Monday, March 3.)

3 It was agreed that, for this time, the notice shall be issued, and the names of Candidates for the Moral Sciences Tripos shall be received by the *Professor of Moral Philosophy;* and for the Natural Sciences Tripos, by the *Professor of Anatomy.*

4 It was agreed that all the Candidates for each Tripos should attend at the beginning of each of the Examinations for that Tripos; but should not be required to send in answers at each.

5 It was agreed that the Additional Examiner in each Tripos should prepare the paper of Questions for the *fourth* day of Examination, being furnished by the other Examiners with such questions as they may think proper; and selecting from these, so that the paper shall be a proper length, and shall contain about equal portions of each of the subjects.

6 It was agreed, that for the present, the papers of questions shall be not longer than a Candidate well prepared could answer in *four hours*, and that four hours be allowed for answering each paper.

7 It was considered desirable that about half the questions should be of a general, and half of a special nature.

8 It was agreed that the merit of the Candidates should be compared by means of *marks*; complete answers to each paper being estimated as worth 100 marks, and 20 marks being, in like manner, assigned to each subject in the fourth day's paper.

9 It was agreed that the places of Candidates in the Tripos should be determined by adding the marks obtained by each in the different subjects, as is usual in compound examinations.

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