

**MATHEMATICS AT YALE.**

**An Excellent Past and a Progressive Present.**

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A steady growth from the first and a very rapid development in the last ten years are the features of the history of the Department of Mathematics at Yale.

In the old days a single professor taught both Mathematics and Natural Philosophy, but in 1836, by the election of Professor Stanley, Mathematics had a chair of its own. When Professor Stanley died in 1853, Professor Newton, although only twenty-five years of age, was appointed to fill the vacancy. For more than forty years, that is, till his death in 1896, the Department was under Professor Newton's vigorous and progressive administration. During this time the Department increased from one professor and two tutors to a staff, in the Academic Department, of five professors and four instructors, and in the Sheffield Scientific School, of two professors and four instructors,—a total of seven professors and eight instructors. In the Academic Department are Professors Gibbs, Richards, Beebe, Phillips, and Pierpont, and the instructors are Messrs. Strong, Westlund, Hawkes, and Sellow. In the Sheffield Scientific School are Professors Clark and Smith, and the instructors are Messrs. Starkweather, Lockwood, Marshall, and Granville.

The instruction in the undergraduate department may be considered first. In looking over the course of study followed half a century or more ago, one is surprised at first sight to observe how small the change is when compared with that which has taken place in the Department of Natural Sciences. In 1836, the year of Professor Stanley's appointment to the chair of Mathematics, the Freshmen studied Day's Algebra and Playfair's Euclid. In the Sophomore year Euclid was finished and Solid Geometry, Plane and Spherical Trigonometry, Logarithms, Mensuration, Conic Sections, Surveying, and Navigation were taken up. In the Junior year Astronomy was required, and Fluxions (the Calculus) was offered as an optional.

**CHANGELESS FORMS.**

These studies are largely what are given to-day. The reason why so little change has been necessary is to be found in the fact that Mathematics is not only one of the oldest sciences, but also the most exact. Geometry received from the Greeks a form so perfect that later generations can add but little. The Elements of Euclid and the Conics of Apollonius of Perga still enjoy the admiration they excited twenty centuries ago. And this is true, though to a less degree, of the other branches of Mathematics,—Algebra, Trigonometry, Analytical Geometry, and the Calculus, the youngest of which was venerable before many of the sciences which crowd our college curriculum of to-day were born.

But, even under these circumstances, changes have been taking place in undergraduate instruction in Mathematics. Perhaps the most radical has been the introduction of the Calculus into the Sophomore year. To effect this, the course of study in this year were divided into two part. The first is the traditional course in Mensuration, Surveying, and Navigation, under the charge of Professors Richards and Beebe. The second, under Professor Phillips, embraces Graphic Algebra, Analytical Geometry, and the Calculus. The advantages derived from this radical change are obvious. Students who wish to make an extended study of Mathematics or Physics and Astronomy will reach the Junior and Senior years prepared for much more advanced work than hitherto. For these students advanced courses are now offered in Algebra and Analytical Geometry, Higher Analysis and Higher Geometry, the last two being really graduate courses. In addition a course of much more advanced character than ever before is given in the Differential and Integral Calculus.

**GRADUATE INSTRUCTION.**

The development of instruction in Mathematics in the Graduate School is as radical and as extensive as in any of the other departments. In the first announcement in 1847 of the courses in the newly founded Graduate School, or, as it was then called, the Department of Philosophy and the Arts, the only course in Mathematics was one offered by Professor Stanley on the Calculus and Analytical Mechanics. On Professor Stanley's death, Professor Newton offered for a number of years "such branches of higher mathematics" as might be "agreed upon with the student." In 1860 the lectures were divided into three sections, of which Mathematics and Physics formed one. Professor Newton had charge of the Mathematics, and his courses were announced briefly as "Pure and Mixed Mathematics." Professor Loomis had charge of Astronomy.

The year 1871 is memorable in the annals of this Department, as it marks the entrance of Professor Gibbs into the school as Professor of Mathematical Physics. He offered the Theory of Wave Motion, Capillarity, and the Potential Function. The number of courses offered by him soon grew, and they now form a stately series of lectures covering nearly the whole range of Mathematical Physics, an object of just pride to all the friends of Yale.

In the same year Professor Newton offered the Calculus, Statics, Dynamics of a Particle, Lunar and Planetary Theories, and Higher Geometry. These remained, with an occasional change to courses on shooting stars and meteors, and the Calculus of Probabilities, the subjects he taught till his death. In 1873 the department received the addition of Professor Clark's instruction, who began to lecture regularly on Definite Integral, Differential Equations, Determinants, Analytical Mechanics, Numerical Approximations, and Least Squares.

**A STORY OF GROWTH.**

Since then the Department has been steadily growing. In 1884 Professors Beebe and Phillips began to give graduate instruction, the former turning his attention to Geodesy and Practical Astronomy, while the latter devoted himself to Geometry, Curve Tracing, and Map Projection. Professor Phillips inaugurated a movement at Yale which has been so successfully carried out in Germany. It has been his constant effort, by the construction of geometrical models and machines, to render graphic and geometrically intuitive many results of advanced geometry and the theory of equations. The collection of mathematical models and machines, has gradually grown under his ceaseless activity to be one of the largest in the country.

Some details may give a more exact notion of the field covered by the Department in the last few years (1896-98). Professor Gibbs, besides his lectures in Mathematical Physics already alluded to, gives courses in Vector Analysis, with its application to Geometry, Astronomy, and kindred subjects, and an advanced course in Multiple Algebra, which embodies for the most part his own investigations in this direction. It is deeply to be regretted that this author, who is so widely and favorably known abroad for his epoch-making researches in Thermodynamics, does not publish an account of his ideas and methods in Multiple Algebra.

Professor Clark lectures at present on Determinants, Theory of Equations, and Differential Equations; Professor Phillips on Advanced Calculus; Professor Barney on Geodesy and Practical Astronomy, and Professor Beebe on Comparison of Orbits and Practical Astronomy and Surveying.

Professor Pierpont devotes himself to the analytical side of pure Mathematics, and has given courses on Introduction to Higher Analysis, Substitution Theory, Galois' Theory of Algebraic Equations, Functional Theory of Real and Complex Variables, Elliptic Functions, Linear Differential Equations, Modular Functions, Theory of Continuous Groups, and Theory of Numbers. Finally Professor Smith, representing Modern Geometry, has given, since his return from Europe in 1896, Differential Geometry, Modern Geometry of the Plane and of Space, Algebraic Curves and Surfaces, and the Theory of

Transformations of Space. In this latter course the theory of Lie's continuous groups play a dominant role.

**CHANGE IN THE METHOD OF TEACHING.**

With this influx of new and thoroughly modern courses, a change in the method of teaching has been made. Instruction, which in the older days was often limited to directing the reading of the students and explaining difficult passages, is now given entirely by formal lectures. The seminary method, which is so efficacious abroad in training young men to be independent thinkers and investigators, has replaced the old custom of solving ingeniously devised problems of more or less trivial nature, which we inherited from England, and which the Mathematical Tripos still unfortunately fosters there.

In close connection with the seminary is the Mathematical Club, founded in 1877 by Professor Giggs. This is one of the prominent features of mathematical life at Yale. The fortnightly meetings, held in the Sloane Laboratory, are largely attended, and the number of papers to be presented exceeds the limits of the time. Two series of papers were, among others of miscellaneous character, on the program for the Fall of 1898: one on the relation between our intuitional and analytical notions of a curve, the other on hypercomplex numbers, of which the well-known quaternions are a type.

An important factor in the education of students of Mathematics at Yale is found in the recently equipped seminary library rooms. Two pleasant and conveniently situated rooms have been set apart for this purpose, and friends of the Department, by donation of money and books, have provided a well-equipped and thoroughly modern departmental library. There are separate drawers and shelves for the books and papers of the students. These rooms are forming a central place of meeting for students in the Department, and everything is done to this end, in the belief that the daily intercourse of students among themselves has an educational value of great importance.

**YALE TEXT-BOOKS.**

Yale has always stood for an educational force; its professors have not only done their part to advance science by original contributions, but they have in an unusual degree helped to make science accessible by writing excellent text-books. This has been particularly true in Mathematics. At the commencement of the century Yale had taken a prominent position in this respect. The mathematical series of Professor Day, afterwards President of the College, had a widespread popularity. The series prepared by Professor Loomis numbered fifteen volumes, and embraced not only Pure Mathematics, but its application to surveying, navigation, and astronomy, as well as a treatise on the allied subjects of Natural Philosophy and Meteorology. It is safe to say that over one hundred thousand copies of these books have been sold. This fact makes comment on their value superfluous. The tradition so early established is being continued. A short time ago, at the request of Messrs. Harper and Brothers, Professor Phillips undertook to prepare a new series of text-books on Algebra, Geometry, Trigonometry, Analytical Geometry, and the Calculus, which are to be fully abreast of the best methods and advances in the science. A characteristic feature is the admirable photogravures of the figures of Solid Geometry, made from models in this subject belonging to the Yale collection. The constant efforts of Professor Phillips, already referred to, to derive all possible benefit from our geometrical intuition by the help of models, is thus bearing fruit in a new and broader field.

The *Scientific Monthly* has announced that a gold medal of the value of twenty dollars will be offered for the best article on some scientific subject, written by an undergraduate of the Scientific Department. This has become possible through the kindness of Professor Chittenden, who gives the medal this year. The main object of this offer is to stimulate undergraduates in all courses to write on science and for the *Scientific Monthly*.

**HARVARD-YALE FIGURES.**

**A Letter From Dean Briggs of Harvard on the Comparison.**

To the Editor of YALE ALUMNI WEEKLY:

Sir:—As a constant reader of the YALE ALUMNI WEEKLY, I am interested in the Yale and Harvard statistics on the first page of the WEEKLY for March 1st. I understand that, in each study, the method of computation (for Harvard, at any rate) was to multiply the number of undergraduates in every course by the number of hours of instruction given per week, and then to add the products. As Professor Morgan points out, our two half-courses in Military Science, each offering three hours of instruction a week for a half-year, contained respectively 146 and 99 students. Thus, according to the YALE ALUMNI WEEKLY, 245 students, each having what amounted to an hour and a half of instruction in Military Science throughout the year, got a total of 367 hours of instruction in Military Science. This is an entirely fair way of reckoning, yet may need explanation. If Yale is said to give 14 hours of instruction in Military Science and Harvard 367, it seems at first to mean a much greater discrepancy than really exists in the amount of instruction offered. Obviously, the fact is that a very much larger number of students elected Military Science at Harvard than at Yale.

Again, as regards Ancient Languages and Mathematics, the fact that those studies are prescribed at Yale, and not at Harvard, is evidence that more importance is accorded to them at Yale than at Harvard; yet it is not evidence that more hours of instruction per week are given to them, unless we accept, as a definition of an hour's instruction, an hour's instruction to one undergraduate.

The statistics of the WEEKLY are clear, when the unit of computation and the relation of the elective system at Yale to the elective system at Harvard are clearly understood. Unless these things are clearly understood, a reader might easily be misled. I do not know whether misleading him would lead him toward Yale or toward Harvard; and my letter, like your statistics, is meant to be wholly non-partisan.

Sincerely yours,  
L. B. R. BRIGGS.

Harvard College,  
Cambridge, March 6th, 1899.

**Resignation of Prof. Hoppin.**

On Monday, March 13th, Professor James Mason Hoppin announced his resignation from the Professorship of the History of Art in the Yale Art School, thus closing a period of thirty-eight years of continuous service in the work of the University.

Professor Hoppin was graduated from Yale at the age of twenty years, in the Class of Forty. After graduation, he studied Law at Harvard and Theology at Andover, and afterwards in Berlin University, Germany.

After his return to America he became pastor of a church in Salem, Mass., where he remained for ten years.

In 1861 he was made professor of Homiletics and the Pastoral Charge in the Yale Divinity School. He occupied this position for eighteen years, finally resigning in 1879 to accept the professorship of the History of Art in the Art School.

During his life Professor Hoppin has published several books. Among them are "Notes of a Theological Student"; "Old England: Its Scenery, Art and People"; "Office and Work of the Christian Ministry"; "Life of Rear-Admiral Andrew Hull Foote"; "Memoir of Henry Armit Brown"; "Homiletics"; "Pastoral Theology"; "Office of the Ministry"; "Sermons on Faith, Hope and Love"; "The Early Renaissance, and other Essays on Art Subjects," and "Greek Art on Greek Soil."

E. Layton DeForest, 1900 S. will be married to Miss Margie D. Bliven, on Wednesday, April 12. Among the ushers will be John F. Archbold, '99 S.; John H. Inman, 1900 S.; John C. Greenleaf, '99 S.; and Eliot Cutter, 1900 S. Mr. DeForest and his bride will sail for Europe on Wednesday, April 19.