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The Cambridge School of Mathematics

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THE

MATHEMATICAL GAZETTE.

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THE CAMBRIDGE SCHOOL OF MATHEMATICS.

CAMBRIDGE is honoured this year by its selection for the first meeting held in England by the International Congress of Mathematicians. The Cambridge School has played a notable part in the development of mathematics in Britain, and it may be of interest if I briefly summarize the leading facts of its history, which is indeed closely connected with that of the University. The School is of more than respectable antiquity and inevitably it has been sometimes flourishing and sometimes the reverse. Here I desire rather to bring out the salient features in its history than to discuss details or individual achievements.

The Medieval Period.—The University is among the oldest in Europe, having been founded about the close of the twelfth century. Its medieval curriculum and studies were much the same as those of other Universities of the time, and there is no need to describe them in this paper.

The Renaissance Period.—The modern development of the University begins with the Renaissance, which was warmly welcomed in Cambridge and was accompanied by a distinct development of mathematical teaching. I date the origin of its Mathematical School from this movement, and the first chapter of the history of the School may be said to cover the sixteenth

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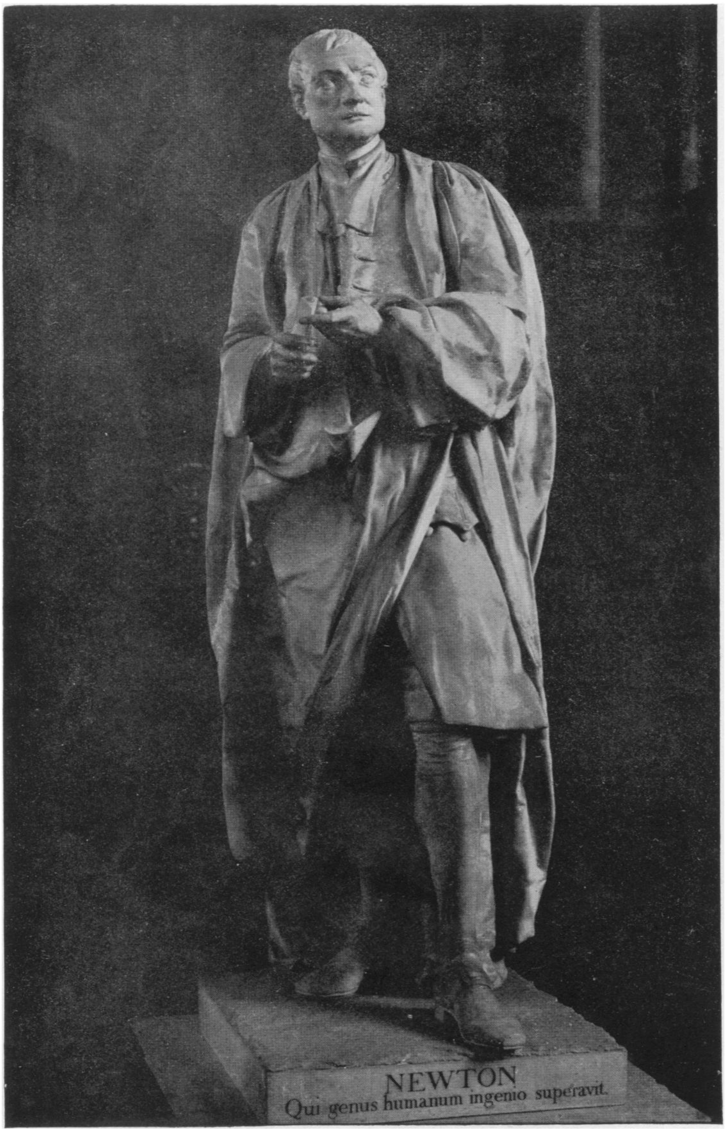

"... Newton with his prism and silent face,
The marble index of a mind for ever
Voyaging through strange seas of Thought alone."
WORDSWORTH, *The Prelude*, III.

Facing p. 311.

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and the early years of the seventeenth century. It is true that, during the greater part of this period, no notable advance in the theory of the subject was made at Cambridge, or indeed in Britain—the first important British discovery in mathematics being that of logarithms, published by Napier in 1614—but it is worthy of remark that all the leading English mathematicians of the sixteenth century were educated at the University, and this fact even though their principal work was done elsewhere may justify my treating Cambridge as being then an important centre of mathematical teaching.

Among the earliest of these sixteenth century Cambridge students I chronicle, in passing, the names of Cuthbert Tonstall, 1474-1559, Robert Recorde, 1510-1558, John Dee, 1527-1608, and Thomas Digges, *circ.* 1530-1595, as representative writers of the time. A trifle later we come across Edward Wright, *circ.* 1558-1615, and Henry Briggs, 1561-1630, both of whom graduated in 1581 and subsequently accepted posts in London. Of these, Wright was a well-known authority on the theory of maps and navigation, and Briggs introduced the decimal notation as an operative form. The general adoption of logarithms was largely due to the efforts of the latter, and it was only the early death of Wright that prevented his sharing in the work. Towards the end of the period we find three men of greater mark in John Pell, 1611-1685, John Wallis, 1616-1703, and Seth Ward, 1617-1689. Much of their work was produced after the middle of the seventeenth century, and away from Cambridge, but it was there that they were made acquainted with and became interested in the subject. Was mathematics then widely studied in the University? It is difficult to say. Wallis, writing in 1635, when still in his teens, says mathematics "were then scarce looked upon as academical studies ... and among more than two hundred students ... in our college, I do not know of any two ... who had more of mathematics than I ... which was then but little ... for the study ... was at that time more cultivated in London than in the Universities." On the other hand, about 1639 we read that Ward had "brought mathematical learning into vogue in the University ... where he lectured his pupils in Master Oughtred's *Clavis*"; Pell, too, was teaching at Cambridge about this time, and his repute was such that he was asked by the authorities at Amsterdam to accept a mathematical chair there.

It will be noticed that the writers hitherto mentioned are now chiefly known by their work after they had left Cambridge. The explanation is that until this time the instruction in the subject in the Colleges was in general slight, while that in the University was carried on by young regent graduates under medieval conditions. In 1597 chairs of Geometry and Astronomy, under the

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will of Sir Thomas Gresham, were established in London, and in 1619 Sir Henry Savile founded chairs on the same subjects at Oxford; other mathematical professorships had been founded even earlier on the Continent. These permanent and honourable posts attracted the best men, and the most brilliant students at the beginning of the seventeenth century—such as Briggs, Pell, Wallis, and Ward—were thus induced to leave for other Universities. It seemed as if there were no career for a mathematician at Cambridge.

The prosperity of a School with no established body of teachers is necessarily precarious, and, at the best, interest in the subject must be intermittent. Thus, when about 1641 the ablest mathematicians had left Cambridge, the study there flagged. At Oxford, where Ward and Wallis held chairs, and at London, it was otherwise: indeed it was from meetings in those cities that the Royal Society arose. The re-establishment of the supremacy of the Cambridge School was due to the influence of Newton, and the wide recognition of the value of his work.

The Newtonian Period.—At the Restoration there was a general rearrangement of things academical as well as political. Just at that time, in 1663, a professorship in mathematics was founded at Cambridge, and this promoted a revival of interest in the subject. Isaac Barrow was the first occupant of the chair. His lectures—on the principles of the subject, geometrical optics, and properties of curves—are extant, but to his disappointment the attendance at them was small. He was however fortunate in having among his pupils Isaac Newton, in whose favour, in 1669, he resigned the chair, thus securing to Newton, when still under twenty-seven, the opportunity to prosecute and promulgate his discoveries.

It so happens that we know the exact course of reading pursued by Newton in his student days, and the line of his early investigations. The former shows what text-books were then available to students, and by way of parenthesis I describe it. Newton came into residence in 1661, when just under the age of nineteen, ignorant of mathematics, and with no intention of taking up the subject. At a Fair at the beginning of term he chanced to buy a book on Astrology, but his ignorance of Geometry and Trigonometry prevented his understanding it. Thereupon he bought Euclid's *Elements* and Oughtred's *Clavis*, both of which he mastered with ease. He then bought Descartes's *Geometry*, which he read, though with considerable difficulty. So far he had had no assistance, but he now definitely took up mathematical studies, and (presumably) worked under Barrow's directions, reading Kepler's *Optics*, Vieta's *Works*, Schooten's *Miscellanies*, Wallis's *Arithmetica Infinitorum*, and again Descartes's *Geometry*.

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He graduated in January, 1665 (N.S.), and was then free to follow his own inclinations. Within the next two years he laid the foundations of much of his future work. He enunciated or used the binomial theorem in April 1665, direct fluxions in November 1665, his theory of colours in January 1666, inverse fluxions in May 1666, and later that year convinced himself that gravity was the force that kept the planets in their orbits, for "in those days," he wrote later, "I was in the prime of my age for inventions." Probably he took pupils, and his note-books were open to them. In Cambridge his reputation was already established.

Newton was elected professor in 1669. His lectures for eighteen out of the first nineteen years of the tenure of the chair are extant. They are chiefly concerned with algebra (universal arithmetic), optics, and astronomy. They were given once a week for one term in the year and each lasted about half an hour, being dictated* as rapidly as his audience could take it down. More important than his formal lectures was the fact that he was accessible to students during two hours on two days every week in term, and on one day every week in vacation when in residence: it was then that he explained difficulties and amplified his exposition. He had exceptional command over the processes of geometry, algebra, and fluxions, but I venture to say that he valued mathematics chiefly as a means of attacking physical problems, and that it was to his theories of geometrical optics, light, and gravitation that he specially desired to attract the attention of his followers.

I need not treat of the publication of his works and the gradual acceptance of his theories. In Cambridge his views were, from the beginning, generally adopted. It was no doubt a tribute to his reputation that a second mathematical chair—devoted to Astronomy and Experimental Philosophy—was founded in 1704; and that in 1710, Lady Sadleir endowed various College lectureships on Algebra and its applications.

I note in particular among Newton's pupils the names of Roger Cotes, 1682-1716, and Robert Smith, 1689-1768, who occupied in succession the Plumian Chair, and Brook Taylor, 1685-1731; and as representatives of the School in England, the names of David Gregory, 1661-1708, Humphry Ditton, 1675-1715, Abraham Demoivre, 1667-1754, and Colin Maclaurin, 1698-1746. The School started with everything in its favour, but its early promise was not fulfilled. It is well known that most bitter feelings were aroused in the controversy whether Leibnitz, before developing the Calculus, had obtained the fundamental ideas of it from Newton or had originated it independently. One result of

*In the Library of Trinity College there is a manuscript volume by Cotes, which probably represents notes thus taken down.

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the quarrel was the separation, under a keen sense of injustice, of British mathematicians from their continental contemporaries. Intercourse and exchange of views are essential to vigour, and the more varied the outlook and training of those concerned, the more fruitful is the intercourse. The self-inflicted isolation of the Newtonian School sufficiently accounts for its rapid decadence. The effect was intensified by the manner in which its members confined themselves to geometrical demonstrations. If Newton gave geometrical proofs in the *Principia*, it was because their validity was unimpeachable, and since his results were novel, he did not wish the discussions as to their truth to turn on the methods used to demonstrate them. But his followers long after the principles of the Calculus had been accepted, continued to employ geometrical proofs whenever it was possible. No considerable body of important discoveries were made by them after his death, which we may accordingly take as marking the end of this period in the history of Cambridge mathematics.

The Eighteenth Century.—During the century following the death of Newton, the work produced at Cambridge was unimportant. There were already two professorships in mathematics: additional chairs were founded, one in 1749 by Thomas Lowndes in Astronomy and Geometry, and another in 1783 by Richard Jackson in Natural and Experimental Philosophy and Chemistry. Most of the professors were however undistinguished, and indeed but little interested in the subject. Then, and well into the following century, a mathematical chair was often regarded only as a prize or a means of securing leisure, and at best, merely as offering a position where a man could pursue his own researches undisturbed by other duties. Notwithstanding this, Cambridge remained the centre of mathematical studies in Britain. Teaching in the subject was excellently organized, and the number of students in it steadily increased. This was due partly to the immense influence exerted by the Colleges and by "Pupil-mongers," but in the latter half of the century is mainly attributable to the development of a rigorous system of examination in mathematics which for a long time formed the chief avenue to University distinctions.

To a foreigner the maintenance of a School by such means must seem paradoxical, but Collegiate Universities, like Oxford and Cambridge, are complex institutions. Every student of the University was a member of a College; it was from his College or from private teachers that he obtained instruction, and it was to his College that he looked for reward and encouragement. The University did not teach him, and beyond seeing that he kept certain statutable exercises for his degree, did little for him. The most important of these exercises were "acts" (theses, and disputations on them), which had to be kept shortly before the

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degree was conferred; the men being admitted to their degrees in an order corresponding roughly to their performances. At the close of the seventeenth century these theses were usually on philosophical questions, the subjects being proposed by the candidates and approved by the proctors or moderators.

It was necessary to prepare carefully for these acts, which made considerable demands on the ability and readiness of candidates. This preparation was the business of College tutors and pupil-mongers, who directed the studies of their pupils for the purpose. The exact status of these pupil-mongers is not known, nor is it certain how far and for what consideration they took pupils outside their own Colleges, but even though we do not know the exact conditions under which they worked, we shall not be far wrong in describing them as private tutors or "coaches." College tutors and pupil-mongers, whether mathematical or not, were deeply impressed by the system of philosophy expounded by Newton, and probably by the end of the seventeenth century it was not unusual to require students to make themselves acquainted in general with his conclusions. Bentley's lectures in 1696 indicate this tendency, and two years earlier, in 1694, Richard Laughton of Clare, the best known pupil-monger of the time, induced a student to submit a thesis on a subject connected with the *Principia*. The younger tutors soon went further, and under their influence mathematics became a usual subject for study: most likely, however, mainly with a view to its applications, and not as an instrument of education. In 1710 the movement had developed so far that Laughton, presiding in the Schools as proctor, persuaded a student to keep one act (out of three) on a strictly mathematical question, and this soon became the customary course.

The normal academic course before the first degree lasted three years and a half. We possess courses of study drawn up by two well-known tutors of the period, showing how this time might or should be occupied. They illustrate what an important part in it mathematics already played. Thus Daniel Waterland of Magdalene, in 1706, gives the following as a normal course of reading in "philosophical studies": in the first year, Arithmetic, Euclidean Geometry, Algebra, Logic, Geography, and Trigonometry; in the second year, Conic Sections, Mechanics, Easy Astronomy, Physics (Rohault), and Philosophy (Locke and Cheyne); in the third year, Elementary Optics, Law and Political Science (Grotius and Puffendorf), Ethics, and Theology; and in the last half-year, Optics, Astronomy, and Metaphysics. Students who continued in residence and studied mathematics further were then advised to read Newton's *Principia*, Ozanam's *Cursus*, Sturmius's *Works*, Huyghens's *Works*, Newton's *Algebra*, and Milne's *Conic Sections*. Text-books were recommended; in later editions they

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were altered, but no material changes were introduced in the course, which was current for half a century. A somewhat similar scheme of study was sketched out in 1707 by Robert Green of Clare, who was deemed an old-fashioned teacher. He recommended his pupils to spend their first year in the study of Classics; the second on Logic, Ethics, Arithmetic, Algebra, Geometry and Corpuscular Philosophy; the third on Analytical Geometry and Natural Science; the fourth on Logarithms, Trigonometry, Fluxions and Infinite Series, Mechanics of Solids and Fluids, and Astronomy. Statements published, widely circulated, reprinted, and not criticized at the time, must be received with respect, but I think these courses represent ideals rather than actual performances, and I cannot believe that either of them was often taken in its entirety by ordinary students. For the range of knowledge implied we cannot rely entirely on the text-books then current, for mathematical tutors, at that time, as later, often used manuscript commentaries embodying traditional methods of proof thus handed on from one generation to another. At a later period the use of such manuscripts became a normal part of the teaching, and this lasted to a time well within my own memory.

From the earliest days the proctors had the power, though the opportunity was not always used, of questioning a candidate at the end of a disputation, but the language used was Latin. Shortly after 1710 there were some difficulties in conducting the exercises and, to give an opportunity of comparing the men, the proctors and moderators summoned all the candidates to the Senate-House, and there publicly examined them, questions and answers being given in English. The advantages of the scheme were so patent that it was retained, and by 1730 may be considered to have been definitely established. With the introduction of an examination of all candidates together, closer attention was paid to securing a strict order of merit, and more confidence was felt in the published order. The Senate-House Examination, later known as the Mathematical Tripos, was partly on philosophy and partly on mathematics, but the latter soon became the essential part. By 1750 the examination had extended to two days and a half. In 1763 the traditional rules for conducting it took definite shape, and the previous disputations were used chiefly to get a rough preliminary order. About 1770 the answers were given in writing, and it was now frankly recognized that the examination was strictly competitive. About 1790 some of the more important papers of questions were printed. In 1799 a pass standard was introduced, and by this time the final Tripos order was settled only by the examination. An important part of the system consisted in papers of problems on all the subjects then read, and designed to encourage originality.

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In the latter half of the century the examination had become a contest carried on under strict rules in which success was keenly sought. The publication of the final class list was one of the chief events of the year. Success in it was regarded as the crown of the academic course, and brought with it, in the shape of a fellowship, an immediate competence and a reasonable prospect of an assured career. As a high place in the final list meant so much to a successful candidate, a class of private tutors arose who made it their special business to prepare their pupils for it. They are the successors of the pupil-mongers of an earlier period. The earliest indisputable instances I can quote are those of John Wilson, whose name is still known by its association with a proposition in the Theory of Numbers, and Robert Thorp. The latter is described, about 1761, as being "of eminent use to young men in preparing them for the Senate-House Examinations and peculiarly successful." And it was added that "one young man of no shining reputation with the assistance of Mr. Thorp's tuition had stood at the head of wranglers." In a grace of the Senate, passed in 1781, it is stated that almost all sophs then resorted to private tuition, and for more than a century subsequently, the practice was well established. These were the men who really directed the reading of the students. Even non-residents, if reputed to be successful coaches, drew pupils. Thus John Dawson, a medical practitioner in the Lake District, regularly prepared pupils in the vacations for the Senate-House Examination, and at least eleven of the senior wranglers between 1781 and 1800 are known to have studied under him.

As I have already remarked, the contributions of the Cambridge School to the progress of the subject during the last three quarters of the eighteenth century were unimportant.

The Nineteenth Century.—The prominent features of the history of the Cambridge School of Mathematics during the nineteenth century are the further development of the system of coaching and the confinement of the subjects studied to those scheduled in the Tripos regulations, accompanied by a striking revival of interest in the subject, and the appearance of a remarkable group of mathematical physicists.

During the early years of the century the evil consequences to the School of its isolation and its use only of Newtonian methods were recognized. Under the influence of Robert Woodhouse, George Peacock, Charles Babbage, and John Herschel, text-books, characterised by a free use of analysis, were produced, and in 1817 the symbols of differentiation were introduced in the papers set in the Senate-House Examination; thenceforward analytical methods were especially cultivated. But the desire to apply mathematics to the problems of the external world soon became apparent, and the physical researches to which I allude later

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will always be regarded with pride as a remarkable feature in the history of the University. Until the last quarter of the century, mathematics remained the dominant study of the place, and for many years the number of undergraduates, reading the subject at any one time, rarely fell short of three hundred.

During this century Cambridge continued to be the principal, though not the sole, centre of mathematical studies in Britain. There were already three professorships in the theory of the subject. In addition to these a chair of Pure Mathematics was founded in 1863; one of Experimental Physics, with a Laboratory attached, in 1871; and one of Mechanism and Applied Mechanics (for Engineering), with a Laboratory and Shops attached, in 1875. Further in 1882 five University Lectureships were established at the expense of the Colleges. But, save in Experimental Physics and Engineering, professors, distinguished though many of them were, were as little in touch with undergraduates taking the normal course as their predecessors in the eighteenth century. In 1849 a Board was appointed to supervise mathematical studies, and it was hoped that one effect would be to bring the professors into closer touch with students, but in this it failed, and throughout this period Cambridge remained almost unique in having a number of eminent mathematical professors with whom the great majority of the mathematical students before graduation were wholly unacquainted; this was not the case in other faculties in Cambridge. During the last twenty years of this century students who continued to read the subject after graduation began, under College pressure, to come in touch with the professors and University lecturers. Still, had there been no chair of mathematics in the University it is probable that the history of the School would have been practically unaltered, all undergraduate teaching having been in effect given by College lecturers and private tutors. The advance of knowledge is a primary duty of professors, but their influence is rarely effective unless they are also active and fairly efficient teachers.

Early in the nineteenth century the Senate-House Examination was confined to mathematics, and became technically known as the Mathematical Tripos. Throughout the century constant efforts were made, with reasonable success, to keep the subjects of examination abreast of the times, and especially to encourage the reading of mathematical physics. Until 1882 the course before the first degree lasted about three years and a half. After 1882 it lasted three years, but a second examination was held in the following year for students who had specialized in higher subjects selected by themselves. To cover in this time the subjects before graduation demanded strenuous and continuous work. It is easy to pick holes in any elaborate scheme, but it may fairly be said that the system ensured a thorough and

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accurate grounding in all the then usual branches of mathematics and their ordinary applications, and that by the time of their first degree men who had gone through it were well equipped to take up higher studies or research, if their inclinations led them that way, while in any case they had had a severe logical training which was an excellent preparation for professional careers. On the other hand, it was objected that the incessant polishing of the instruments to be used later was as weary as it was unnecessary, that the mental discipline was too severe and too narrow, and that an examination test gave unreasonable encouragement to the cultivation of rapidity, while the straining to combine conciseness with accuracy disturbed the due presentation of the subject. Be this as it may, the Tripos and its regulations dominated the situation, and Cambridge mathematics and mathematicians of the nineteenth century were the direct product of the system. Judged by the output, I do not think it can be said to have resulted in failure; and may-be Cayley, Sylvester, Adams, Green, Stokes, Kelvin, and Maxwell—to mention no others—were none the worse for having been compelled to study seriously subjects other than those in which they were most interested.

From its foundation a distinctive feature of the Tripos had been the production of a list arranged in order of merit of those who passed, and for most of the time this feature had been highly prized. Towards the end of this period the maintenance of this order became a subject of controversy. That it ensured a thorough grounding and wide reading, compelled industry, and that the men were placed and could be placed in proper order according to the conditions of the examination was not denied. It was however urged that competition necessarily led candidates to attach undue importance to the order in the final list, thus inducing them to work too hard and to confine their reading within the limits of the schedules of the Tripos, and that its retention brought out exactly those results to which objection was taken, as stated above. Finally, but not until 1909, order of merit was replaced by an alphabetical arrangement in classes.

A remarkable feature of this period was the fact that until the closing years of the century, nearly every student read with a private tutor, and that two or three private tutors obtained in succession almost a monopoly of the direction of the studies of advanced honours students. Thus William Hopkins, 1793-1866, in the twenty-two years from 1828-1849, had among his pupils 175 wranglers, of whom 17 were senior, 44 in one of the first three places, and 108 in one of the first ten places. So again Edward John Routh, 1831-1907, in the thirty-one years from 1858-1888, had between 600 and 700 pupils, most of whom became wranglers, 27 being senior in the Tripos and 41 Smith's

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prizemen. To organize teaching on this scale demanded rare gifts.

Perhaps it may be of interest to describe, by way of example, the general features of Routh's system. He gave catechetical lectures three times a week to classes of eight or ten men of approximately equal knowledge and ability. The work to be done between two lectures was heavy, and included the solution of some eight or nine fairly hard examples on the subject of the lectures. Examination papers were also constantly set on Tripos lines (book-work and riders), while there was a weekly paper of problems set to all pupils alike. All papers sent up were marked in public, the comments on them in class were generally brief, and, to save time, solutions of the questions were circulated in manuscript. Teaching also was supplemented by manuscripts on the subjects. Finally to the more able students he was accustomed, shortly before their Tripos, to give memoirs or books for analyses and commentaries. The course for the first three years and the two earlier long vacations covered all the subjects of the Tripos—the last long vacation and the first term of the fourth year were devoted to a thorough revision. Of what is called cramming there was no trace; Hopkins and Routh might say that a particular demonstration was so long that it could not be required in the Tripos, but none the less they expected their pupils to master it. The system had faults, but at any rate it was under Hopkins and Routh that nearly all the best-known representatives of Cambridge mathematics in the nineteenth century were educated. The effectiveness of teaching of this kind was dependent on intimate constant personal intercourse, and the importance of this cannot be overrated. The scandal of the system consisted in the fact that the men were compelled to pay heavy fees to the University and Colleges for instruction, and yet found it advantageous to go elsewhere at their own expense to get it. During the last quarter of the nineteenth century College lecturers began to share with the Coaches the general direction of studies. Post-graduate work has also to some extent been brought under the influence of professors and University lecturers—these not uncommonly suggesting subjects for dissertations for fellowships, Smith's Prizes, etc. But the students thus influenced are not numerous, and it still remains true that the majority of mathematical undergraduates are so out of touch with the professors in the subject as to be unacquainted even with their personal appearance.

I have already alluded to the brilliant achievements of the Cambridge mathematical physicists of this period. The beginning of this movement may be traced to Airy and his contemporaries, it was developed by Green, and we may consider it definitely established by the labours of Stokes, with whom I associate the

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names of Kelvin and Maxwell, their experiments being combined with mathematical investigations. Maxwell's work at the Cavendish laboratory has been carried on by Lord Rayleigh, Sir Joseph Thomson, and numerous investigators working there under them—the teaching and inspiration here being directly due to the professors. The resulting School seems to me to be the direct successor of the Newtonian School of the seventeenth century, and I do not doubt that were Newton here now it is with the Cavendish laboratory that he would wish to be particularly associated. But this branch of Cambridge mathematics is still making history, and therefore I content myself with only a brief reference to it. This work is, I think, the most striking achievement of the School during last century; I may also mention, as directly due to it, the production of a large number of excellent text-books, and in recent years some valuable work on the fundamental assumptions and principles of pure mathematics.

The Present Period.—In this article I have not unnaturally avoided mentioning the work of those who fortunately are with us to-day, and for similar reasons I do not propose to say anything about the progress of the School in the opening years of the twentieth century. The reconstitution in 1909 of the Tripos, and the destruction of many of the distinctive features of the former scheme must profoundly modify the future history of mathematics at Cambridge, and perhaps the long-continued efforts to bring students into closer touch with professors and lecturers may be at last crowned with success. The change in the Tripos regulations has been accompanied by a curious alteration in the popular subjects, and to-day but few of the young graduates who desired the change are interesting themselves in those branches of applied mathematics once so generally studied, but rather are turning their attention to subjects like the Theories of Functions and Groups. It is too early to say whether this is only a passing movement.

By way of supplement to the foregoing account, I append a list of those who have held the various University chairs and lectureships. In a collection of portraits of mathematicians which I possess, I have likenesses of nearly all the holders of these posts, and shall be pleased to show them to any Members of the Conference who may care to look at them.

W. W. Rouse Ball.

The *Lucasian Professorship of Mathematics* was founded in 1663 by Henry Lucas. The successive occupants of the chair have been: Isaac Barrow, 1664-1669; Isaac Newton, 1669-1702; William Whiston, 1702-1711; Nicholas Sanderson, 1711-1739; John Colson, 1739-1760; Edward Waring, 1760-1798; Isaac Milner, 1798-1820; Robert Woodhouse, 1820-1822; Thomas Turton, 1822-1826; George Biddell Airy, 1826-1828; Charles Babbage, 1828-1839; Joshua

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King, 1839-1849; George Gabriel Stokes, 1849-1903; Joseph Larmor, 1903 *et seq.*

The *Plumian Professorship of Astronomy and Experimental Philosophy* was founded in 1704 by Thomas Plume. The successive occupants of the chair have been: Roger Cotes, 1707-1716; Robert Smith, 1716-1760; Anthony Shepherd, 1760-1796; Samuel Vince, 1796-1822; Robert Woodhouse, 1822-1828; George Biddell Airy, 1828-1836; James Challis, 1836-1883; George Howard Darwin, 1883 *et seq.*

The *Lowndean Professorship of Astronomy and Geometry* was founded in 1749 by Thomas Lowndes. The successive occupants of the chair have been: Roger Long, 1750-1771; John Smith, 1771-1795; William Lax, 1795-1836; George Peacock, 1836-1858; John Couch Adams, 1858-1892; Robert Stawell Ball, 1892 *et seq.*

The *Sadlerian Professorship of Pure Mathematics* was founded in 1863 from a benefaction given in 1710 by Lady Sadleir. The successive occupants of the chair have been: Arthur Cayley, 1863-1895; Andrew Russell Forsyth, 1895-1910; Ernest William Hobson, 1910 *et seq.*

The *Cavendish Professorship of Experimental Physics* was founded in 1871 by the University; the laboratory attached being built at the expense of the then Chancellor, the Duke of Devonshire. The successive occupants of the chair have been: James Clerk Maxwell, 1871-1879; John William, Baron Rayleigh, 1879-1884; Joseph John Thomson, 1884 *et seq.*

The *Professorship of Mechanism and Applied Mechanics*, with laboratories and shops attached, was founded by the University in 1875. The successive occupants of the chair have been: James Stuart, 1875-1890; James Alfred Ewing, 1890-1903; Bertram Hopkinson, 1903 *et seq.*

Five *Lectureships in Mathematics* were created in 1882 under the directions of Royal Commissioners, and subsequently two others tenable, if desired, with one of the above, were founded. The successive holders have been: Joseph John Thomson, 1884; Andrew Russell Forsyth, 1884-1895; William Herrick Macaulay, 1884-1887; Richard Tetley Glazebrook, 1884-1898; Ernest William Hobson, 1884-1910; Joseph Larmor, 1885-1903; Richard Pendlebury, 1888-1901; Henry Frederick Baker, 1895 *et seq.*; Augustus Edward Hough Love, 1898-1899; Hector Munro Macdonald, 1899-1904; Herbert William Richmond, 1901 *et seq.*; George Ballard Mathews, 1903-1905; James Hopwood Jeans, 1904-1906, 1910-1912; John Gaston Leathem, 1905 *et seq.*; Robert Alfred Herman, 1906 *et seq.*; Edmund Taylor Whittaker, 1905-1906; Thomas James I'Anson Bromwich, 1909 *et seq.*; John Hilton Grace, 1910 *et seq.*

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