The present state and future prospects of mathematical and physical studies in the University of Oxford / [Baden Powell].

THE PRESENT STATE

AND

FUTURE PROSPECTS

OF

MATHEMATICAL AND PHYSICAL STUDIES

IN THE UNIVERSITY OF OXFORD,

CONSIDERED

IN A

PUBLIC LECTURE,

INTRODUCTORY TO HIS USUAL COURSE,

IN EASTER TERM, MDCCCXXXII,

BY THE

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1832.

In my Courses of public Lectures (whenever, namely, by the circumstance of a Class being collected, I have been able to give any) I have, from time to time, taken occasion to advert to the condition of the Mathematical and Physical Sciences in this University, and have never omitted any opportunity for urging the necessity of endeavouring by every practicable means to promote a more extended cultivation of them, than at present prevails.

With the hope of contributing further to the success of the same object, I have embraced the present opportunity of placing in a more prominent light the claims which I conceive these branches of study have on the attention and support of all who are really well wishers to the advancement of this University in utility and reputation. And I have adopted this mode of giving greater publicity to my view of the actual state of the case, as it is a point which has long appeared to me of the greatest importance to the real interests and objects of our institutions, but which unhappily gains very little general

attention, and is too frequently regarded with indifference, or even with a feeling of suspicion and dislike.

If we take a retrospective glance at past times, we find little to give us a correct notion of the actual extent to which the Mathematical and Physical Sciences were formerly pursued here. That a few highly eminent individuals have shed a lustre on these departments, will prove little in regard to the general character of the studies of the place. We are justly proud of the names of Saville, Wallis, and Briggs; at a subsequent period we claim those of Boyle, Wren, and Gregory, of Halley, Stirling, and Bradley; whilst in still later times we boast a Horsley and a Robertson. But these illustrious men may have pursued their recondite researches, and have run their career of distinction, without exciting any kindred feeling for their pursuits among their contemporaries, or exercising any influence on the studies, epecially of the junior part of the University. This was probably in a great degree the case; but there are few data left us by which we can form an accurate opinion. In one way, indeed, some sort of estimate may be formed; from the records, namely, which are in existence, of the attendance formerly given to some of the public Lectures on

these Sciences; which, it would appear, was usually far more numerous than at present. Down to a period within the memory of persons now living, the public Lectures, both in Geometry and Astronomy, but more especially in Chemistry and Experimental Philosophy, were constantly and fully attended: and at least the latter considered almost a regular and indispensable part of an Academical course.

Of the *extent*, indeed, to which these scientific studies were actually carried, in the absence of any precise standard, we have perhaps no reason to form any very exalted idea.

But the important point is, that *some attention* to Science (such as it was) seems to have been *generally* evinced: and some knowledge of these subjects, if but little, have been almost invariably acquired by every one who studied at all.

If we look back to the ancient institutions of the University, the Experimental Sciences being of comparatively modern introduction, we cannot perhaps consider them as *literally* coming within the range of that course which was prescribed by the old Statutes. But it is important to observe, that the Mathematical and Physical Sciences, *as they were known in that age*, and to the full extent to which they had then reached, were recognized and enumerated as

regular and legitimate branches of Academical instruction. And the principal circumstance to which attention should be directed, as well in the ancient Statutes as in the Records of the past history of Oxford, is the distinct recognition, both in theory and in practice, of the principle, that scientific studies were to be regarded *not as an exclusive distinct department, to be cultivated to a great extent by a few of peculiar genius*, but always as one portion of a comprehensive series of the liberal Sciences, to be gone through as constituting the appropriate course of the *faculty of Arts, by all Candidates for Degrees in that faculty*.

This was indisputably the tone and spirit of the old system of the Schools. But when in later times, owing to a variety of causes, that system had lost its efficiency, and had degenerated into a mere collection of empty forms, the very idea of a comprehensive system of Academical Study seems to have been lost with it.

In the first attempts to remedy the evils of such a state of things, the earlier form of the Examination Statute, though the old and just principle was by no means lost sight of in theory, yet the tendency in practice was directly and obviously towards the neglect of an enlarged course of the Sciences, and the recognition of

one or two branches as the sole essentials of Academical learning.

The subsequent division of the Examinations into *two* departments, and *no more*, confirmed and fixed the impression, that the whole of real Academical learning consisted in the Classics and Logic, to which Mathematics might be added by the few who had a genius that way.

Every later step in the alterations which have taken place in the Statute has tended more and more strongly to perpetuate the influence of the same principle.

But looking more particularly to the Mathematical and Physical department, the extent to which these branches have been generally cultivated during this period admits of being ascertained by more exact criteria, from the institution of the Classes of Honours at the Public Examination; a source of evidence which affords but a lamentable view of the condition of these Studies. These published lists constitute the only ground on which the University recognizes the pretensions of the Candidates, and we may therefore fairly consider them as affording an estimate of the number who pursue these Studies. And it will appear beyond dispute, to any one who takes the trouble of counting, that the *proportion* which the number of *Mathematical*

Class-men bears to the number of those who *passed* in each year, from the commencement of the system to the present time, so far from having experienced any increase, has *considerably diminished* in the later years. Yet we hear it continually asserted, that Mathematical Studies have greatly advanced in Oxford. The advance can only be understood in regard to the *extent* to which these Studies are carried, and the *subjects* they are made to embrace, when pursued, as they must be, by those few who are Candidates for the highest Honours: and these unquestionably have been greatly extended of late years. The printed Questions, commencing from the Examination of Mich. Term, 1827, are now before the public, and they will be admitted to reach to topics of as high a description as can be thought desirable: indeed, the question would rather be the opposite way, whether, instead of proceeding so far in one direction, it would not be preferable to take a wider range of physical and general subjects.

But all this applies only to the *few*. If we proceed in our enquiry respecting the *many*, of these nothing appears in the Class-paper. But it is alleged, that those who pursue these studies to a certain extent amount to a considerable number, of whom the Schools afford no estimate;

that is, we have a system of Examination which is thus admitted to fail in bringing out latent talent, in rewarding general attention to study, and in affording to every Candidate a fair measure of credit for whatever degree of ability he may possess, unless it chance to be of the highest order; an admission which constitutes a severe reflexion on the system; an admission, that it is a system adapted to the few, and unfavourable to the many; flattering to genius, and repressive of mediocrity.

The defective estimate afforded by the Schools may be in some degree corrected and enlarged, from what we know of the system privately pursued in Colleges: in some of which an attendance on Lectures in a portion of the Elements is enforced upon all Undergraduates; as also in other branches on many who never ultimately appear in the Schools in this department. Attendance also is given to the Public University Lectures by some few, who afterwards lay aside the study.

The examination of a portion of the Candidates in Euclid at the Responsions, as well as (under the Statute of 1830) at the final Examination in Euclid, also, with the *optional addition* of elementary questions in Algebra and Trigonometry, and on the first principles of Natural Philosophy, may

henceforth be considered as a further source of evidence: but as far as a year's trial has enabled us to speak, the small proportion of the Candidates who take up this department at all, and the use generally made of the additional *privilege* so liberally allowed, are sufficient proofs of the low ebb to which these studies are reduced, among the majority even of those who are led to enter upon them.

In fact, no one at all acquainted with the state of the University can need much detail of evidence to convince him of the truth of these general statements: that if a considerable proportion of the Undergraduates go through a part of the Elements of Euclid, it is chiefly by compulsion, without an idea beyond the letter of the text, and this often learned by rote: if a smaller proportion advance a little beyond this, having no adequate stimulus to counterbalance their difficulties, they soon abandon the pursuit: and if a few persevere to the higher parts, they do so only to that precise amount, which is to secure them from falling into the second or lower Classes; or finally with a view to the Mathematical Scholarships.

The majority then approach these subjects with awe, do only just so much and in such a way as fulfils a compulsory requisition, and, as

soon as they can, eagerly discard the very recollection of it: while the few who are led on by genius or ambition pursue the study extensively, but too often in such a manner, as is productive of little real advantage, or systematic improvement. The facts of the case will hardly be questioned, but they may and too generally do fail to excite any attention: and to contend that what are admitted as *facts* are also *evils;* to feel any regret at their existence, or any apprehension at the prospect of their continuance and increase; much more, to express any wish, or suggest any expedients, for their diminution or removal, is too generally looked upon as idle, chimerical, and of an innovating and dangerous tendency.

The evils of such a state of things ought to be sufficiently apparent on the face of the above statements. But the mischief becomes more distinctly apparent, when we consider how little either of the two extreme courses (just described as the usual alternative) can conduce to what even the supporters of the system themselves avow as the real objects of Academical study, viz. the general cultivation and exercise of all the intellectual faculties.

I will not here enter upon any argument as to the justness or propriety of this principle, which has been upheld in this place as that which

ought to pervade and direct all Academical pursuits and systems. But I am disposed to contend, that, strongly as it may be avowed in theory and in name, it is totally lost sight of in practice and in reality.

There are those who have maintained and professed, that the University recognizes no distinct departments of instruction, but seeks the general improvement and exercise of the mind: statements which appear to me hardly reconcileable or intelligible. But supposing the principle (such as it may be) admitted, how is it acted upon? and how are these professions verified by the existing system? Wherein are we to recognize the pursuit of such a course of studies, tending each in its specific way to open, enlarge, and exercise the different faculties of the mind? When in point of fact the whole system, if system it can be called, in by far the great majority of cases, is limited to one confined routine of Classical literature, in which none of the higher intellectual powers are brought into play, and those which are, often to little good purpose.

It has even been formally contended, that it is a matter of indifference what are the particular subjects of study, provided only that *something* is studied regularly, and that habits

of attention and thought are actually exercised: and a distinction drawn between studying any subject as a science, and as an exercise for the mind. But if the subjects be indifferent, it would seem wiser to choose those which are otherwise instructive. And (as far as the Mathematical Sciences are concerned) it appears to me they can only be studied in one way. I suppose it will hardly be contended, that any useful exercise is given to the mind in learning Euclid by rote, or in solving equations like enigmas. Yet something of this kind we are necessitated to suppose, since the system is actually enforced which prefers even the farce of thus going through Euclid's propositions, to allowing the Student a choice of subjects connected with elementary Science, among which he might surely find some suited to his capacity, though Euclid might be beyond him.

If, however, any such distinction could be intelligibly supported, still the two objects would seem by no means incompatible, and we might as well secure both. In fact, the two methods (if two can be distinguished) must be so blended, that it is impossible to acquire a real and satisfactory knowledge of any subject of science, as a science, without obtaining the most valuable exercise of all the reasoning powers in doing so. The two objects appear to me inseparable, and

the intellectual exercise so afforded of the most extensive application.

But I shall not waste time in the refutation of such idle theories; nor say more in regard to the neglect of Science in this University, for the purpose either of *substantiating the facts*, or *shewing* that they are *evils*. I will proceed to enquire briefly into the probable *causes* of these evils, and the *remedies* for them.

The first and most obvious cause is the want of *preparation* in elementary knowledge *previous to admission into the University*. It has been too commonly the case, that the Student has entered upon his Academical course utterly unacquainted with the most elementary notions of Mathematics, and hence has to commence the toil of the first initiation at a period of life when it becomes doubly irksome and distasteful; and then to attain any proficiency, a *sacrifice of time* is required, disproportioned to that given to other studies. Hence he has hardly any alternative, but either to devote himself to these Studies exclusively, or to throw them aside altogether.

Other difficulties originate in the actual prosecution of the elementary Studies, from the *manner* in which they are commonly conducted. Among these, the chief perhaps arises from too

close and undeviating an adherence in the outset to the *letter of Euclid's Elements.* This complaint attaches both to the Public Examinations, and the Responsions: and since from these College instruction takes its tone, the same fault has too widely pervaded the whole system.

The excellencies of Euclid appear to me to have been often overrated; especially as applied to the purposes of elementary instruction; but granting that the system is faultless, and that it affords the most salutary of all mental exercises, still if it be so repulsive, that the Student cannot be brought to go through it beneficially, the attempt defeats its own object.

I have heard it maintained, that there are individuals whose minds are so constituted, that they are physically incapable of the degree of abstraction of thought necessary for going through Geometrical demonstrations. If, as perhaps is the case, there be some truth in the assertion, the same individuals may yet be very capable of understanding other parts of Science. The same mental peculiarity would by no means render the Student incapable of comprehending Algebra, and still less the results of experimental investigation, and the first principles of Natural Philosophy.

A great cause of the neglect of Physical Studies,

properly so called, is the too common rejection of them along with Mathematics. But the neglect of the one by no means necessarily involves the neglect of the other. The Physical Sciences may be pursued to a very considerable extent with scarcely any introduction of Mathematics; and even when Mathematical reasoning is applied, such a knowledge of it as supposes the learner to be perfectly at home in the letter of Geometrical demonstrations, is far from being indispensable for following up many very interesting portions of such investigations, and the study of those laws which regulate some of the most remarkable phenomena of the material world.

But it will be almost superfluous to say, the most efficacious and deeply-seated causes of the evils already described will be found *in the system of Public Examinations*.

The operation of these causes has been so clearly and forcibly pointed out, in the representation of the case lately printed by the Public Examiners, that I can say nothing more than what would be a mere repetition of the arguments contained in their unanswered and unanswerable "Reasons for the suggestion of certain alterations in the Examination Statute," 1832. The broad interval between the several Classes: the discredit attaching to the inferior Classes: the total absence

of all motives to do *a little:* all arising obviously out of the alphabetical arrangement, and the non-publication of the names of the pass-men, or rather the existence of any distinction between passing and honours.

These are the main and original sources of the whole evil, which can never be too often or too forcibly pressed upon the attention of the University.

Again, Mathematical attainments do not open the road to Academical distinctions and situations. In a few instances they may possibly have done so: yet, even with the additional stimulus of the Scholarships lately founded by the liberal subscriptions of the University, the incentives are such as to call forth the ambition and exertions of but very few. While, on the other hand, the attention to these pursuits will be repressed, lest it should interfere with the more cherished Classical studies, which are the passport to the whole range of Academical as well as Ecclesiastical preferment.

From the consideration of the *evils* and their *causes*, I proceed to the *probable remedies*, and means of *improvement*.

Our principal hope, in the first instance, lies in the appearance which we must recognize with much satisfaction of an increasing introduction of

elementary Mathematical instruction at some, at least, of the public Schools: and the better preparation of our students before their entrance.

Again, much is to be expected from the circumstance, that all the principal Colleges are now possessed of Mathematical Tutors, able and desirous to carry forward the studies of their pupils into the highest departments, as well as to diffuse a general taste for the pursuit.

Much has been said of late on the comparative advantages of the Tutorial and Professorial systems of instruction. But in the particular instance of Mathematics, no one can entertain a doubt as to the superiority and even exclusive practicability of the system of the private Lecture Room. Even in the Professorial Lectures, (that is, whenever a few Students have been collected from those Colleges which did not happen to have a Mathematical Tutor,) I have found it absolutely necessary, and especially when advancing to the higher parts, to adopt this plan, and assimilate the mode of instruction as closely as possible to that of the College Lecture; though, even if equal in other respects, such Lectures must fail in being equally effective, from the different relation in which the Professor stands to his Class.

In this respect, therefore, the advancement of these studies is chiefly to be looked for in the

increasing efficiency of this description of Lectures, and the supply of books adapted for the purposes of them.

These remarks must, of course, apply principally to the more recondite and analytical parts of the subject; for it must not be forgotten, that there are many portions even of pure Mathematics, in which considerable assistance may be given to the student from Lectures of the public kind.

The conception, for example, of a number of points connected more especially with the geometrical view of the Sections of the Cone, with the mechanical description of various Curves, and with Geometry of three dimensions, are most advantageously illustrated by means of models and moveable diagrams: as also many other parts of the subject are susceptible of useful elucidation by the exhibition of schemes and tables of various kinds: all which are of a nature well suited to the Public or Professorial Lectures. Many illustrations also of an historical or critical kind, which seldom find their way into elementary treatises, may excite increased interest in the study; and some general descriptive views of the different branches may assist and guide the actual investigation of the details by the student himself. These and the like topics form the sub-

ject of those Courses of Public Lectures which I have given, whenever I have been able to collect a Class; and some at least of which it is presumed are not of a nature capable of being supplied in College Lectures. But with respect to the study of the Mixed Branches, or of Natural Philosophy, the absolute necessity for an attendance on public experimental Lectures is too obvious to require notice.

In either case, however, it seems a subject well worthy of consideration, how much more efficient and useful Lectures of this description might become, if they were seconded by the *cooperation* of the *College system*, and made, as they easily might be, to form a *regular part of it.* There may be many points in which the *Tutorial*, and many others in which the *Professorial*, system, may have its peculiar advantages; but the greatest benefits are to be looked for in a judicious and *systematic combination* of the two.

But after all the improvements or increased activity which may be given to any system of Lectures, it must be evident we shall proceed to no purpose, without a corresponding improvement in the *Public Examinations.* It will need no arguments to prove, that these will always be the first moving principle of the whole machinery; and the obvious conclusion is, that

the Examination system requires to be regulated on such a principle, as shall induce and encourage *the many* to pay some attention to these subjects, instead of leading only *the few* to pursue them to a high degree; so as to make an acquaintance with at least the principles of Science become as *essential a part of a liberal education*, as a knowledge of the Classics is at present considered to be.

I speak of the Public Examinations solely with respect to the Mathematical and Physical departments, although impressed with the conviction, that similar evils exist in some degree in other departments also: but here it is that I am mainly concerned; and here it is also that the evil exists in the most pernicious form.

It appears to me, that no person, not labouring under the most unhappy prejudices or the most lamentable infatuation, can doubt or deny, that the tendency of the present system is to encourage (what I will admit, if they please, to be an *excessive* cultivation of) Mathematical Science among a very few, and to discourage it altogether among the many.

Circumstances already referred to tend to the alternative of doing the utmost, or nothing; and the Examination system, instead of counteracting, only more powerfully, enforces this mischievous

tendency; and the broad distinction, susceptible of no modifying circumstances, between the several Classes and between honours and a mere pass, and for passing the sole alternative of Logic, or the four books of Euclid; these circumstances produce the direct and obvious consequence, that the Candidate esteems no Class worth attaining but the first: if he does not feel nearly secure of his place there, he infinitely prefers passing without notice, to a place in any of the lower Classes; and to secure his passing will do nothing beyond the mere quantity of Euclid which is absolutely exacted.

It cannot, I conceive, admit of any serious doubt, that the appropriate remedy consists in the simple expedient of making some knowledge, however little, of some parts *either* of Geometry, *Algebra*, or *any of the branches of experimental Science*, at the entire option of the Candidate, *obligatory for admission to a Degree:* of printing the names of all Candidates, distinguishing those who excel even in the lowest Class, and of breaking up the wide intervals between all the Classes, by making subdivisions in them wherever obvious differences in the merit of the Candidates require it.

Of all the *objections* which I have ever heard urged against such a measure, I have never chanced to hear one which was directed against

the certainty that it would *accomplish the end here in view*, whatever might be said on other grounds. And the other grounds of objection I have never been able to understand. They consist chiefly in certain abstruse principles, with which such suggestions are held to be at variance; especially as tending to lower that *pure* and *elevated* tone of *moral feeling* which at present prevails among the Candidates.

In thus urging the necessity of some improvement in this branch of Academical study, it must not be supposed I advance its claims as superior to those of other branches.

The sole principle on which I contend for giving it a greater degree of encouragement, is simply that of an *equal* claim to attention, which ought to be advanced for *every one* of those departments which are acknowledged as legitimate branches of Academical study. And the proper ground of complaint appears to me solely that of the *undue precedence* given to one or two of these branches, whilst others are almost wholly neglected, or, if encouraged, are encouraged only as *secondary* and separate objects of pursuit, in which the Student may, if his taste incline him, obtain distinction, but which do not fall in with the regular routine of the Academical system.

My argument is, in fact, no other than that which would really result from the principle

so loudly contended for by some with so little meaning, that a *general* education is the specific business of University studies: whilst, with a lamentable blindness to the real nature of the case, they would neglect the most important of those branches, whose *aggregate* constitutes a *general* education, when that word is used with any definite meaning.

If *general* education be acknowledged as the legitimate design of an University, it is impossible to understand in what it is to consist, unless in going through a course of at least all the principal branches of what constitute the liberal sciences, or more precisely those which afford equal exercise to all the chief intellectual faculties, and tend to enlarge the understanding, by presenting, at least in their more comprehensive principles, the leading departments of human knowledge. But in what sense the mere routine of continuing to read a certain portion of the Greek and Roman poets and historians, with the addition of learning by rote a few technicalities of Logic, can be called general education, or by what perversion or delusion this can be considered as answering the purposes of Academical instruction, or fulfilling the requisitions of an Academical course for supplying the various departments of Church and State with fit and able men duly qualified to fill and to adorn them, is difficult to say.

In contending for the necessity of measures to ensure the more extensive cultivation of Mathematical and Physical Science, and for their recognition as constituting an *essential and indispensable branch of Academical study*, I waive the arguments which might be fairly deduced from the extreme utility and importance of these Studies considered in themselves; and I decline urging the wider introduction of them, as it might fairly be urged as an improvement demanded by the spirit of the present times. I am content to rest the question solely on the acknowledged and long established principles of our Academical institutions: and will contend, that the *neglect of these studies is a modern innovation on the spirit and principle of the ancient Statutes;* and that to those principles we are bound carefully to recur, and diligently to adhere.

The legitimate system of an University is surely that of "*Universitas literarum,*" and if we only look back to our existing Statutes, we find the prescribed course for the faculty of Arts comprising a complete range of the Sciences as then known. To *contract* the extent and *limit* the range thus prescribed is not merely to be deficient in the cultivation of the knowledge of the age, but is even to *retrograde* beyond the age of our Statutes.

These distinctions are not those of mere empty names. *The faculty of Arts* constitutes a portion of the system as necessary now as it was in former ages; the Degrees in that faculty, which is the road to all the higher faculties, are still at least *equally* important; and the due qualifications for the attainment of them should be subject to the same jealous scrutiny now as ever. And I must still consider it a most glaring reproach to us to send out, as we annually do, a host of *Bachelors of Arts, profoundly ignorant of the most common principles of Science.*

Nor can it be said that an increased attention to matters of Science (especially when some previous preparation is secured) would in any way *interfere* with the due prosecution of other Studies, or make too great inroads on the *time* of Students already occupied to the full, when we consider the lamentable idleness in which too large a proportion of our Undergraduates waste the short portion of the year during which they reside in the University; in pursuits too often vicious: but if innocent, or even desirable in themselves, yet such as *might* be followed *elsewhere*, and which therefore must be followed *here* to the *neglect* of those which are *proper to the University*.

But how much more forcibly might such con-

siderations be urged, if the University system, by extending its range of studies, offered a fair choice under each department, and gave due encouragement even to the lowest attainments; and the Student had not to allege, that he was driven into idleness, because the one or two limited tracks to which he is restricted are unsuited to his taste or capacity: and that since he cannot do enough for a Class, it is useless to attempt any thing?

But besides the importance of keeping in view the principles of our established Academical constitution, and adhering to the model of past times, we cannot but derive from the circumstances of the *present age* the most powerful arguments for the necessity of increasing attention to the promotion of Physical and Mathematical Science. Scientific knowledge is rapidly spreading *among all classes* EXCEPT THE HIGHER, and the consequence must be, that that Class *will not long remain* THE HIGHER. If its members would continue to retain their superiority, they must preserve a real *preeminence in knowledge*, and must make advances at least in proportion to the Classes who have *hitherto* been below them. And is it not a question, whether the same consideration does not in some measure apply to the ascendancy and stability of the *University* itself?

NOTES.

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Of the attendance on Public Lectures in former times, some mention will be found in the Memoir prefixed to Bradley's Miscellaneous Works, Oxford, 1832. pp. xxxviii. and xcix.

In a pamphlet of considerable interest, entitled, "On the alleged Decline of Science in England: by a Foreigner;" London, 1831, ascribed to Dr. Moll; some remarks occur on our Universities, in the course of which the author candidly owns, that these institutions appear of so particular a nature, and so differently constituted from those with which he is acquainted, that it would be unwise to hazard an opinion on them. He however goes on to say, "it is generally understood, that there are Mathematical and Astronomical Professors both at Oxford and Cambridge, who seldom or never lecture, and who often do not reside at all at the University. I am possibly blinded by continental prejudice, but to me this appears a glaring abuse, which elsewhere would call for a speedy remedy."

Perhaps the learned writer would be more surprised to be told, that these Professors *do sometimes* lecture to an audience composed of half-a-dozen persons, or less: but to collect so many is a rare event: and that not only does the governing part of the University take no measures for remedying the abuse, but that the very Professors themselves make repeated applications to have

the system altered which occasions the evil, but to no purpose. It is but justice, however, to mention the happy occurrence of one very recent instance to the contrary, which may be hailed as a presage of improvement. The Head of one College has enjoined upon his Undergraduates an attendance on a Course of Experimental Lectures, and has secured it by an examination. This is indeed a step of great importance; but it is merely the act of an individual, and applies only to one College. Partial as it is, it must be productive of incalculable good: it is only remarkable, that such a plan should not have been systematically practised long since generally throughout the University, and extended to other subjects also.

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As I hope these pages may fall into the hands of some readers out of the University, it may not be superfluous to give a brief sketch of some parts of the system referred to in the text.

The actual course of sciences prescribed by the ancient institutions of the University will be understood on consulting the Corpus Statutorum, Tit. IV. Sect. i. §. 2. et seq. These enactments relate to the different Public Readers and Professors, their times of reading, and who are to be their auditors. Our principal concern however, at present, is with the *subjects* on which it thus appears to have been the intention of the University that all students should be employed. Many members of the University even, at the present day will be a little surprised, perhaps, at the extent of the enumeration, of which the following is an abstract.

For the first year of the Undergraduate's residence are prescribed Grammar and Rhetoric. For the second and thenceforward to the B.A. Degree, Logic and Moral Philosophy. From the commencement of the third year to the completion of the first year after the B.A., Geometry, which (see Appendix Stat. p. 29.) includes Trigonometry, Arithmetic, and Algebra, Geodæsy, Mechanics, and the theory of Music. From the commencement of the third year also till the M.A. Degree, the study of Greek is enjoined.

From the first year after the B.A. till the Degree of M.A. the subjects are to be Natural Philosophy, Metaphysics, History, Hebrew, and Astronomy: which last (by a reference to the same clause as in the Geometry) is understood to embrace besides Astronomy, properly so called, Gnomonics, Geography, the theory of Navigation, and Optics.

Of the distribution or order of these subjects, it will not be necessary to say any thing, nor to consider whether they embrace precisely such a course as we should chalk out at the present day. But what I wish to insist upon is, the distinct recognition of the *principle of a comprehensive course of the liberal Sciences*, as the appropriate employment of Scholars in the faculty of Arts.

The Candidates for the Degrees of B.A. and of M.A. were enjoined to undergo a Public Examination in the subjects on which they had been thus respectively engaged, with the addition of Philology and Latin Composition.

"Artes autem seu Scientiæ in quibus examinandi

erunt, sint illæ ipsæ, in quibus, et quatenus seu quousque, per Statuta Academicæ, Lecturas audivisse tenentur."

..... " Neque vero in Philosophicis solis (intra quos fines stetit angusta superioris Seculi Eruditio) verum etiam in Philologicis instituatur Examen," &c. *Corpus Stat.* Tit. ix. Sect. ii. §. 1.

This Examination, let it be observed, applies to *all* Candidates, and leaves no discretionary power in the Examiners to *dispense with* any of the subjects. And the form of the testamur is very explicit,

" A. B. per vel coram me (die mensis) examinatum (prout Statuta requirunt) in *singulis Artibus seu Scientiis* quas et quatenus per Statuta audivisse tenetur, laudabiles progressus, et pares ei gradui quem ambit fecisse comperio:" &c. Ibid. §. 2.

The causes which in process of time reduced this Examination to a mere form, might perhaps be traced, but are not material to our present purpose.

In the Statute of 1800, introduced for the purpose of remedying this state of things, the scheme was tried of a separate Examination for honours. With respect to the *ordinary* Examination, we here for the first time perceive the introduction of that pernicious principle, the power of *dispensing with any of the Sciences*, which are still enumerated nearly in the ancient form.

" Artes autem, seu Scientiæ, in quibus examinandi erunt, sint hæ quæ sequuntur; scilicet, Pro Gradu A.B. Grammatica, Rhetorica, Dialectica, Moralis Philosophia, et Mathematices ac Physices Elementa.

" Pro Gradu B.J.C. Grammatica, Rhetorica, Dialectica,

Moralis Philosophia, Historia, Jurisprudentia, et Mathematices ac Physices Elementa.

" Pro Gradu A.M. Mathematice, Physice, Metaphysice, et Historia. Quibus etiam pro hoc Gradu adjiciatur Lingua Hebraica.

" Cæterum quod ad hæc attinet, quæ huc usque pro unoquoque Gradu designata sunt, *Examinatoribus liberum esto quemlibet Candidatum vel in hisce universis, vel in aliqua parte horum* (*prout ipsis satius visum fuerit*) *examinare.*" Addenda Corp. Stat. p. 119.

The same principle pervades all the later forms of the Statute, though the subjects are more *compendiously* enumerated.

" Instituatur igitur examen in Rudimentis Religionis, in Literis Humanioribus, et in Mathematicarum Scientiarum et Physices Elementis: et in examine cujusque Candidati is ordo servetur.

..... " Ceterum quod ad Literis Humaniores et Mathematicorum Scientiarum et Physices elementa attinet, Examinatoribus liberum esto quemlibet Candidatur vel in hisce universis vel in aliquâ parte horum (prout ipsis satius visum fuerit) examinare: Modo ut Dialecticæ ratio habeatur, et ut tres isti scriptores Græci et Romani semper adhibeantur." *Ibid.* p. 161.

This last quotation is from the *amended* Statute of 1806, to the other provisions of which I will refer presently. But the effect of these Clauses is evident: from the moment they were enacted, the whole course of the Scholastic Sciences was virtually destroyed, and the three Classics with Logic became the sole essentials

of Academical study; to which Euclid might be added at the option of the Candidate.

The Statute of 1800 first introduced the system of public honours, awarded to those who distinguished themselves in a separate Examination held specially for this purpose, distinct from the ordinary Examination for the Degree of B.A. The range of subjects was enjoined to be the same as in the ordinary Examination; but here there was no dispensing power: the following express provision shews how carefully the ancient principle was adhered to in this Examination, though discarded in the other:

"Neminem vero in alterutram harum schedularum referri volumus qui aut Literas Humaniores, aut *aliquam ex Artibus seu scientiis*, in quibus examinandus fuerat manifesto neglexerit, utcunque ceteros Candidatos ex reliqua post se longe post se reliquerit." *Ibid.* p. 124.

The first Class, or "Qui se Examinatoribus Publicis *maxime* commendaverunt," was limited to twelve, and arranged in order of merit; but without any distinction of the departments in which they excelled. The second Class designated in like phrase, with the substitution of *egregie* instead of *maxime*, was unlimited in number; and those who obtained a place in either Class were exempt from many forms and exercises.

It was found, however, during the trial of five years, that no second Class was ever formed, and the first never amounted to more than four individuals. Thus, notwithstanding all the stimulus of emulation on the one hand, and privileges on the other, Candidates

would not come forward. The Examiners experienced some difficulty in placing in their exact order, in one comparative scale of merit, Candidates who excelled, one perhaps in moral Science, another in Philology, and a third in Mathematics; the Examination too being all or chiefly vivâ voce. The generality of Candidates also felt, that there was a broad and dangerous gulph between the ordinary Degree and the Honours, which few had the courage to attempt to pass.

Each of these evils would have appeared to an ordinary apprehension to admit of no very difficult remedy. The first by distinction of departments, and by giving the *same* questions to all in each department, and *therefore* in writing; and the second by making only one Examination for all, and classifying *every* Candidate.

Instead of this, by the Statute of 1807, one single department, viz. the Mathematical, was separated from all the others: but since the order of merit was abolished, and the alphabetical substituted, this separation was quite uncalled for: as far as it went, however, the principle was good. The strict injunction of vivâ voce was compatible only with the alphabetical arrangement, and the union of the Class and pass-men was inefficient, without a classification of the pass-men. But great difficulties and opposition were encountered in making these changes, and more particularly a jealousy was felt on the part of Colleges, lest there should be some unfair play with their men: and the check to this was imagined to consist in the vivâ voce system. To this absurd jealousy, therefore, all other advantages were

sacrificed. It will not be necessary to enter into a detail of the evils arising out of these causes, under which the University has ever since been labouring.

In each of the *two sole* divisions of Academical study, the standard of course was gradually and enormously raised. Hence *division of labour* both among *Candidates* and *Examiners* became indispensable. The Classical studies flourished extensively: the labour of the Examiners became insupportable: the separation of three Mathematical Examiners in a distinct School, reluctantly granted by the Statute of 1825, was an excellent step, had it only been adopted in other departments also: but without it Examiners were not to be found.

At length, after more than twenty years of continual complaint and dissatisfaction; after repeated testimonies of the most able and experienced Examiners that the system could not go on; after the most violent and tedious discussions, and several abortive attempts; the Statute of 1830 made a notable change, in which the main feature is, that the grand indispensable principle which had all along been contended for as the sole safeguard of the true Academical character of the Examination, the adherence to which had been the chief, perhaps sole, cause for the introduction of the system of 1807, and the alphabetical arrangement, the absolute requisition, namely, of the *vivâ voce* method, as the *essential portion of the Examination*, this vital principle was at length greatly modified in *theory*, and *totally abandoned* in *practice*. In the Mathematical School, the "integrum tempus" of those who are com-

pelled to *sit* is thus reduced to very agreeable limits.

This grand obstacle being now removed, it does not appear what difficulty remains to hinder a recurrence to the old and just principle of the original Examination System; and which had been ably advocated by two of the anonymous writers who kept up so memorable a paper war during the stormy period of the discussions previous to the Statute of 1830; as well as approved by many whose opinion is entitled to great consideration.

The labour of the Examiners has doubtless been abridged by the sacrifice of the principle of vivâ voce; and by the union of the Mathematical Examiners in the general work. A very trifling improvement has also been made on the system of classification, in the institution of four Classes: but these radical difficulties remain untouched; viz. first, *the extreme invidiousness of the task of deciding upon the absolute admission or rejection of a Candidate into or from a given Class;* and, secondly, *the difficulty, without any means of qualifying the decision by a graduated scale, of fairly assigning the relative value of acquirements in so many different branches*, as are included under the Literæ Humaniores, in order to fix the *absolute standard* for the Classes. The first of these evils being felt in a tenfold degree in the *Mathematical* School, from the peculiar nature of the subject, whilst the latter is peculiar to the Classical. And, thirdly, the inefficiency of all means of inducing Candidates of inferior pretensions to come forward, the lower Classes even with the new

addition of a fourth being still shunned as a degradation, rather than sought as a distinction. This applies to the fullest extent in the Mathematical School; though not to so great a degree in the other.

The system of examining all Candidates together by printed questions on paper has cleared the way: it only remains to make a further subdivision of departments; to oblige every Candidate to appear somewhere in each department; and to subdivide the Classes to such an extent as is obviously called for by marked differences between the performances of the Candidates.

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The following table contains a view of the numbers of those who obtained Mathematical honours of all Classes in each year, from the commencement of the system to the last year, compared with the whole number of those who passed.

	Number of Candidates.	
Year.	Passed.	Obtained Mathematical Honours.
1807	22	6
1808	163	12
1809	144	14
1810	152	11
1811	153	15
1812	153	9
1813	182	14
1814	180	14
1815	169	9
1816	163	15

1817	181	12
1818	225	20
1819	218	11
1820	225	11
1821	271	15
1822	279	20
1823	280	12
1824	295	8
1825	258	12
1826	284	15
1827	314	20
1828	259	16
1829	303	14
1830	273	16
1831	279	22

On these data the reader is at liberty to adopt what mode of calculation he pleases; but in any way, the result stated in the text will be fully substantiated. If we take, for instance, the averages of the two periods of twelve years prior to 1831, it will be found that the proportion in the first period may be stated in round numbers as about *one* in *thirteen;* in the second, it is not more than *one* in *twenty;* and in 1831, when we have the addition of the fourth Class, the ratio is still barely *one* in *thirteen.*

Page 9.

The Statute of 1830 is in many respects a retrograde movement: especially so in regard to the pass-examination in Mathematics. The language of all the former

Statutes was simply and generally " Mathematicarum Scientiarum et Physices Elementa." But in the present instance, though this phrase is retained in one passage, yet when the Statute proceeds more specifically to the subject of Examination, the choice is limited, and the Examination must be " in quatuor ad minimum Euclidis Geometriæ libris." Thus the Candidate is precluded from choosing any portion of Natural Philosophy, unless he *also* goes through some propositions of Euclid. Under this absurd and discouraging restriction it was yet considered by the Examiners as well to try what could be done in encouraging the Candidates, who might know something of those subjects, to bring it to bear, and accordingly a paper of very elementary general Physical questions, together with some on Algebra, &c., was appended to those in Euclid. This plan afforded the result, (at least in the two first Examinations under this system,) that out of the whole number of Candidates, though a certain portion had " got up" the four books of Euclid, not more than two or three could add Vulgar Fractions, or tell the cause of day and night, or the principle of a pump.

Page 21.

It is a point which can hardly be contested by any one who will consider the matter dispassionately, that the suggestions stated in the text as to the system of the Mathematical and Physical Examinations, contain the only practicable method by which the study of this department can *at once* be made *general* among the Candidates, and those of *all* degrees of ability be each encouraged to do

his *best.* This has been long since seen and acknowledged by all those who have been engaged in the Mathematical School for several years past. These individuals have continually addressed memorials to the Heads of Houses, in which they have *gradually* suggested the several points which have more lately received the sanction of *the body of Examiners* of last year.

A memorial from the Mathematical Examiners, June 9, 1828, adverted to some of the minor evils, and urged the necessity of a complete separation of the two Class lists. Another of December 6, 1828, went further, and dwelt more explicitly on the necessity of a scale of honours more accordant with the real merits of the Candidates. This was further urged, and the liberty of making discretional subdivisions asked for, in a memorial of April 2, 1829. A distinct proposition in favour of an arrangement in order of merit, signed by both the then Examiners and their predecessors, was sent in November 11, 1830. Lastly, came the representation of the Examiners, *both Mathematical and Classical*, of December 1, 1831, and which was subsequently printed, with their reasons in support of it, urging the same considerations generally. These repeated testimonies, coming from all those who have successively filled the office, ought to have settled the question. And at present it is believed, that a large portion of the Members of Convocation are disposed to support the recommendations of the Examiners. The last representation of the Examiners was discussed by the Heads of Houses, who, on the 30th of January, 1832, came to the re-

solution, that "the Examination Statute having been so recently enacted, it is not at present expedient to propose to Convocation any alteration in its details."

As soon as this resolution was communicated to me, (then one of the Examiners,) I lost no time in sending in my resignation, conveyed in a letter to the Vice-Chancellor, which I requested might be laid before the Heads of Houses, containing an explicit statement of my convictions as to the absolute necessity of those changes in the system which had all along been contended for by the Mathematical Examiners, and which I have advocated in the foregoing pages. The latter part of the letter was as follows: "I trust I may be permitted without offence to add the strongest expression of my conviction, that the general and total neglect of the elementary studies of Mathematical and Physical Science, *as an essential part of a liberal education,* is a most glaring defect in the system pursued in this University; the removal of which is loudly called for by the circumstances of the age, and the existing state of knowledge around us; and that it can only be effected, and might be so to the full extent desired, by *requiring of every Candidate* for a Degree to shew at his Examination a knowledge of *some portion* of *Physical or Mathematical Science;* and by adopting in this department a *graduated* scale of honours, in which the name of *every* Candidate should appear from highest to lowest."

I will add no comment on the suggestion I thus presumed to make, trusting that such comment is sufficiently supplied throughout the whole of these pages.

Page 23.

So great has been the advance of *correct* principles and *moral feeling* among us of late, that I must entreat pardon for bringing into notice so flagitious a sentence as the following.

" Cum menti humanæ ad vires suas et facultates explicandas nihil magis incitamento sit quam *honesta æmulatio;* cumque istiusmodi æmulationem publica quadam observantia et indulgentia, quasi præmiis in medio positis, *accendi quam maxime et foveri æquum sit;* Statutum est, &c." *Addenda Corp. Stat.* p. 121.

This, it should be observed, is an avowal of the principle on which our legislators in 1800 thought themselves warranted in proposing their profane scheme of Examinations for honours, and arrangement in order of merit.

It may be necessary to inform the non-Academical reader, that the objections here glanced at were actually and seriously advanced, in the various discussions on the Examination system, and by some eminent members of the University.

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As an illustration of the low views of Mathematical Science prevalent in this place, I cannot help quoting an expression from the very classical inscription on the Monument lately raised to the memory of a distinguished ornament of this University; and not less so from his Mathematical than from his other attainments: ..... " qui quum in auditorio domestico Ædis Christi,

elementa Matheseos, *ceterasque eruditæ antiquitatis* disciplinas, scienter tradidisset," &c. Incidental expressions are often strong testimonies to prevalent feelings; and in this instance, of such as I cannot pass without a remark. The implication that the deceased taught Mathematics *as a branch of ancient learning*, is surely neither *correct* in point of *fact*, nor *just* to the memory of one who lectured both in Algebra and Newton's Principia; and was perhaps the first who studied and recommended the modern analysis in Oxford.

Nor is it more happy as to the implied approbation of the principle, that Mathematical Science is to be regarded either as a mere medium of education, or as a department of literature, deriving its force not from demonstration, but from antiquity. I do not know who wrote the inscription.

I have here all along adverted to the studies proper to the junior portion of the University, and referring to the mere qualifications for the Degree of B.A. Much might be said on the subject, taken in a more extended point of view, and in relation to the pursuit of Mathematical Science and Physical investigation in the University. Here indeed a variety of causes operate to discourage such studies: but none more so than the deficiency in elementary instruction in these branches, and the absence of any general diffusion of a taste for them, or of any interest which might be taken, or congenial feeling excited, in regard to those who may be engaged in such pursuits. It is not that there is wanting a spirit of the most munificent liberality in

coming forward to support institutions for the promotion of Science, such especially as the Mathematical Scholarships thus founded in 1830, or other plans having like objects in view: but that the University does little towards the actual progress of Scientific discovery, and that these pursuits are regarded as of a separate class distinct from the regular objects of Academical studies: and it must be considered how deeply seated in what has become the very constitution of the place, are the causes which lead to this result. Allowing for the operation of those causes, the University has evinced a disposition to encourage Science. But it is to those causes themselves that I am desirous of directing attention, and to the suggestion of means for their removal. This will alone tend to secure a due cultivation of Science on its proper Academical basis, and to advance the utility and reputation of the University equally in these departments, as in all others which properly come within the scope of its system.

THE END.

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