MASSACHUSETTS INSTITUTE OF TECHNOLOGY

ANNUAL REPORT

OF THE

PRESIDENT AND TREASURER,

DECEMBER 13, 1899.

BOSTON:
ROCKWELL AND CHURCHILL PRESS.
1900.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

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PRESIDENT AND TREASURER,

MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

The President's Report for last year included a list of military records of Institute men who had service in the Spanish War. In view of the impossibility of securing complete information at that time, a separate pamphlet has since been prepared, and will be mailed on application.

January, 1900.

BOSTON:
ROCKWELL AND CHURCHILL PRESS.
1900.

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Communications should be addressed to the Secretary of the Institute.
(See page 16.)

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To the Corporation of the Massachusetts Institute of Technology:

The inauguration of presidents in four neighboring New England colleges has been the occasion for *ex cathedra* utterances regarding the educational problems of the time. The new heads of universities have made solemn declarations of facts and principles, have stated their projects for college government and their conception of the great educational task which they are undertaking, and they have been favored with the advice of their fellow-presidents. The gatherings have been very large, and the whole educational corps has been animated with a sense of the intimate connection between all institutions of learning.

It seems fitting, in taking note of these events, to pass in review our own place in the educational work of the institutions of our country, and to see what share of the advice or comment we can apply to ourselves.

The following points are most worthy of our attention: a college president describes the older days, when the curriculum was intended to contain all the studies necessary for a liberal education, and draws a picture of the good fellowship of the students united in the accomplishment of a simple common task, and he speaks of the development of professional schools as the first of the disturbing elements which complicated the problem of college education. The study of principles and of the methods of inductive science, which the professional schools soon established as their chief work, awakened dissatisfaction with the college curriculum, and the impossibility of teaching everything in four years led to an elective system in colleges. The president of Yale gives a very frank statement of what he calls the dangers and evils of the present system of university instruction, and among them he places loss of *esprit de corps*, and he makes a very

interesting comparison between the academies at West Point or Annapolis and the modern college, giving the following description of the military and naval students: "A homogeneous body of men pursuing a common scheme of studies with a common end in view, and with rigorous requirements as to the work which must be done by each individual. In the modern American college the community of interest is less, the community of hard work is very much less. If this college spirit once passes away, the whole group of qualities known by the name of college democracy is in danger of passing away also."

While desiring to place before you the especial province of the school of applied science, and to make some comparison with that of the college, and using the words quoted as a text to introduce the subject, it would be ungenerous towards the courageous speaker not to point out that the above passage should be interpreted by the whole body of his discourse, and that it formed the prelude to admirable statements of projects for education in manhood and citizenship.

It is a part of our duty as the governing body of this institution to consider how our task and our opportunities may differ from those of other branches of higher education, and I think that we may begin by congratulating ourselves, not upon the superiority of our management, but upon the fact that our task is made a relatively simple one by the character of our students. They come to us with the purpose more or less well defined of taking some share in the achievements of this age of scientific progress; we educate them to this end, and send them out into the world equipped to do certain kinds of work. Whether such an education is not also a general and a liberal one is a question which will be alluded to later. Such a body of students is of necessity homogeneous, for the known fact that this course of study is arduous and demands a mind trained to mathematical discipline operates a selection before entrance, while a prescribed curriculum and a mature understanding of the application of the

studies to professional work lead the students to strive constantly towards a common goal.

Esprit de corps in college is succeeded in after-life by the professional spirit with its declared standard of honor and distinctness of purpose, so that in the civil as well as in the military professions men are bound together, and form a disciplined element in the community.

About ninety per cent. of our graduates are at present following some branch of applied science, and they constitute a considerable fraction of the body of professional men, thirty thousand or more, who are actively occupied with the work for which they were educated, and who are taking a large part in transforming methods of conducting old industries and enriching the country by introducing new ones, as has been done so successfully for chemical manufacturing in Germany. A glance at the present modes of directing work in construction, manufacturing, or engineering shows a strong contrast with the wasteful processes of the earlier part of the century, when the opportunities for a scientific education were rare.

The most important American scientific schools began to be established during the period 1835–1870, and they were the first for the Anglo-Saxon race, since those in England, except mining schools, have followed ours. Before that time some of our engineers were trained in France and Germany, most of them picked up what education they could in an office, and the West Point Military Academy was the only place where a systematic engineering education was given. Among the officers who left the army soon after graduation from West Point somewhat more than half took up some scientific occupation, and the proportion is somewhat larger after long military service, but it is a mistake to suppose that even in those early days a large proportion of our engineers received its admirable training.

The following are the numbers taken from General Cullum's biographical notices: Twelve hundred cadets were graduated at West Point between 1802 and 1843, and of these two hun-

dred and fourteen took up, during some period of their lives before 1867, often a very short time, some occupation related to civil engineering, becoming contractors, surveyors, railroad superintendents, teachers of mathematics, etc. It is plain that civil service was, as it should have been, usually subordinate to military duties, and I cannot refrain from speaking of the testimony borne to the value of the education at our national military academy by these biographies, and of the solemn impression left upon the mind by the perusal of the brief records of early death upon the field or of the long military service of twelve hundred cadets. It can only be compared to a visit to a soldiers' graveyard.

Any institution whose fixed course of studies maintains a high educational standard and strengthens a distinct purpose till it is settled for life is doing its true work as a professional school. The college of to-day seems to be accepting another task as its most important function: that of directing and giving play to scholarly and social tastes, and if we may trust the passage above cited, it is still in search of the most satisfactory methods.

The task of the university which undertakes to direct both systems is a very large one, and it may be well questioned whether it is not too large for a single administration. This opinion usually prevails in Europe, where the professional schools of science have been given an independent existence, and the present year marks an epoch in their development, since the great Polytechnic School of Charlottenburg has acquired the right to give the degree of Doctor of Philosophy. This step was taken by special intervention of the German Emperor after active opposition from the University of Berlin. The next step seems likely to be the attempt to establish a diploma for applied science, to which the university degree shall be preparatory.

In this part of our country, where the resources of the state are sparingly employed for higher education, the choice has not been free, and it has usually been a matter of necessity to utilize small funds to the best advantage by adding scien-

tific branches to college studies, and most of our scientific schools have so grown up under the shelter of a college. They have often been organized by men outside of the college, and in some instances their early history has not been a story of tender nurture by their alma mater, although at present our universities are proud of the growth of their schools of applied science and consider them an integral part of their system. Some of these schools have gained during their youthful experience a habit of taking care of themselves which has been decidedly to their advantage, since their faculties and trustees have acquired and maintained a considerable share of independence of action.

Our northwestern states have undertaken university education at public cost and on a liberal scale, and the universities have grown with great rapidity. All branches of higher education have been united under a single management, and the size, the strength, and the completeness of its university are matters of pride to the state. The unity of administration is promoted, at least in theory, by putting its control in the hands of a small board of regents appointed by the Governor or elected by the people. These are men of prominence whose influence is potent in presenting budgetary and other interests to legislatures. The president and faculty usually take the initiative in the appointment of professors and instructors. We find in the state universities departments of law, medicine, engineering, and more rarely of architecture, and frequently our own courses have served as models for teaching applied science. Some of the universities founded since 1865 by private endowment have also given from the beginning equal place to the applied sciences and to the academic departments.

Such have been the circumstances amid which our important scientific schools have been developed, and generally attached to a university. The pioneer among them, however, the Rensselaer Polytechnic Institute at Troy, has had no such support, and our own school with its larger programme has been fortunate in finding at Boston a centre of educational enterprise ready to aid and sustain an institution striving to

find new means of satisfying new demands. The founder of this school and his successors have laid these problems before you, the governing body. You have aided in the solution, and have helped to bring new questions before the whole community, and we are now enjoying the fruits of our independent existence and of the undivided attention of our Faculty and Government to an educational scheme more simple than that of our universities, while the reputation of the school is built upon the unhindered devotion of Faculty and students to a distinct and high professional ideal in education.

Some allusions have been made to the differences between foreign institutions and those of the United States, and it is worth while to say a few words regarding an American institution which scarcely exists elsewhere, namely, the trustees or lay government of educational establishments in this country. It is often supposed that all the oldest universities of Europe were in the hands of the clerks, as was the case at Paris and Oxford; but the earliest of all, in Italy, were schools of law and medicine, and were more democratic than any which have been known since. They were governed by students who hired their professors, told them what to teach, and decreed fines, and even the death penalty for neglect of duty. To-day in Europe the selection of teachers and the introduction of new studies are the province of the ministry of public instruction, and such questions are consequently dealt with by a permanent board of experts. In America groups of citizens have taken upon themselves to decide the most intricate educational questions; boards of trustees have received charters from the states conferring upon them various degrees of authority for the government of our universities. Usually they have complete control of financial affairs, but often the President and Faculty have considerable power in the appointment of teachers. These lay bodies confer degrees after examinations by the Faculty, and occasionally they have abused their privilege to confer the honorary degrees of M.D. and Ph.D. without examination.

The founders of colleges have been moved sometimes by

recollections of their scholarly days, but more often by the generous desire to provide for others privileges which were lacking in the arduous time of their youth. Men in the hurry of a business life have been mindful of the tastes and wants of the abstruse scholar; and schools of applied science have been founded and sustained by directors of our great enterprises who had little schooling themselves, or whose college course was restricted to classical studies. These citizens have well understood the needs of their time and country; in some cases they have formulated[1] them with signal distinctness and good judgment, and have called upon men of learning to carry out their plans. This conjunction of circumstances has been most favorable when innovators in education, like Rogers and Walker, have met men like John Cummings and others who have participated in the government of this school, and carried on an enterprise with faith and constancy through many evil days. Such governing bodies, unlike ministries of education abroad, have frequently been obliged not only to decide upon new courses of study, but also to pay for them from their own pockets, and each demand has met with a generous response not only from those of our own government and from our alumni, but also in a very remarkable way from men quite unconnected with the Institute who have put their wealth in your hands for distribution without reserve or restriction. It is easy to understand that the expenditure of funds under these conditions should be made with the shrewdness of the best business methods, and economy of production is one of the most notable features of American institutions of higher education, and is sometimes in strong contrast with those of Europe. Former reports have alluded to the attention which American methods of education in science have attracted in Europe, and again this year we have received visits and requests for information from persons charged with the establishment of schools of applied science in England, in Germany, and in Russia.

The citations in the beginning of this report have been

[1] See letter of Abbott Lawrence reprinted in "Engineering News," 1892, 460.

used to call attention to the contrasts which exist between the training of the scientific school and that of the college. During the thirty-four years which have elapsed since the foundation of this school two systems of education have progressed along divergent roads, and, curiously enough, it is now only a portion of the colleges and the schools of applied science which have been faithful to certain scholastic traditions which have been wholly or in part abandoned by many of the colleges. Professional requirements have compelled us to establish complete courses of graded and interdependent studies leading to a degree of bachelor of science, and, although we cannot say, as was said of the old degree of bachelor of arts, that it testifies to the attainment of all liberal knowledge, we can affirm that a student who has ascended step by step through such a course has received mental training which sends him far on the road to a liberal education, and that he has received the best guidance in the art of using one piece of knowledge to learn another.

The school of applied science is with reference to general studies intermediate in position between the college and those law and medical schools which require collegiate preparation for entrance. These professional schools can assume that their students have had the requisite general culture, and confine their teaching exclusively to professional subjects.

Our students are of collegiate age, usually with high-school preparation, and for them a strictly professional course would be too narrow. Our single degree of Bachelor of Science is intended to mean that a student has not only been taught facts and methods, but also that some attention has been given to the literary presentation of ideas, and that he has such an acquaintance with the range of modern thought as will show him where to look farther for general culture. No attempt can be made to enable him to explore in the original language those noble documents which have preserved the genius and learning of the past, and the great branches of ancient languages and literature so important in university studies find no place in our curriculum. Philos-

ophy is also omitted. The remaining groups under which university studies may be classed are taught to our students; namely, Modern Languages and Literature, including English; Mathematics; Chemistry; Physics; History and Political Science; Natural History; Architecture, and History of Art. The two latter subjects are treated as professional, and do not enter into all the courses. French and German are taught at the beginning of the course, so that the student can within the limits of technical studies make use of the languages as a Frenchman or a German does to acquire knowledge of facts; and such knowledge is required for use in many of the courses. The habit so acquired of freely using foreign languages opens the door to the enjoyment of modern literature. We have carefully guarded the time set apart for general studies like History, Literature, and Political Economy against the encroachments of professional subjects; but it is all too short to accomplish its object.

It must be frankly admitted that the old ideas about the relative dignity and precedence of studies have everywhere been abandoned, but questions of utility concerning the different branches of general studies are still under consideration, and these are more easily settled in a scientific school than in a college, because the declared purpose of the student is more definite. It is not, however, to these matters that reference was made in speaking of old traditions, but rather to the prescription of curricula made under the assumption that a teacher, or rather a council of teachers, can offer the best plans for a symmetrical course of study. The heads of some of our universities, after long trial of the elective system, hold exactly the opposite opinion regarding the needs and desires of their collegiate students, and the results of complete freedom of choice are spoken of with unqualified approval. Moreover, it is a significant fact that no active discussion of these diverging points of view is now going on in educational journals, and earnest convictions favored by reasons of convenience and popularity are spreading the elective system through our colleges. It is not within our province to criti-

cise this policy as applied to colleges, except in so far as we are called upon to defend our own system against the opinion that we are giving the narrower, and the college the broader education. The classical studies are not within the compass of a four years' course for a degree of Bachelor of Science, but the degree of Bachelor of Arts is equally narrow, for it may be taken with few scientific studies, and, in fact, mathematics, the experimental studies, and particularly physics, are neglected in colleges where the choice is free, in a way to show that in this age of scientific achievements intellectual curiosity does not run parallel with the progress of the times. Science was more popular with literary men during the last century, when every one desired to be encyclopædic, and a picture of the times is given by Voltaire's stay with the Marquise Du Châtelet at Cirey, where the lady was publishing the philosophy of Leibnitz, and her friend paid his court by editing Newton's Principia.

Athletic sports are ever growing in importance and do much to establish the popularity of our institutions of learning. A football game was this year offered as part of the inaugural exercises of a western college, and advertisements of preparatory schools show woodcuts of the pupils on horseback, in boats, or on the football field. Such sports can never receive the same attention in this Institute that they have at present in the more leisurely college life, but it may be explained that it is not the severity of our studies, but rather the time consumed in laboratory work and in drawing which makes the successful pursuit of competitive athletics difficult. Exercises which should be enjoined on a sedentary student, were it necessary to lay injunctions, are less important for ours, who are kept on their feet a considerable portion of the school hours, but every one knows that gymnasium work is restful as well as pleasant after other active occupations, and time and opportunities are offered for such exercises even with our present gymnasium, which is looked upon as a temporary one. Reference will be made later to a project for the erection of

a new building which will doubtless give great impetus to interest in physical exercises.

The popularity of college life which is taking young men from their homes to live in college towns depends greatly upon its social side, and in small towns where the population is collegiate the direction of the social element — taking the word in its broadest sense — presents great importance and considerable difficulty. Perhaps the best results for Anglo-Saxon youth have been obtained in England, where those unique associations of teachers and students which form the colleges within the university, although founded originally as charities for poor scholars, have now established a most agreeable and instructive, though somewhat expensive, mode of living for the wealthy. These units of the university organization offer some of the safeguards and pleasant features of family life, and they serve to promote friendly rivalry in athletic sports within the university. In America athletic events are rarer. They take large proportions between universities, and suffer from publicity and from the intervention of the newspaper, often a disturbing element in modern education. Students dwelling together have established clubs here and elsewhere, which have nothing classic about them except their Greek-letter names, and which do not fulfil the offices of colleges. But when not too elaborate they form pleasant associations of young men with tastes and occupations in common, and they are small centres in which good fellowship and attachment to their institution have active sway. Our own position is far removed from that of a collegiate town, because students coming from abroad soon come in contact with the larger society of a city, and this is facilitated by the fact that nearly half of our students live in their own homes and doubtless introduce their comrades to them. It may be added that this fact does much to lessen the temptations incident upon residence in a large city.

A change is now taking place in our northwestern states which will tend, if it spreads, to shorten the time of residence in colleges and in institutions like ours. The citizens of

those states demand and obtain in many of the large towns a gratuitous advanced course in their high schools intended to be nearly equivalent to the freshman and sophomore years of colleges. The students can thus remain in their homes to complete a course which they regard as final, or go to college only for the last two years. It does not yet appear that this change has had any effect upon the time of entrance of our northwestern scholars, and it is probably more than counterbalanced by measures taken to keep them at home. The University of Michigan makes a reduction of fees for citizens of the state, and the rates are so low in all the state universities that students are less disposed to go abroad. [California offers free tuition, with alluring advertisements of cheap board, and the tuition at other state universities is from $15 to $30.]

It is impossible for our endowed institutions to compete in the price of tuition with those supported by public funds, nor does our policy at present tend in that direction. We are endeavoring to use the funds placed at our disposal, not to make education cheaper, but to make it more valuable. Each yearly report gives an account of new men and apparatus added to our means of education, and last year it was stated that the cost of educating a student greatly exceeded his tuition fee, so that, if he looks upon his professional training as an investment which should bring in a quick return in the form of a professional salary, the investment may be considered each year a better one. It is fully appreciated that our high tuition fee would place our school beyond the reach of worthy scholars, were it not that generous donors have within the last two years added largely to the scholarship fund, so that now an income of about $24,000 can be applied to providing free, or partially free, tuition, while important sums in addition to that above named can be used to aid the graduate work of advanced students and teachers.

Although special foundations for professorships have been a common form of donation, sometimes an embarrassing one when the fund has become inadequate, it is very rare that funds have been made available for the benefit of

members of the instructing staff prevented from performing active duties as teachers. Mr. Augustus Lowell, who has long studied the needs of our Institute, having been a member of the Executive Committee since its establishment sixteen years ago, has this year taken the initiative in the establishment of a fund which is intended to provide for this want. His letter, accompanying a gift of fifty thousand dollars, expresses the wish that this sum shall be the nucleus of a fund of which the income shall be used for the benefit of the teaching staff of the Institute in cases of illness, death, or retirement, subject to such regulations as the government may from time to time see fit to adopt. The donor has left the door open for others to associate themselves with him in this good cause by requesting that the fund shall have no personal designation, and it is earnestly hoped that the foundation proceeding from this generous nucleus will grow to be commensurate with that for scholarships.

It will be noticed that Mr. Lowell's gift is not called a pension fund, and that the only restrictions made upon its use serve to indicate a general purpose without hampering the freedom of action of our government. Our charter and our customs have given the Corporation, acting through its Executive Committee, larger powers than those possessed by most college trustees, and there is every reason to think that the Faculty will feel that their interests will be better cared for if no binding regulations are made at the present time. It does not seem necessary for us to make any rule until the fund has become larger, many cases have been dealt with, and customs established.

Steps have been already taken in other institutions to make the pension system part of the contract between government and teacher, in order to give greater security to the latter, and the idea is good; but the execution stumbles upon difficulties, chief among which may be named the impossibility of distinguishing by rule between qualities of work, and the difficulty of fixing for either side the time for terminating a service. The military system cannot be

applied in the same way to all colleges, because they differ greatly in the mode of appointment and continuance in office of their professors. Usually the question of the obligatory retirement at a certain age would be raised, and for us this would be a new issue which we are not called upon to deal with at present, and we may continue to hope that the Faculty will lose no professor until the professor has lost his faculties.

The Corporation has this year lost two of its members by death. Walbridge A. Field, Chief-Justice of the Commonwealth, was an *ex officio* member. Judge Field's high abilities and character would have been looked to for support in time of emergency; but, although he was acquainted with our work and took a friendly interest in it, his official duties prevented him from taking part in our deliberations.

Mr. Samuel Johnson was elected in 1897 a member of the Corporation and served on the Committee on Finance. His death deprives us of the counsels of a man whose fidelity and good judgment had caused his advice to be sought by many important enterprises of private and charitable business.

The Faculty has lost by death the head of the Department of Modern Languages, Prof. Alphonse N. van Daell, who was granted leave of absence to seek a health resort in Europe, and died at Wiesbaden after a very short illness, March 27, 1899. Dr. van Daell was a member of a distinguished Belgian family, and after accomplishing an extended course of study in the universities of Louvain, Liège, Paris, Bonn, and Berlin, he came to America in 1876, and held professional positions in our schools and colleges until, in 1886, he became director of the course in modern languages at the Boston High and Latin Schools. In 1889 he accepted the chair of modern languages in the Institute.

He made himself not only the master of our language, but also of our modes of thought, and took a keen interest in the affairs of his adopted country, so that he possessed rare qualifications for successfully imparting a knowledge of foreign languages and literature. Added to the accurate and wide

learning of a scholar was the intimate association with European life of an accomplished gentleman. His kindly interest in the students and his zeal and conscientious care made him an excellent teacher, while his genial qualities made his companionship agreeable and instructive to all who knew him, and his loss is deeply felt by his colleagues.

Walker Memorial Gymnasium.

A committee of nine members has been appointed by the Alumni Association to take steps to procure funds for raising a suitable memorial building for a gymnasium, and an encouraging interest in the undertaking has been shown by former students of the school, now numbering about six thousand. One of our principal buildings already bears General Walker's name, and the desire has been universal to perpetuate also in this new building the remembrance of his active and manly interest in the physical as well as the moral welfare of our students. It is hoped that the subscriptions will reach one hundred thousand dollars; and the plan of the committee will very probably include some accommodations for student reunions, and perhaps other social purposes.

The Buildings.

Considerable expense has been incurred this year in permanent improvements upon the Rogers and Walker buildings. Three fire-escapes of substantial design, in keeping with the outlines of the buildings, have been put up, and some changes of rooms are noted in the reports of departments.

A bronze tablet commemorative of the military service of General Walker was presented by the Commandery of Massachusetts of the Loyal Legion, and has been placed near the entrance door of the general library.

The principals and teachers of neighboring schools were invited to visit the Henry L. Pierce Building on the 14th of February, and the visitors were shown the rooms devoted to

architecture, biology, geology, and industrial chemistry, in each of which are new and interesting accommodations for science teaching.

Telephones. The Bell Telephone Company has again shown its consideration for our work in pure science as an ally to industry, and we owe to its liberality an important telephone service between our different buildings. The somewhat complicated system, with twenty-seven stations, was planned by Mr. Hammond V. Hayes, electrical engineer of the company, and by Professor Puffer, and we owe thanks for their good offices as well as for the very generous favor extended to us by the Company.

Paris Exposition.

The Institute has been invited by the United States Commission to take part in the educational exhibit at Paris in 1900. Cornell University and the Institute are asked to represent engineering and architecture.

The Commission has made a special allotment of wall space in response to our request for place to display architectural drawings, and although it is not as large as desired, it is hoped that a proper exhibit can be made. Photographs with explanatory text have been prepared to show the scope and methods of instruction at the Institute, and special attention has been paid to architecture and the engineering departments in order to meet the wishes of the United States Commission.

The Library.

This is the tenth report since the establishment of the office of Librarian, and it may not be inappropriate to preface it with a brief review of the growth of the Library during these ten years. Dr. Bigelow reports that until the year 1889 such books and periodicals as were needed were purchased by the professors as part of the laboratory supplies of their respective departments. There was no uniformity as to the arrangement or cataloguing of the books, and nothing was done to prevent duplication. The receipt by the Chemical

Department of the library of Professor Nichols led to an arrangement being made whereby Mr. C. W. Andrews, Instructor in Chemistry, was engaged to spend his summer vacation in cataloguing the library of that department. Later he accepted on similar terms the task of making a general catalogue of all the books in the Institute — an undertaking which undoubtedly seemed the more necessary because of the recent receipt of a large and very valuable collection of books and pamphlets from Mrs. W. B. Rogers. Finally, in 1889 Mr. Andrews was appointed Librarian of the Institute. After a careful examination of the different systems in use, the Dewey system of decimal classification was adopted and applied to all the books. In order to prevent unnecessary duplication a rule was adopted that all new books should be purchased through the librarian; but several copies of the same book may be required for use in different departments.

When Mr. Andrews entered upon his new position the Institute possessed about 17,545 volumes and perhaps 8,000 pamphlets, distributed in ten libraries, of which only five had been catalogued. From this time on, the new books were catalogued when received, and by devoting his summers to the work Mr. Andrews succeeded in completing the catalogue of old books in 1893. The amount of work and the disadvantages under which it was done can be fully appreciated only by one who has attempted a similar task. The room provided for an office was very small and inadequate, and the duties of the librarian included everything from the work of office boy upward, except a certain amount of routine clerical work that was intrusted to an assistant. The only aid received from attendants in the departmental libraries was in copying the cards for the departmental catalogue, mostly done by hand. The General Library was then simply a place where first-year students might study their lessons, and where books could be stored that were not wanted elsewhere. The other libraries, although small, contained many books and sets of periodicals of great value.

At the end of the fiscal year 1898–99 the total number of

volumes in the libraries of the Institute exceeds 50,000 and the total value of the libraries is estimated at $112,000. The librarian has an office which, although small, is sufficiently commodious for the ordinary work. He has an efficient assistant, who is a trained cataloguer and is capable of undertaking any part of the work that may properly be delegated to an assistant. Three of the attendants in the departmental libraries are also skilled in cataloguing, and do that part of the work for their respective departments under the supervision of the librarian. All cards added to the general or the departmental catalogues are typewritten. The libraries of the departments of English, Modern Languages, and Military Science having been incorporated with the General Library, and the whole housed in a suitable room, the General Library is much more nearly what its name implies, although much is still to be desired in that direction.

An examination of the following table will show that the growth of the libraries in number of volumes has been steady and continuous. The average annual increase for the ten years is 3,260 volumes. The minimum is 1,867, and the maximum 4,080, occurring in the first and second years respectively.

GROWTH OF THE LIBRARIES DURING THE TEN YEARS FROM 1889 TO 1899.

YEAR.	1889.	1890.	1891.	1892.	1893.	1894.	1895.	1896.	1897.	1898.	1899.
Net accessions, vols.	. . .	1867	4080	3320	3607	4045	3190	3357	2974	2696	3438
Total vols., Sept. 30	17545	19412	23492	26812	30419	34464	37654	41041	44015	46711	50149

The separate contribution of each department toward the total growth is shown by the table which follows:

GROWTH OF THE LIBRARIES BY DEPARTMENTS DURING THE TEN YEARS ENDING SEPT. 30, 1899.

LIBRARIES.	ANNUAL INCREASE IN VOLUMES.		
	Average.	Maximum.	Minimum.
History and Economics	653.5	963	448
Engineering	641.9	900	233
General[1]	421.8	720	115
Physics	396.0	587	99
Chemistry	380.0	476	272
English	203.7	479	89
Architecture	158.7	265	61
Mining	156.4	271	106
Biology	133.5	194	56
Geology	101.0	212	22
Margaret Cheney Room	13.9	36	0
Total	3,260.4		

Owing to differences in the rate of growth the relative sizes of the libraries have changed considerably during the ten years. In 1889 the largest library was the Chemical, with 3,756 volumes, and the one next in size was the Library of History and Economics, having 2,969 volumes. Now the Library of History and Economics is the largest, having 9,504 volumes, and the Chemical Library with its 7,556 volumes is reduced to fourth place, while the Engineering Library is next to the largest, having reached the considerable size of 8,822 volumes. These departmental libraries still maintain their place, however, among the leading technical libraries of the world.

Our system of departmental libraries is a product of the natural growth of the Institute, having arisen by the accu-

[1] Until 1897 the libraries of Mathematics, Military Science, and Modern Languages were regarded as a part of the General Library, as in this table, while the English Library was regarded as separate.

mulation of books purchased from time to time as they were needed for the use of the various departments. When it began to be realized that in these scattered collections we possessed a library of considerable size and of great value, the departmental system had become so firmly established and was found to meet the needs of the Institute so well that there was little thought of making any change.

This system was adopted from the start by Johns Hopkins University and the University of Chicago, and within the last few years the principle has been applied cautiously and to a limited extent in some of the other leading universities which formerly had simply one central library. Thus at Harvard, while the great departments of the university like the Law School, Divinity School, and Zoölogical Museum have long maintained separate libraries, it is only recently that sixteen "Laboratory and Class Room Libraries," aggregating 20,500 volumes, have been established for the various departments of Harvard College. The only trace of this system at Yale appears to be in the library of the Sheffield Scientific School, consisting of about 5,000 volumes, largely mathematical. From this there is set apart a special Chemical Library, a small library of History and Political Science, and private technical libraries on the subjects of Geology and Mineralogy. In his report for 1897 the librarian of Columbia University states that departmental libraries are about to be established for the departments of Zoölogy, Mineralogy, Geology, Palæontology, and Mining. At Cornell University about 15,000 volumes out of a total of 196,000 in the general library are deposited in the seminary rooms and department and laboratory collections.

The libraries of five of the great technical schools of Europe, as classed in Minerva,[1] surpassed ours in the number of books in 1897–8: Hannover, 145,000 volumes; Vienna, 81,044; St. Petersburg, 75,500; Buda Pesth, 55,682; Aix-la-Chapelle, 48;000.

[1] No statistics in regard to libraries are given for Charlottenburg nor the schools of London and Paris.

During the year 1898–9 the following additions were made to the library:

By purchase	1,621
From the bindery	878
Gifts	1,616
Total accessions	4,115

After deducting books purchased to replace lost volumes, books counted twice, etc., the net accessions are 3,438 volumes, 527 pamphlets, and 24 maps. The distribution of these accessions and their cost among the different departments is exhibited in the table below:

TABLE OF NET INCREASE DURING THE YEAR 1898–99, SHOWING THE COST OF THE SAME, AND TOTAL CONTENTS AND ESTIMATED VALUE OF THE LIBRARIES OF THE INSTITUTE, SEPT. 30, 1899.

LIBRARIES.	NET INCREASE.				TOTAL CONTENTS.		
	Volumes.	Pamphlets.	Maps.	Cost.	Volumes.	Pamphlets & Maps.	Estimated Value.
General Library. (General	249	143	.....	$80.11	4,254	3,566	
General Library. (English	163	1	.....	181.77	2,535	38	
General Library. (Mod. Lang.	48	.....	.....	110.32	642	18	
General Library. (Military Sci.	6	.....	.....	5.35	142	6	
Totals Gen. Lib.	466	144	.....	$377.55	7,573	3,628	$10,570
Architecture	223	10	.....	794.82	2,448	210	18,402
Biology	114	15	.....	165.64	2,185	419	4,890
Chemistry	328	31	.....	557.36	7,556	1,546	16,932
Engineering	900	184	23	1,488.59	8,822	3,581	20,123
Geology	93	4	.....	107.14	1,931	822	4,412
History & Economics,	496	44	1	525.06	9,504	3,165	14,988
Mathematics	258	11	.....	652.06	906	174	2,028
Mining	271	66	.....	274.92	2,325	407	5,196
Physics	272	18	.....	421.42	6,283	707	13,964
M. Cheney Room	17	.....	.....	.....	616	13	1,357
Totals	3,438	527	24	$5,364.56	50,149	14,672	$112,866

The value of the libraries was calculated as follows: Architectural Library at $7.50 per volume, Library of History and Economics at $1.50, General Library at $1.30, all other libraries at a general average of $2.20, and all pamphlets at 20 cents. These figures were adopted after a careful study of the cost of total accessions by purchase and binding from Oct. 1, 1890, to Sept. 30, 1898.

We are now receiving 840 periodicals and other serial publications at a total cost to the Institute of about $2,000 per annum, as is set forth in detail in the following table:

TABLE OF PERIODICALS AND OTHER SERIAL PUBLICATIONS RECEIVED DURING THE YEAR 1898–99.

LIBRARIES.	NUMBER RECEIVED.					ESTIMATED COST.			
	Gifts.	Paid by Dept.	PERIODICAL ACCOUNT.		Totals.	Paid by Dept.	PERIODICAL ACCOUNT.		Totals.
			Exch.	Subs.			Exch.	Subs.	
General . .	32	1	16	26	75	$6.00	$38.40	$84.47	$128.87
Architecture,	2	2	7	30	41	4.40	16.80	178.41	199.61
Biology . .	15	6	8	37	66	21.10	19.20	230.94	271.24
Geology . .	16	1	8	5	30	2.50	19.20	20.95	42.65
Chemistry .	86	14	13	39	152	42.95	31.20	185.53	259.68
Engineering,	48	24	56	54	182	51.12	134.40	233.41	418.93
History and Economics,	50	28	5	68	151	61.19	12.00	225.79	298.98
Mathematics,	. .	. .	2	13	15	. . .	4.80	52.93	57.73
Mining . .	10	3	21	22	56	4.95	50.40	77.87	133.22
Physics . .	9	13	28	29	69	9.49	67.20	146.44	223.13
Lowell School of Design .	. .	. .	. . . .	3	3	. . . . .	. . . . .	10.00	10.00
							$393.60	$1,446.74 393.60	
Totals . .	268	82	164	326	840	$203.70	. . . . .	$1,840.34	$2,044.04

The remaining statistics of the libraries for the year may be tabulated as follows:

SUMMARY OF EXPENDITURES FOR THE LIBRARIES, EXCLUSIVE OF SALARIES.

Books and binding	$5,364.56
Periodical account	1,933.02
Expense account	233.79
	$7,531.37
Less receipts from sale of duplicates	90.16
Total	$7,441.21

OTHER STATISTICS OF THE LIBRARIES.

Number of orders issued for purchase of books	1,376
Number of order slips returned to heads of departments as duplicates,	191
Number of the same reordered	14
Suggestions for purchase sent to heads of departments	1,743
Number of the same approved	462
Books received for inspection	281
Number of the same purchased	63
Number of orders for binding and lettering	1,278
Cards added to the general catalogue	2,811
Total number of cards in general catalogue	44,953
Books and periodicals borrowed for home use:	
General Library	877
Biological Library	215
Chemical Library	1,938
Engineering Library	2,270

The statistics in regard to the borrowing of books represent only a part of the use made of the libraries. Not only have a large number of books been borrowed from the libraries not mentioned in the list above, but in all the libraries many books are being used constantly for reference without being taken from the room, and no record is kept of the books used in this way.

During the year considerable progress has been made upon a subject catalogue of the Chemical Library, although the only time available for this purpose has been what the assistant in charge could spare from her other work. A beginning has been made on subject catalogue of the books on public health and sanitary engineering in the Engineering Library by the assistant in charge of that library. The plan is to make ultimately a complete subject catalogue of all the books on that subject in the Institute, this being especially desirable

because the books are divided between the Engineering, Chemical, Biological, and Architectural Libraries. The subject entries are made upon colored cards to distinguish them readily from the author and title entries, and they are filed alphabetically in the general catalogue with the other cards. When the plan has been carried out, it will be possible for any one wishing to look up the literature to come to the general catalogue and there in one alphabet find under the subject headings references to all books on these subjects in any of the libraries of the Institute. Copies of the subject cards will also be filed in the catalogues of the libraries in which the books are placed. These beginnings are but part of a plan to make the general catalogue finally a complete dictionary catalogue, both by author and subject, of all the books in the libraries of the Institute. As an author catalogue it is complete, but the completion of the subject part is an ideal which it will take many years to attain with the force at present at the disposal of the Librarian.

Of the gifts received during the year special mention should be made of the following: — a number of reports and public documents from Senator George F. Hoar and Hon. Samuel W. McCall; 194 volumes, chiefly on engineering and mining, belonging to the late Gorham P. Faucon and presented to the Institute by his mother; from Mrs. Sarah A. Floyd, 11 volumes on chemistry, from the library of her son, Charles W. Floyd; from Professor Richards, Rziha, Lehrbuch der gesammten Tunnel-Baukunst, 2 vols.; from the authors, Report on the Purification of the Ohio River Water at Louisville, Kentucky, by George W. Fuller, and Matter, Energy, Force, and Work, by Prof. S. W. Holman; from Professor Burton, Flammarion, Popular Astronomy, Whymper, Travels among the Great Andes, Muster-Blätter f. d. topographischen Arbeiten d. k. preuss. Landes-Aufnahme, Compte rendu de la Congrès internationale des Sciences géographiques, 1891; from Mr. Samuel Cabot, Vignola, Règles de cinq Ordres d'Architecture. Mrs. Henry Draper has sent us the third volume of Sachs, Modern Opera Houses, and she has continued her subscrip-

tion to Comptes rendus de l'Academie des Sciences de Paris. Mrs. W. B. Rogers has continued her subscription to Nature and Popular Science Monthly. Professor Runkle presented the library during the summer with 34 books and 14 pamphlets, in addition to the most notable gift of all; namely, the greater part of his mathematical library, which was deposited with the Institute during the summer of 1898. This library was fully catalogued before being placed upon the shelves, but as it was at first received as a deposit, and not a gift, it was not entered in the record of accessions. These books are kept together on special shelves in the new and well-equipped room provided during the year for the Mathematical Library.

Changes in the Faculty and Corps of Instruction.

Dr. Adolph Rambeau, Ph.D., has been appointed Professor of Modern Languages to fill the vacancy caused by the death of Professor van Daell.

Dr. Rambeau is of Huguenot descent, and belongs to a French family which fled to Geneva after the revocation of the Edict of Nantes, and afterwards settled in Germany. His collegiate education was at Wittenberg, where he was grounded in Latin, Greek, and mathematics, and his university studies were in classical and Germanic philology, and especially in Romance languages and literatures. He pursued these studies from 1871 to 1874, in 1876, and during different periods after 1876, at Halle, Marburg (Ph.D., 1877; licentiate, 1879), and Paris. Four years, 1874–78, were spent in travelling in southern Europe, Egypt, Algiers, and the United States, and the Italian, Spanish, and English languages were mastered. From 1878 to 1879 he was instructor in the Romance-English Seminary of the University of Marburg, and lectured upon Chaucer and the English literature and language. From 1879 to 1892 he held similar positions at colleges, finally with the honorary title of professor, in Strasburg, Wiesbaden, and Hamburg. In 1891 a linguistic exploration

was made in northern France. In 1893 Dr. Rambeau accepted a call to Johns Hopkins University; in 1894 he became Associate Professor of Romance Languages. He taught French and Italian languages and literatures, and lectured in the graduate department upon comparative phonetics and French pronunciation, and also taught Spanish under the auspices of the public school teachers' association of Baltimore. Dr. Rambeau is one of the editors of a linguistic and pedagogic periodical, and has published a scientific work upon Parisian pronunciation, Chrestomathie Française, also some articles upon Egypt and the East; literary and philological studies upon the "Chanson de Roland," Chaucer's "House of Fame," and Dante's "Divine Comedy"; an edition of old French dramas by Adam de la Hale; educational studies and books for the use of students and teachers; and a great number of articles in American and European philological journals.

Dr. Arthur A. Noyes has been appointed Professor of Theoretical and Organic Chemistry. Dr. Noyes completed our course in Chemistry in 1886. He was appointed Assistant in General Chemistry in 1887, Instructor in Analytical Chemistry in 1890, Instructor in Organic Chemistry in 1892, Assistant Professor of Organic Chemistry in 1894, and Associate Professor of Organic Chemistry in 1897.

Assistant Professors Jerome Sondericker, Allyne L. Merrill, and Edward F. Miller, of the Departments of Applied Mechanics and Mechanical Engineering, have been appointed Associate Professors of Applied Mechanics, Mechanism, and Steam Engineering respectively. Professor Sondericker was appointed Instructor in Applied Mechanics in 1885, and Assistant Professor of Applied Mechanics in 1890. Professor Merrill was appointed Assistant in Mechanical Engineering in 1885, Instructor in Mechanical Engineering in 1887, and Assistant Professor of Mechanism in 1891. Professor Miller was appointed Assistant in Mechanical Engineering in 1886, Instructor in Mechanical Engineering in 1888, and Assistant Professor of Steam Engineering in 1892.

First Lieutenant James Hamilton has been detailed by the War Department and appointed Assistant Professor of Military Science in consequence of Captain Bordman's resignation to become Adjutant of the 26th Infantry, now in service at the Philippine Islands. Lieutenant Hamilton was graduated from West Point in 1890, and has recently resigned from military service and taken up the practice of law.

Mr. Joseph Willard has been appointed Lecturer on Business Law, and will take up the course formerly given by Mr. Brandeis.

Messrs. Carleton A. Read, Frederic H. Keyes, Alexander W. Moseley, and Frederick A. Hannah, Instructors in Mechanical Engineering, have resigned in consequence of favorable opportunities elsewhere. Mr. William J. Drisko, Instructor in Physics, has been appointed Professor at Colby University. Dr. Wendell has returned after leave of absence and resumes the instruction given during his absence by Mr. Drisko. Mr. Charles T. Wentworth, Instructor in History, has also resigned and is now teaching at the B. M. C. Durfee High School in Fall River, Mass. Mr. Myron L. Fuller, Assistant in Geology, has been appointed Instructor. Mr. Francis H. Dike has succeeded Mr. Léon E. Bernard as Instructor in French.

The following Assistants have terminated their connection with the Institute:

Edward M. Bragg,	Frederick L. Edmands,
George M. Holman,	Elbridge C. Jacobs,
Areli H. Jacoby,	Carleton S. Koch,
Louis J. Seidensticker,	Percy G. Stiles,

Robert G. Valentine.

The following new assistants have been appointed:

Henry E. Andrews, A.B., in English.
Charles W. Berry, S.B., in Mechanical Engineering.
Arthur A. Blanchard, S.B., in Theoretical Chemistry.
Fred E. Busby, S.B., in Industrial Chemistry.
William D. Coolidge, S.B., Ph.D., in Physics.
Alvan L. Davis, S.B., in Mining Engineering.

Harrison W. Hayward, S.B., in Mechanical Engineering.
Walter H. James, S.B., in Mechanical Engineering.
Fred. L. H. Kimball, S.B., in Mining Engineering.
William S. Newell, S.B., in Mechanical Engineering.
George H. Priest, S.B., in Oil and Gas Analysis.
George H. Riker, S.B., in Mechanical Drawing.
Norman E. Seavey, S.B., in Physics.
Miles S. Sherrill, S.B., in Analytical Chemistry.
Frank R. Swift, S.B., in Mechanical Engineering.
Etheredge Walker, S.B., in Mining Engineering.
Charles-E. A. Winslow, S.B., in Biology.

William Skarstrom has been appointed Instructor in Gymnastics, in place of H. J. Boos, resigned.

Entrance Requirements.

Solid Geometry has now become an absolute entrance requirement without evidence that it occasions serious difficulty on the part of teachers or applicants.

The number of students passing more than our requirements in modern languages continues to increase, there being 33 applicants who passed Advanced German and 98 who passed Advanced French the present year, while 41 passed both Elementary French and Elementary German.

Scholarships.

The work of the Scholarship Committee of the Faculty has increased this year beyond previous experience. Your Executive Committee assigned for the present year $7,000 from the Austin Fund for undergraduate scholarships. The number of applicants for Institute scholarships up to the present time has been 164, while 137 submitted applications for the 40 State scholarships. Sixty-seven of these made applications in both places, leaving the total number of applicants considered by the Faculty and the State Board of Education 234. Of these 43 have received scholarships to the amount of full tuition, 129 others have received smaller

amounts, averaging somewhat more than $100 each. It may be added that, in accordance with the act of the Legislature authorizing division of State scholarships, 26 of the 40 were so divided, thus increasing the number of recipients to 66.

Graduate Scholarships.

The graduate scholars of the current year are Messrs. Lewis B. Abbott, of the class of 1899; W. T. Keough, of the class of 1888; and Clifford M. Swan, of the class of 1899. Mr. Abbott is a candidate for the Master's degree; Mr. Keough is continuing his special work in Naval Architecture; Mr. Swan is a candidate for the degree of Doctor of Philosophy.

Fellowships.

Mr. George K. Burgess, of the class of 1896, retains the Savage Fellowship, and is continuing his studies in Paris. The Swett Fellowship, held last year by Mr. Coolidge, of the class of 1895, has been awarded to Mr. Gorham Phillips Stevens, who took his Bachelor's degree in Architecture in 1898, his Master's degree in 1899. Mr. Stevens is now engaged in architectural study in Europe.

The following work has been done by the fellows of last year:

Mr. Herbert W. Chamberlain, of the class of '95, last year appointed a fellow, died on the 26th May, 1899, at Siena, Italy, while pursuing, together with his wife, also a graduate in Architecture, a series of investigations and measurements upon characteristic examples of Italian architecture. The Institute had already received many carefully measured drawings, showing work of great promise, and the deepest regret is felt at Mr. Chamberlain's untimely death.

It has been noted elsewhere that George V. Wendell and William D. Coolidge have completed their fellowship work, and have entered the instructing staff of the Institute.

Dr. Wendell was Assistant, 1892, and Instructor, 1893–96, with a very responsible position in charge of recitations of

the second-year class in physics. In 1896 he was granted the Savage fellowship, and leave of absence, took his Ph.D. degree at Leipsic in 1898, and remained a year longer studying at the University of Berlin. His work in Leipsic was principally in optics, and he presented a research on rotary dispersion for his thesis. At Berlin he investigated the conduction for heat of rarified gases, an important subject in connection with the kinetic theory of gases. A research was also undertaken upon the electric conductivity of bismuth in a magnetic field.

Dr. Coolidge studied Physics and Chemistry at the University of Leipsic, in 1897–99, and during the latter year he was appointed assistant to Professor Drude. He presented as his thesis research dielectric oscillations in wires, and gave an experimental lecture at the Dusseldorf meeting of German scientists on a new method for the demonstration of electrical oscillations in wires.

The Coöperative Society.

A large contribution to the scholarship fund has this year been made from the profits of work by this student society, and they recommend certain of their comrades for the grants of scholarships which are made by a committee of the Faculty. The work is in itself helpful, and consists in supervision of the sale of text-books, drawing materials, and other articles, made by tradesmen affiliated with the society, and the sale of second-hand books belonging to members. Stands for the sale of these articles have been placed for the convenience of our students in several of our buildings. The profits are derived from membership tickets, sales, and advertisements.

The establishment of rules and of forms of contracts has been the subject of much consideration among the student members, and they have been asked by the United States Director of the Department of Social Economy to send an account of their methods of doing business to the Paris Exposition.

New Courses of Instruction.

An optional course in Landscape Architecture has been planned to diverge from the architectural course in the second year, and Mr. Guy Lowell, who graduated from the Institute in 1894, and has recently received a diploma at the French government school of Fine Arts, has been appointed to lecture upon this subject, which he has made an object of special study while in Europe.

In addition to the programme elaborated by our own departments, engineers, landscape gardeners, and architects have been consulted, and our thanks are due for the very carefully considered projects of work which have been made for us. Each author has shown a tendency to multiply studies in his favorite branch, so that the only difficulty has been in reducing the number to a suitable course, of which a schedule will be issued later. A main feature of the new option will be a very thorough course in Horticulture at the Arnold Arboretum, which is under the direction of Mr. Charles S. Sargent. Horticultural and botanical studies in the laboratory and the field will extend through three years, and ample opportunities will be offered not only to learn the habits of trees, shrubs, and plants, but also to study landscape gardening effects in the park of the Arboretum, which is of easy access from our Institute. Excursions will also be made for the same purpose to suitable localities. The engineering practice required for grading, masonry, and other work will be taught, so that correct plans and estimates can be made. Architectural studies and skill in design and composition are most essential parts of the course.

The consultations referred to above give added proof that a course in Landscape Architecture, which has now become one of the professional demands of our country, can be best given in conjunction with a strong school of architecture and engineering, and we are fortunate in being able to establish a connection with the Arboretum, which Mr. Sargent's publications have made known throughout the world as a great horticultural station.

An option in Heating and Ventilation has been added to the three already existing in the Department of Mechanical Engineering. The technical requirements are now so distinctly marked that it has been found advantageous for a mechanical engineer, after he has mastered the earlier parts of the theory of his profession, to decide whether his studies of the fourth year shall turn towards marine engineering, locomotive construction, or mill engineering; and we believe that heating and ventilation has now stepped into a place of similar prominence, and that more extended instruction should be given. We are informed by persons interested in the school that professional situations are awaiting young men equipped in this special engineering branch; and our thanks are due to Mr. J. E. Powell, chief mechanical and electrical engineer of the Treasury Department, Washington, for carefully considered suggestions regarding studies.

Professor Woodbridge will give the new course of instruction in this option, in addition to the shorter course now given at the Institute, and will make the students acquainted with professional practice, by showing them work which he and others are engaged in, and by setting problems in designing plants.

Departmental Reports.

Mathematical Department. — The work of the department has progressed along the usual lines. In the arrangement of work for the present year some changes have attended the discontinuance of instruction in solid geometry, which is now an absolute requirement for admission. An increase in the number of students taking differential calculus has led to a corresponding increase in the number of sections into which the class is divided, from 12 to 14.

Mention was made in the last Report of the preparation of Room 20 in the Rogers Building as a Mathematical Library. The room is now fully furnished, and the members of the department are much gratified at having quarters conveniently and pleasantly situated, handsomely fitted up, and

well adapted in every way to the purposes intended. Ample space in the cases has been provided to allow for the expected growth in books and models during a number of years, while the plan is such that the cases can readily be extended whenever needed.

The Library has just received a most notable increase in the number and importance of its volumes through the generous gift by Professor Runkle of his entire collection of books in Mathematics and Astronomy. This collection consists of about 450 volumes, besides many pamphlets and monographs, and contains numerous rare and valuable treatises that are now difficult to obtain. It comprises also many of the early numbers of mathematical journals, and a very complete collection of text-books illustrating the progress and development of the teaching of elementary mathematics in this country during the past seventy years. In recognition of Professor Runkle's long and eminent service as a senior member of the mathematical department, and of his generous interest in the library, it has been named by the Executive Committee "The Runkle Library of Mathematics." By means also of the special appropriation last year and a needed increase in the annual appropriation, the library is now in excellent condition to meet the needs of our Faculty and students. The following periodicals are regularly received:

Acta mathematica, American Journal of Mathematics, Bulletin of the American Mathematical Society, Annals of Mathematics, Bulletin des sciences mathématiques, Journal für die reine und angewandte Mathematik, Journal de mathématiques elementaires, Journal de mathématiques pure et appliquées, Mathematische Annalen, Messenger of Mathematics, and Quarterly Journal of Mathematics Pure and Applied.

Courses I. and XI., Civil and Sanitary Engineering. — The new arrangement of the rooms of the department affords ample accommodation, and the work can now be carried on with greater efficiency than ever before. In particular, the collec-

tions of photographs, drawings, and samples of material are now rapidly increasing. During the past year the department has received the following gifts: One thousand three hundred and ten blue prints; eighteen framed photographs; seventy unframed photographs, among which is a set of twenty photographs of engineering work in Vienna, received from Prof. F. von Emperger, and an album of twenty-three large photographs from the Gütehoffnungshütte, in Germany; four hundred and forty-nine charts from the United States Coast and Geodetic Survey; and eight charts from the United States Geological Survey. A large number of samples of building materials have been received from various firms and individuals. Particular mention should also be made of a gift to the department from Mrs. E. H. Faucon, of Milton, Mass., in memory of her son, Gorham F. Faucon, of a large number of valuable engineering books and of one hundred and eighty-two sheets of foreign plans and maps of great interest. An impulse wheel, three feet in diameter, with fittings, has also been presented to the Institute by the American Impulse Wheel Company of New York, through the courtesy of Mr. A. V. Garratt, Engineer of the Lombard Water Wheel Governor Company. In addition to the persons who have thus contributed, the thanks of the Institute are due to President Tuttle, of the Boston & Maine Railroad; W. H. Barnes, General Manager of the Boston & Albany Railroad; and A. C. Kendall, General Passenger Agent of the New York, New Haven, & Hartford Railroad, for courtesies of various kinds. The department has also purchased a large number of new instruments for use in surveying and hydraulics, including four new plane tables, a new current meter, several barometers, and numerous smaller instruments. The equipment of the geodetic observatory has been increased by the addition of a dip circle and by two special switch-boards to be used in connection with longitude determinations. The collection of photographs of the department has also been increased by the purchase of over fifteen hundred new photographs and a large number of new slides.

The range of occupation open to graduates in this department is steadily increasing, and at the present moment the demands upon us for engineers show that a much larger number could find immediate employment. Even during the years of business depression, the department each year had more applications for men than it was able to supply, and during the past year the demand was greatly increased.

SUMMER SCHOOL OF THE CIVIL ENGINEERING DEPARTMENT. — The twelfth summer school was held at Cherryfield, Me., in June last, and was attended by twenty-five third-year students, the largest number that has ever attended any summer school of the department. The work was in charge of Professors Burton, Porter, Robbins, and Barton, and Instructors Sweet and Hosmer, with the assistance of Messrs. Parker and Clapp of the class of 1899.

The party left Boston June 8th and returned July 8th. Three weeks were spent at Cherryfield, Me., devoted to work in geodesy and hydraulic measurements. A base line was measured and a system of triangulation developed which was used as a basis for a plane table survey on a scale of 1 to 5,000, with contours at intervals of ten feet. A square mile of territory was mapped in this way, including the five dams on the Naraguagus river. The discharge of the river was determined by the use of floats and current meters, and the meters were rated in still water. The elevation of the crests of the different dams above mean high water was measured, thus enabling the gross horse-power at this point in the river to be computed. Meteorological and tidal observations were taken at Milbridge, a short distance from Cherryfield on the coast. A plane table survey was made of Milbridge harbor and about a hundred soundings taken, locating the channel. A visit was made to the old Epping base of the United States Coast Survey, which was measured in 1857.

At the close of three weeks of surveying, a geological excursion was taken under the direction of Professor Barton. The party spent a day at the Joggins Coal Mine in Nova

Scotia, visited iron and gold mines near Halifax, and after a very interesting and instructive trip to the points of geological interest arrived in Boston July 8th.

An appropriation has been made to send Professor Burton and a small party to Georgia in the middle of May to make time observations in connection with the total solar eclipse of May 28th. The equipment of the geodetic observatory will be used in these observations, and in addition an arrangement has been made for the loan of two 5-inch Clark telescopes with mountings.

Course II., Mechanical Engineering. — A planer has been added to the equipment of the engineering laboratories and this, together with the engine lathe and speed lathe which we have already, will enable us to have some of our machine tool work done at the Institute instead of outside.

A three-stage air compressor has been ordered, having a capacity of 100 cubic feet of free air per minute, which it can compress to a pressure of 2,500 pounds per square inch. In consequence, however, of the great activity in all kinds of business it has not yet been delivered.

Attention is called to the facilities offered by the following firms to our students doing Thesis work:

Through the kindness of Mr. Hayden, the Vice-President of the Boston & Albany Railroad, Messrs. B. S. Hinckley and H. A. B. Campbell were enabled to make for their thesis a series of economy tests of a two-cylinder compound locomotive recently built for the road. The locomotive was a twelve-wheel engine carrying heavy freight which exerted, on an average, about 600 horse-power, and at times more than 1,000 horse-power. The tests involved the determination of the horse-power developed, and also of the coal and water consumption in each of six runs from Albany to Springfield.

By the courtesy of Col. E. D. Meier Mr. H. L. Morse was enabled to make a series of tests of a Diesel motor which was on exhibition at the fair of the Massachusetts Charitable Mechanic Association.

The publication of the results of tests in the "Technology Quarterly" has been continued; No. XI. was published in Vol. XII., No. 3, of the Quarterly in September, 1899. The following publications have been made by members of the department, viz.:

A new and revised edition of the Notes on Dynamometers, Planimeters, Governors, and Fly Wheels, by Professor Lanza.

A new edition of the Notes "Illustrations of Engines and Machines," by Professor Peabody.

Two articles on "Testing" in "Machinery," by Professor Miller.

APPLIED MECHANICS. — The range of tests made in the laboratory of Applied Mechanics during the past school year involved:

Tension of high carbon steels.
Crushing strength of brick.
Tests of iron and steel in tension.
Tests of aluminum.
Crushing of 2-inch cubes of cement.
Transverse tests of wrought-iron bars.
Tests of aluminum wire.
Tests of steel wire.
Torsion of $1\frac{1}{16}$-inch diameter cold rolled steel shafting.
Torsion of aluminum rods and wire.
Torsion of steel rods and wire.
Tests on strength of rope.
Tests to find efficiency of knots for holding rope.
Transverse tests of spruce and yellow-pine beams.
Testing cement in tension.
Mixing cement for testing.

The space gained in the laboratory has also enabled us again to pursue investigations upon the effect of applying the load to timber beams for a long time.

SHOPWORK. — The total number of students receiving instruction is 238. Many of these take more than one course, and they are divided among the different classes as follows:

Carpentry and Wood Turning	104
Forging	95
Chipping and Filing	72
Machine Tool Work	42
Metal Turning	47
Pipe Fitting	4
	364
Students taking work in two or more classes and counted more than once	126
	238

The total number in 1897–98 was 210; in 1898–99 it was 231.

The Machine Shop now accommodates 23 students, and the class now taking the machine tool work in two sections numbers 42. Had there been no summer course it would have been impossible to accommodate all applicants this year. Should the number of students taking the work continue to increase it is probable that arrangements will need to be made for a greater number of sections or for increased equipment in the crowded departments.

The improvements made last year have been of great advantage. The instruction room for the machine-shop has proved so convenient that similar rooms are recommended for the wood-working and forging departments. The equipment remains essentially the same as for last year. It is hoped, however, to add a turret lathe to the machine shop equipment before the end of the school year.

Course III. Mining Engineering and Metallurgy. — The whole lower floor of the Rogers Building is now used by this department, and the work is conducted to great advantage. The lecture charts and specimens are within easy distance of the lecture-room. The lecture-room, library, laboratory, and offices can all be quickly reached from each other. As a result of these new facilities the thirty-one members of the present large fourth-year class, in the mining and metallurgical laboratories, are carried through their studies with relatively greater ease than the smaller previous classes, and are receiving a better course of instruction. The class is

divided into three sections. Professors Richards, Hofman, and Lodge take charge of a section each for a week in rotation. By this arrangement every student in the class has either taken a part or performed the whole work in eighteen different processes or experiments, distributed over ore-dressing, roasting, smelting, amalgamating, and leaching.

The arranging and labelling of the collections of ores and metallurgical products has been interrupted by the great demands of the laboratory. This work will be continued as time is found for it.

The ore-dressing laboratory has received the following additions to its plant: an Embrey belt vanner, which can be used either for the ordinary vanner work or for the special work of concentrating extremely fine slimes; a Wilfley table, which will introduce the student to this new and most useful class of concentrating tables. The assaying room has received large additions to its furnace plant, and now has twenty crucible furnaces, thirteen muffle furnaces, and a new oil burner muffle furnace.

Professor Richards' book on Ore Dressing is now in the hands of the printers.

A new edition of Professor Hofman's book on Lead has been issued.

Professor Lodge's new lithographic notes on Assaying are now ready.

THE SUMMER SCHOOL OF METALLURGY was this year held in New Jersey and Pennsylvania. Visits were made to smelting works and mines. The former were given the most prominence; the party numbered ten, including Professors Richards and Hofman, together with eight members of the second, third, and fourth year classes in mining engineering. At Bergen Point, N.J., the smelting and refining of copper was studied at the works of the Orford Copper Company. The blast furnaces, the open hearth department, the shops for making guns and armor plate of the Bethlehem Iron Works were inspected at Bethlehem, Pa., and the manufacture of spelter and zinc-white was studied in the

works of the New Jersey Zinc Company. At and near Pittsburgh, Pa., the party made studies of blast furnaces in Shoenberger & Company's works and in the great Duquesne plant of the Carnegie Steel Company, Limited; of Bessemer steel plants at Jones and Laughlin's and at the Edgar Thompson works; of open hearth steel plants at Shoenberger's and at the Homestead Works; of the manufacture of iron tubes at the National Tube Works; of fire bricks at the works of Harbison and Walker; of puddling at the Sable Iron Company's works; of wire rolling and drawing at the American Steel and Wire Company's works; and of crucible cast steel at the Crescent Steel Company's works. The party visited the coal mine of the Essen Coal Company, where electric machinery has been largely introduced.

The thanks of the department and of the Institute are due to the gentlemen in charge of the above works for the kind and sympathetic interest taken in the students, to whom the freedom of the works in each case was cordially granted.

Course IV., Architecture. — Since the last report no changes have been made in the arrangement of studies of the regular course.

The option in Architectural Engineering introduced last year is now well under way, and will present an excellent class for graduation next spring.

The recently created option in Landscape Architecture offers opportunity for study in new directions, and is a distinct step in advance. The course of study is the result of the fullest coöperation between the Institute and practising landscape architects of the highest rank in their profession. The value of this assistance will be better understood when it is known that no precedent exists on which to base such a course, and that the prescribed studies represent the result of personal experience during years of active practice. The schedule of studies in this option has been under consideration for some time and now approaches complete form. Next term the department will be prepared to receive students in the second-year work of this option.

Although no change has taken place in the titles of the studies of the regular course, considerable internal change has been developed in the professional courses. Among these improvements may be mentioned the free use of lantern-slide illustrations for all lectures, the addition of valuable details to the courses in history of architecture and construction, the frequent use of models instead of casts for freehand drawing, and the better draughtsmanship shown by the classes in design. It has, however, been felt for some time that closer correlation is needed in the professional work of the different years, and that the more complete study of the later periods of the history of architecture should be introduced as soon as possible.

The greatest addition in equipment is due to the purchase last summer of sixty-five casts of Roman architecture, which offer excellent opportunity for the study of good antique and renaissance detail. Part of these casts are now temporarily placed in the studio and library, awaiting the arrival of the larger fragments that are to be specially made for the department. Among the large casts are the full-size section of the cornice of the temple of Castor and Pollux in the Roman forum, the order from Trajan's arch at Beneventum, and a portion of Sansovino's monument to Cardinal Girolamo Basso della Rovere in the Church of Santa Maria del Popolo at Rome.

The Library is improved each year, and although few expensive books have been added lately, new photographs to the number of 2,900 have been added and are now being put in circulation, 3,000 old photographs have been remounted on cards of uniform size, 400 lantern slides have been added to our previous large collection, and a new and enlarged card catalogue provided for the use of students and instructors.

In the Exhibition Room, in addition to the continuous display of drawings, large numbers of photographs and diagrams of historical importance are arranged each week to illustrate the regular lectures and to assist students to a working knowledge of architectural precedent.

At the request of the department the visiting committee from the Boston Society of Architects has been changed from nine to three members, the committee consisting this year of Mr. Robert S. Peabody, Mr. R. Clipston Sturgis, and Mr. Philip Hale. Because of Mr. C. Howard Walker's absence in Europe, Mr. Walter H. Kilham is giving the lectures of the course in history of ornament. Mr. Harry W. Gardner, Instructor on leave of absence, and Mr. George P. Stevens, the holder of the Swett fellowship, report progress of studies in the north of Italy, and that several measured drawings have been made as "envois" in Bologna and Florence.

The department mentions with deep regret the death at Siena, Italy, last June, of Mr. H. W. Chamberlain, one of our most conscientious and loyal graduates. Mr. Chamberlain was working under the direction of the department, and had sent home one set of drawings made in Rome. His remaining sketches and measured drawings are now being drawn in formal manner by Mrs. Chamberlain, and will be given to the Institute.

A large number of our graduates desire to continue their studies abroad and a year's architectural study and travel in Europe forms an excellent continuation of the regular course and the benefit, direct and indirect, is great when the studies are properly directed under scholarship supervision. The Perkins graduate scholarship is devoted to this purpose and a part of the Austin fund is available, but other foundations would render great aid to the Architectural department.

The Rotch prizes given annually to students in the department were this year awarded to Mr. L. B. Abbott and Mr. J. F. Clapp.

SUMMER SCHOOL OF ARCHITECTURE. — The Summer School of Architecture this year had a very profitable European tour. Starting from Genoa, two weeks were spent in Milan, Brescia, Verona, and cities of north Italy, including a five days' visit in Venice. After a quick return from Venice

to Genoa the party began its bicycle ride along the western Riviera to Paris through Mentone, Monaco, Nice, a section of the Maritime Alps, Frejus, and Toulon to Marseilles. Then turning north, two weeks were spent in the Rhone Valley visiting Aix, Arles, Nîmes, Avignon, and many architecturally interesting towns, finally leaving the valley at Viviers for the climb over the Cevennes mountains to the higher levels of the Puy de Dôme region, — a very interesting trip through sections seldom visited by tourists. Passing through Riom, Vézelay, Sens, Moulin, Nevers, Bourges, Troyes, and Fontainbleau, the school reached Paris in good condition on August 10th.

Much hard riding was encountered in the mountains of the Riviera and the Cevennes and in pushing against the strong head winds in the Rhone Valley, but these hard days were offset by many delightful rides.

Measured drawings were made at Venice and Arles, and sketches were made in most of the towns visited. Over 700 negatives were taken with hand cameras of important details, interesting buildings, and local scenes. The successful pictures will be added to our library collections of photographs and lantern slides, filling up many vacant spaces. The school passed through very rich architectural regions, and profited greatly by observation and local study. It is only to be regretted that more students could not take advantage of the opportunity.

Courses V. and X., Chemistry and Chemical Engineering. — No important changes have been made in these departments, and the rearrangement of rooms made in the summer of 1898 has proved as satisfactory as was predicted last year. Owing to the increased size of the classes, the corps of chemical instructors has been increased by the appointment of two new Assistants in Analytical Chemistry and Theoretical Chemistry respectively.

A ventilating fan, driven by an electric motor, has been placed on the roof of the Walker Building and connected with the flues leading from the hoods in the laboratories of organic

chemistry on the fourth floor, and of analytical chemistry on the third floor. By means of this fan a much larger volume of air is drawn into these laboratories than formerly, and as this is made to pass out through the hoods, a marked improvement in temperature and ventilation of the room and in the working efficiency of the hoods has been the result.

The first-year laboratory has been renovated and improved by wholly renewing the drainage system, putting new tops upon the laboratory benches, adding 80 permanent lockers in place of the same number of temporary lockers, and substituting open top gutters for sinks. This includes the renewal of the platform and all the piping.

A short course in shopwork has been arranged for Course V. designed to familiarize the student with the common tools to enable him to construct or repair the usual chemical apparatus.

It is pleasant to note that there is an increasing appreciation of the value of the William Ripley Nichols Chemical Library, as shown by the number of persons who consult it, and their often enthusiastic commendations of its completeness. The additions of the important chemical publications of the year have been made, as usual.

ORGANIC CHEMISTRY. — Twenty-nine students are working in the laboratories of organic chemistry.

A room has been equipped as a tool-room for the use of the Chemical Department, and is fitted with a power lathe run by an electric motor, and with an ample supply of tools for the work required to be done. Another room has been equipped as a "dark-room" for photographic work, and is proving itself most valuable.

The room adjoining the Kidder Chemical Lecture-room, formerly used as a store-room, has been partitioned off so that one-third serves for the preparation of experimental lectures, and the remainder, a space of 16 × 30 feet, is now used as a special research laboratory and is provided with electrolytic apparatus beside the usual laboratory fittings. It is now occupied by one of the Instructors in Organic Chemistry

and by two graduate students, one working on the atomic weight of tellurium and the other on a special organic investigation.

ANALYTICAL CHEMISTRY. — The total number of students taking analytical chemistry is 145, of whom 77 are taking qualitative and 68 quantitative analysis at the present time. This is a slight increase over the total number of last year, and is nearly sufficient to fill the two laboratories of analytical chemistry.

It is interesting to note that the number of students who present evidence of having had sufficient training in chemistry in the secondary schools to admit of excuse from the work in general chemistry of our first year is gradually increasing. Twelve such students have been admitted to the classes in analytical chemistry this year, and are carrying on the work of the course successfully. Such of these students as are anticipating the chemical courses of the later years will, in many instances, desire to take more extended courses in inorganic chemistry in the time thus gained, and questions relating to their instruction and accommodation will probably soon present themselves for consideration.

No changes, except in details, have been made in the methods of instruction in analytical chemistry during the past year. The services of an additional Assistant in the instruction of the advanced students became a necessity as a result of the large number in these classes.

A valuable microscope, especially equipped for use in the examination of metals, has been added to our equipment, and Dr. Fay has devoted much attention to metallographic work during the past year, including the direction of thesis work of this character.

The Laboratory of Sanitary Chemistry has been fitted with electric heaters for the Soxholet extraction apparatus, thus avoiding the danger from fire in the use of ether and gasolene. There has also been installed a specially designed still for the supply of doubly distilled water for the use of the Chemical and Physical Departments in conductivity experi-

ments and water analysis. The Notes in Sanitary Chemistry are to be published in the spring under the title "Air, Water, and Food."

The laboratory for Oil and Gas Analysis has received a fine collection of essential oils from Fritzsche Brothers and Dodge & Olcott, of New York.

For work in sugar analysis a Scheibler saccharimeter has been purchased.

TEXTILE COLORING. — The new Textile Coloring Laboratory is found to be in every way a great improvement over the old one. The lighting of this room with north skylights, thus avoiding direct sunlight and reflected light from colored objects, enables the student to match colors for dyeing to shade with greater ease and precision than could be done in the old laboratory. Eleven students took the textile coloring option last year, which includes about thirty lectures and sixty hours of laboratory work.

During the term visits were made by the class to the Robert Bleakie Co., Woolen Mill, Hyde Park, Mass., Mr. C. F. Allen, Treasurer, and to the Middlesex Dye, Bleach, and Print Works, Somerville, Mass., Mr. George L. Gilmore, Superintendent, to whom thanks are due for courtesies.

INDUSTRIAL CHEMISTRY. — Thirty-eight students worked in the new laboratory last year. Its superior ventilation was fully demonstrated during the year. A small ore crusher has been added to the equipment of the laboratory.

The class attending lectures upon Industrial Chemistry numbered forty-three, and the instruction comprised sixty-seven lectures and nine written and oral recitations. The usual number of lectures were given by gentlemen not connected with the Institute, and excursions made to the following works: Curtis Davis Soap Company, Cambridgeport, Mr. E. D. Mellen, Treasurer, Mr. J. W. Loveland, Manager; Farwell Bleachery, Lawrence, Mr. Kirke W. Moses, Agent; International Paper Company, Russell Mills, Lawrence, Mr. Hugh J. Chisholm, President, Mr. G. F. Russell, Manager; Lewis' Wool Scouring Mill, Lawrence, Mr. H. Bradford Lewis,

Superintendent; Malden Gas Works, Malden, Mr. Thomas H. Hintze, Superintendent; Merrimac Chemical Works, South Wilmington, Mr. A. P. Howard, Superintendent, Mr. H. Howard, Assistant Superintendent; Union Glass Company, Somerville, Mr. J. de Cordova, President. The Institute is under obligations to the above-named gentlemen, and to Mr. D. J. Flanders, General Passenger Agent of the Boston & Maine Railroad, for courtesies extended to our students in connection with these excursions.

The new lecture-room in the Henry L. Pierce Building has proved very satisfactory as to lighting and acoustics. It is arranged for the exhibition of lantern slides, but the darkened room causes difficulty in taking notes; consequently one hundred and twenty-five India-ink drawings and about seventy charcoal sketches have been prepared by Dr. Thorp, all sufficiently large to serve as wall charts, and their use has been found much more satisfactory than lantern slides.

A fund generously provided by Mr. Samuel Cabot has enabled Dr. Thorp to spend the summer in visiting the principal chemical manufactories of England, France, and Germany.

BOOKS PUBLISHED. — Thorp, F. H.: Outlines of Industrial Chemistry (second revised edition).

Richards, Ellen H.: The Cost of Living as Modified by Sanitary Science.

Gill, A. H.: Gas and Fuel Analysis for Engineers (second revised edition).

Gill, A. H. (compiler): A Register of Publications of the Institute (supplement to the third edition).

ARTICLES PUBLISHED. — A. A. Noyes: 1. Die Beziehung zwischen osmotischer Arbeit und osmotischem Druck.

2. Die thermodynamischen Ausdrücke für die Lösungs- und die Dissociationswärme von Elektrolyten.

Richards, E. H.: The Relation of the Higher Educational Institutions to Commercial and Expert Work.

G. W. Rolfe and George Defren: Manufacture and Use of Brewing Sugars.

S. P. Mulliken and H. Scudder: A Simple Color Reaction for Methyl Alcohol.

Whitney, W. R.: The Nature of the Change from Violet to Green in Solutions of Chromium Salts.

Woodman, A. G.: On the Determination of Added Water in Milk.

Courses VI. and VIII., Electrical Engineering and Physics. — In these courses there has been continued development in various directions. The lectures in General Physics in the second year have been materially aided by the addition of much new apparatus for demonstration, especially in electricity and light. A serious difficulty in connection with these lectures is that while there has been a vast increase in the number of topics that must be considered at length even in a course for beginners, the allotted number of exercises is no greater than it was twenty years ago. Some relief is afforded by the fact that about eighty per cent. of the students have studied physics to some extent before entering the Institute, which was not formerly the case; so that a more philosophical treatment of the subject is possible, while the recitations also allow of the omission of certain of the less difficult topics from the lectures.

The last year closed the connection with the department of Mr. Wm. J. Drisko, who has recently been appointed to the chair of Physics at Colby University. He resigned his position of Instructor in Physics after having taken charge of the recitations for the past three years. Mr. Drisko has been singularly successful in this onerous work, and has won the respect alike of his pupils and colleagues. During the present year the recitations in physics are again in charge of Dr. Wendell, who has returned from a three years' course of study in Leipsic and Berlin.

The Laboratory of General Physics has acquired several valuable pieces of apparatus during the past year, among which may be mentioned a Zeiss comparator, a Zeiss spherometer of novel construction, a Michelson refractometer, and a Rowland concave grating with mounting for photographing

the spectrum. A new photometer room has been fitted up for work with the spectrophotometer and Weber photometer.

The introduction of physical laboratory work into the Course in Chemistry in the second year, with lectures at the same time on physical measurements as previously arranged for Courses VI. and VIII., has proved of decided advantage to the students, and a like arrangement for all the engineering courses is very much to be desired.

The enlargement of the Physico-Chemical Laboratory mentioned in last year's report has greatly facilitated the instruction given therein. A large electrically heated and regulated thermostat six feet by three feet has been devised and added to the equipment of the laboratory, by which a great saving of time is effected for the students by allowing various lengthy operations to be carried on continuously during the night.

The work in this laboratory suffers from the necessity of having to accommodate classes and students working on theses at the same time. Special rooms for investigation for students taking physical theses are very greatly needed.

In the Laboratory of Electrical Measurements a number of new experiments have been introduced and the purchase of additional apparatus has allowed of much improvement in others. An important addition is that of two small specially constructed dynamos of high voltage for testing and calibration of instruments, and also a set of standard resistances of large carrying capacity, standardized at the German *Reichsanstalt*. These constitute a portion of a complete set of calibration apparatus now being designed and constructed in the Rogers Laboratory, which when completed will allow of exact verification of electrical measuring instruments for both direct and alternating currents throughout the widest range. Beside these there have been added several Wheatstone bridges, a Rowland electrodynamometer and an apparatus designed in the laboratory for photographic study of the form of alternating current waves. The amount of instruction called for in this laboratory has been greatly increased by the

recent introduction of a large amount of advanced work for the students in the chemical courses.

In the Laboratory of Electrical Engineering much new apparatus has been added, this being largely made within the department. Worthy of special mention are a set of model lecture apparatus for illustrating the behavior of polyphase motors and compensators, and a set of transformers designed to show the various possible combinations and connections, and to exhibit their effect. Also worthy of notice are a new apparatus for the stroboscopic study of the alternating current arc, and a collection of arc-lamps of various types for testing. There is at present in process of construction in the laboratory an assemblage of apparatus for familiarizing the students with the various special methods of testing polyphase alternating current machinery. This comprehends eight or ten instruments and transformers built expressly for the purpose, together with a switch-board of peculiar construction.

During the last year the lack of sufficient engine power in the dynamo room has been seriously felt. The rapid and excessive increase in the call for electricity for purposes of general illumination has at times exceeded the available power, so that serious and on occasions even dangerous overloading has occurred. A partial remedy has been provided by an enlargement of the supply mains from the Edison system. There is abundant dynamo capacity for all present needs, but a new engine will be necessary to secure the proper illumination of the Rogers and Walker Buildings.

The increased space which was allotted last year to the Laboratory of Heat Measurements has allowed of much improvement in the instruction; indeed, without such enlargement it would have been physically impossible to give the instruction called for. Notwithstanding the advanced character of the work it is at present taken by about seventy-five students, miners, chemists, and physicists. The equipment of the laboratory has been greatly increased and is now

excellent, including much apparatus of original design and construction.

Two new optional courses of lectures have been established in the department, not required, but open to students approved by the Faculty. The first of these, by Mr. Louis Derr, is devoted to Calculating and Computing Machines, their theory and use, and is intended to lead the students to a more extended use of such aids to computation. A second course is upon the Applications of Polarized Light in Physics and Chemistry, by Dr. George V. Wendell. This will contain a full discussion of the theory and construction of different forms of polarimeters, saccharimeters, and other similar apparatus, and of their various applications.

At the present time the department is contemplating the presentation to the Faculty of a modification of the course in Physics — Course VIII., — which will give to students desiring it a better preparation than is at present available either at the Institute or elsewhere for entering upon the practical applications of electro-chemistry. Such a preparation calls for a larger amount of pure and applied chemistry than is properly given in a course in Electrical Engineering, while certain branches that are important in the latter course are not especially needed.

The department is still greatly cramped for room, a want which is well understood by the Corporation, and upon which I need not enlarge.

Books Published.

H. M. Goodwin: The Fundamental Laws of Electrolysis (Harper's Science Series).

L. Derr: Notes on Dynamo Design.

L. Derr: Notes on Methods of Telegraphy.

Articles Published.

S. H. Woodbridge: Congressional Report on Ventilation of House of Representatives, Washington.

S. H. Woodbridge: Report to Public Health Association on Car Sanitation.

S. H. Woodbridge: Car Sanitation, Paper read to New England Railroad Association.

S. H. Woodbridge: On the Ventilation of Audience Halls. Series of papers now issuing.

H. M. Goodwin and G. K. Burgess: The Osmotic Pressure of Certain Ether Solutions and its Relation to Van't Hoff's Law.

H. E. Clifford and J. S. Smyser: The Acetylene Standard of Light.

C. L. Norton: On the Rapid Measurement of the Tensile Strength of Cotton Fibres.

R. R. Lawrence: On an Automatic Mercury Pump.

H. W. Smith: On a Method of Measuring the Frequency of Alternating Currents.

Course VII., Biology. — The relief felt by removal to comfortable and spacious quarters in the new Henry L. Pierce Building has in this department been very great. The year's work was somewhat broken by the unavoidable delays in completion of the several laboratories, but this was more than made good by the greater convenience, during the last half-year, and especially at the beginning of the present year. Experience has proved that the general arrangement and equipment of the biological laboratories is in every case but one entirely satisfactory. Professor Sedgwick states that "the lighting and coloring are admirable; the relative absence of dust and noise is most welcome; the construction and furnishings are substantial and suitable." The bacteriological laboratory alone has proved to be unsatisfactory. Owing to the increasing size of the classes and the number of special workers in this subject and in sanitary and industrial biology, all carried on in the same room, this laboratory is already crowded. It is hoped that as soon as possible a more spacious room, or set of rooms, may be provided for this work.

The growing importance of practical laboratory work upon the theories and the arts of the purification of sewage and

water by natural and artificial processes, not only for biologists but also for chemists and engineers, has led Professor Sedgwick to urge the immediate construction of a special sanitary laboratory on the site of the present bicycle shed, in the court-yard of the Trinity-place buildings. He advises that such a laboratory be modelled on a small scale somewhat after that maintained for the last twelve years by the State Board of Health at Lawrence under the direction of a distinguished member of our corporation, Mr. Hiram F. Mills. In a laboratory of this kind those of our students who desired to do so might become practically familiar, by actual experiments, with the principles and processes which the Lawrence Experiment Station has worked out for the benefit of engineers and sanitarians; and if such a laboratory should be built it might well be made two stories high, the lower — like the Experiment Station in Lawrence — largely underground, the upper well lighted and suitable for classes in bacteriology and sanitary biology, including opportunities for some chemical work upon sewage and water.

The usual work of the department on the sanitary side has been continued by Professor Sedgwick, and an important piece of research has been completed under his direction by Mr. C.-E. A. Winslow, a graduate in Biology in 1898, who made this work the basis of his thesis for the degree of Master of Science in June, 1899. The investigation is entitled "Experimental and Statistical Studies on the Influence of Cold on the Bacillus of Typhoid Fever and its Distribution; with special reference to Ice Supply and the Public Health."

The course in Industrial Biology, comprising the practical application of bacterial and other microörganisms of fermentation to various technical and manufacturing processes, increases steadily in scope and importance. Its object is two-fold: first, to teach the application to the industries of useful organisms in their most important rôles; and second, to give some knowledge of organisms which may cause trouble in industrial processes, and to provide methods for their control or destruction. The theory of fermentation

is dwelt upon in detail, especially in the light of recent advances in our knowledge of the chemistry of enzymes. This course affords a common meeting ground for the practical biologist and the technical chemist. The students examine and study the action of the microörganisms in question, and, on a small scale, carry on some of the processes as these are used commercially. The relation of bacteria to sundry transformations in Nature which have a direct industrial or economic bearing — such as the fixation of nitrogen, nitrification, and oxidation — is also considered. The work on the improvement of processes of food-preservation, begun three years ago by Mr. S. C. Prescott of this department and Mr. Wm. Lyman Underwood, has been continued with valuable results. These were in part embodied in a paper presented at the joint meeting of the Atlantic States and Western Packers Associations at Detroit, in February last, the largest meeting of men engaged in the food-preserving industries ever held in this country. The work of Messrs. Prescott and Underwood is regarded as of so great value to these manufacturers that for the third year in succession Messrs. Prescott and Underwood have been asked to give some of the results of their investigations before these annual meetings.

While much of the work of this department is now directed towards the applications of biology to sanitary and industrial processes and their improvement, the fundamental basis of these and similar applications in its more purely scientific aspects is not neglected. An important part of the work in physiology continues to be directed toward the proper understanding of the problems of personal hygiene, and with each year the efficiency of this portion of our work is increased. There is a field for physiology as well as for bacteriology outside the very important one which each fills in the medical school. Year by year the attention given to practical problems of hygiene is increasing, and the solution of these problems must come not merely from physicians, but from physiologists as well. This is notably the case, for ex-

ample, with the important matter of school hygiene, which must take account of such physiological questions as physical training, fatigue, heating, lighting, ventilation, and the like, questions which can be solved only with the coöperation of those who are connected with school work and who have at the same time had proper training in applying scientific principles to the solution of the questions in hand. Professor Hough continues his studies on the physiology of muscular exercise, and together with Miss Ballantyne, a graduate of this department in 1899, has made investigations upon the effects of changes in external temperature upon the circulation of the blood in the skin. A preliminary report of their results has been published.

The only changes of importance in the staff of this department are the resignation of Dr. George M. Holman, Assistant, after two years of faithful service, and in the appointment in his place of Mr. C.-E. A. Winslow.

Course IX., General Studies. — In the work of this department there has been but little change during the past year. A new option is being given by Professor Sumner on Politics of Eastern Asia. Particular attention is given to recent commercial and trade developments. A graduate of this course, class of 1899, Amasa A. Holden, was awarded the first prize of $150 by the American Protective Tariff League for an essay on "The American Merchant Marine: its Restoration by Means of Discriminating Duties." During the early part of the year Professor Dewey was a member of a committee of the American Economic Association which made a report on the Federal Census, with a view of improving the methods of this administrative work of the United States government. He has also edited General Walker's miscellaneous writings on political economy in two volumes, entitled "Discussions in Statistics and Economics." Professor Ripley has also brought out in final form his essays on anthropology in a volume entitled "The Races of Europe." This is accompanied by a supplementary volume entitled "A Selected Bibliography of the Anthropology

and Ethnology of Europe," published by the Trustees of the Boston Public Library. The latter volume offers an interesting example of the co-operation of expert service with an important branch of the municipal government of Boston. Especial mention should be made this year of the commendable work of the Walker Club, an organization of students of the Course in General Studies, in the successful bringing out of a play which netted over $600 in aid of the Walker Memorial Gymnasium Fund. This play was managed entirely by students, and, although given once outside of Boston, as far as observed did not interfere with the regular school work.

The advance in English work, which has during recent years shown itself in secondary schools, enables the instructors in the English Department to appeal with more and more confidence to the intelligent interest of students. Each year there are more men from various courses who wish to enter the classes in advanced composition and literature, with a wide recognition of the value of such work to students of technical branches.

For some years the department has given to fourth-year students in mining engineering a course known as "Memoirs." It consists of a thorough revision of the English of abstracts made from technical articles in French and German magazines. The course thus has the threefold purpose of putting the student in touch with the work of foreign experts in his own profession, of keeping his knowledge of modern languages in working condition, and of giving him regular practice in the accurate use of English in connection with his special line of work. A similar course is to be given to first-year students in architecture. They will be required to read in French selections from the work of the best writers on architectural subjects, and to write essays on topics suggested by these articles. This written work will be criticised for English. This extension of the work of the department is gratifying, because it is by thus working in conjunction

with other departments that English composition may be most successfully taught in a scientific school.

In the October number of the "Technology Review" was published a paper by Mr. R. G. Valentine, recently an instructor at the Institute, giving an account of the work of the department in English composition, and the original methods which have, with good success, been devised and put into practice.

Course XII., Geology. — One year ago the working force of the Department of Geology was busily engaged in getting the specimens and the appliances for teaching into places where they may be readily obtained for use. Since that time good progress has been made toward a systematic arrangement of the collections so as to make them most serviceable in the work of teaching. Professor Crosby has so rearranged the petrologic and lithologic collections and a considerable portion of the mineralogical collections in over four hundred wooden trays that they are constantly ready to be placed before classes and thereby furnish each member a distinct series for individual study. Also a considerable amount of work has been accomplished in the numbering and labelling of the specimens of minerals, and these may now be freely used without danger of losing a record of their locality or other facts concerning them, and much has been done in the classification of the fossils, and progress has been made in the identification, numbering, labelling, and cataloguing the specimens.

The books of the Geological Library have been numbered and classified, but work remains to be done to complete the cataloguing.

The Geological Department, through two of its representatives, has had an opportunity of coöperating with the United States Commissioners to the Paris Exposition and the Massachusetts Board of Paris Exposition Managers in gathering collections of minerals and of building stones of the United States for the exhibit which the Government is to make at Paris. Professor Crosby, as one of the mineralogists to the

Commission, has collected over 400 minerals of the classes of carbonates and phosphates, making a collection which of its kind is perhaps unsurpassed by any in the country. The total cost of nearly $800 was furnished through the kindness of the Massachusetts Board of Paris Exposition Managers. Mr. Fuller, Instructor in Geology, acting as Special Agent to the United States Commission, has brought together a series of more than 300 samples of the more common and important building and ornamental stones of this country. The collection includes over a hundred polished slabs of marble, onyx, and serpentine, seventy-five dressed and polished samples of granite, and a large number of samples of representative sandstones, limestones, and slates.

At the close of the Paris Exposition these collections, with an aggregate value of more than $1,500, are to be returned to the Institute and will be incorporated with our other collections. The minerals are of unusually fine quality and will make a very important addition to the value and attractiveness of the collections of the department. The addition of the series of building stones to those we already have will make the Institute the possessor of an exceptionally valuable collection and one well adapted to giving instruction in the course in building stones.

Course XIII., Naval Architecture. — The arrangement of the work of the department has been much favored by the quarters assigned to it at the beginning of the year. A large increase in numbers has made it necessary to add to the space in the drawing-room for the third and fourth years, for which purpose a lecture-room adjoining was taken. To provide for the numbers that may be expected another year, Professor Peabody requests that the entire third floor of Engineering Building B may be cleared of partitions and made into a drawing-room for the third and fourth year classes of the department. A room with glazed walls in one corner of the proposed drawing-room can be made to provide for drawing cases, instruments, and other property of the department. At present the space is divided into three rooms,

one being used as a model-room and store-room, and the other two as drawing-rooms. It may be noted that the fourth-year class now numbers thirteen, the third-year class twenty-two, and the second-year class about twenty. Accession from other colleges is likely to give twenty or more in the third-year class next year.

Progressive speed trials were made by the department on the U. S. S. "Manning," with the consent of the Secretary of the Treasury, and under the authority of Captain C. F. Shoemaker, Chief of Division of the Revenue Cutter Service. These trials were made on June 9, 1899, over the measured mile maintained by the Bath Iron Works, at Southport, Me. The party which made these trials included Professor Peabody, Assistants Clark and Riley, and five graduates from the department. A report of the trials has been prepared for the annual meeting of the Society of Naval Architects and Marine Engineers, to occur the 16th inst.

The department has now graduated five classes, numbering thirty-five in all. Of these, three are in business, one is Instructor in Naval Architecture at the Institute, three others are Assistants or Instructors at the Institute, and twenty-eight are engaged in the practice of their profession.

SUMMER COURSES.

The attendence at summer courses this year was as follows:

I. Mechanical Drawing and Descriptive Geometry. 30. (Prof. Faunce.)
II. Mathematics: Analytic Geometry. 12. (Mr. George.)
III. Architecture. (*a*) Shades and Shadows. 3. (*b*) Elementary Design. 4. (Mr. Gardner.)
IV. Chemistry. (*a*) Analytical Chemistry. 12. (Dr. Walker.) (*b*) Organic Analysis. 2. (Dr. Mulliken.)
V. Physics. (*a*) Mechanics, Light, and Electricity. 18. (Mr. Drisko.) (*b*) Heat. 12. (Prof. Clifford.) (*c*) Physical Measurements. 9. (Dr. Goodwin.)
VI. European History. 6. (Mr. Wentworth.)
VII. Modern Languages. (*a*) French. 4. (Mr. Blachstein.) (*b*) German. 21. (Prof. Vogel.)
VIII. Mechanism. 6. (Prof. Merrill.)
IX. Shopwork. (*a*) Woodwork. 14. (Mr. Merrick.) (*b*) Forging. 12. (Mr. Lambirth.) (*c*) Chipping and Filing. 5. (Mr. Smith.) (*d*) Machine-Tool Work. 23. (Mr. Smith.) (*e*) Metal Turning. 4. (Mr. Smith.)

STATISTICS.

THE CORPS OF INSTRUCTORS.

The catalogue of this year shows the number of instructors of all grades to be 135, inclusive of those concerned with the mechanic arts, but exclusive of those who are announced as lecturers for the year only. The addition of these raises the total to 172. This year's catalogue will show an increase of seven in the number of lecturers and some changes in the grades of professors and instructors. Allusion has already been made to the augmentation of the number of the instructing staff; without counting lecturers, the number of instructors to that of students bears the proportion of one to eight and eight-tenths. This proportion is a most characteristic figure, and is intimately associated with the quality of the instruction. The following table shows the distribution among the several classes of instructors, in comparison with last year:

	1898–99	1899–1900
Professors	23	24
Associate Professors	7	9
Assistant Professors	23	21
Instructors	53	46
Assistants	28	35
Lecturers	30	37
Total	164	172

Students and Graduates.

The registration of this year, as by the catalogue now in press, amounts to 1,178. The following table shows the registration of successive years from the foundation of the Institute:

Year.	No. of Students.	Year.	No. of Students.
1865–66	72	1883–84	443
1866–67	137	1884–85	579
1867–68	167	1885–86	609
1868–69	172	1886–87	637
1869–70	206	1887–88	720
1870–71	224	1888–89	827
1871–72	261	1889–90	909
1872–73	348	1890–91	937
1873–74	276	1891–92	1,011
1874–75	248	1892–93	1,060
1875–76	255	1893–94	1,157
1876–77	215	1894–95	1,183
1877–78	194	1895–96	1,187
1878–79	188	1896–97	1,198
1879–80	203	1897–88	1,198
1880–81	253	1898–99	1,171
1881–82	302	1899–1900	1,178
1882–83	368		

Students by Classes.

The aggregate number of students for 1899–1900 is divided among the several classes as follows:

Fellows	2
Graduate students, candidates for advanced degrees	2
Regular students, Fourth Year	183
" " Third "	193
" " Second "	199
" " First "	303
Special students	296
Total	1,178

Assigning the special students to classes, according to the predominant studies pursued by them, we reach the following division of the whole body among the several years:

Class.	Regular.	Special.	Total.
Fellows	2	...	2
Graduates of the M.I.T.	2	...	2
Fourth Year	183	75	258
Third Year	193	101	294
Second Year	199	94	293
First Year	303	26	329
Total	882	296	1,178

THE COURSES OF INSTRUCTION.

The following table presents the number of the regular students in the second, third, and fourth years, by courses:

YEAR.	Civil Engineering.	Mechanical Engineering.	Mining Engineering and Metallurgy.	Architecture.	Chemistry.	Electrical Engineering.	Biology.	Physics.	General Course.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	Total.
4th Year Class.	38	37	25	16	18	22	2	2	2	10	4	..	8	183*
3d " "	33	36	17	17	24	27	1	3	5	11	4	1	14	193
2d " "	28	40	18	20	16	35	5	2	4	9	6	..	16	199
Total . . .	99	113	60	53	58	84	8	7	11	30	14	1	38	575*

The following table shows the figures of the total line in the foregoing table, in comparison with the corresponding figures for the next ten preceding years:

YEAR.	Civil Engineering.	Mechanical Engineering.	Mining Engineering and Metallurgy.	Architecture.	Chemistry.	Electrical Engineering.	Biology.	Physics.	General Course.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	Total.
1888	71	100	12	21	28	74	4	5	12	11	..	..	..	338
1889	79	99	14	30	29	91	9	5	12	14	6	..	..	388
1890	79	95	18	27	27	105	11	4	13	18	7	3	..	407
1891	81	104	17	33	23	108	11	5	19	28	9	3	..	441
1892	76	106	19	37	35	112	9	5	16	34	5	3	..	457
1893	78	97	22	50	39	141	4	10	19	31	10	2	8	511
1894	88	111	19	48	50	137	5	9	19	35	13	2	20	556*
1895	88	118	25	67	59	126	7	11	14	25	10	3	22	575
1896	99	117	24	65	66	106	7	11	11	34	8	..	25	573
1897	109	119	38	71	60	90	8	9	10	36	7	1	26	578*
1898	93	108	52	64	64	94	6	8	12	38	7	1	33	574*
1899	99	113	60	53	58	84	8	7	11	30	14	1	38	575*

*Deducting those counted twice.

The following table shows, by classes and by courses, the number of regular students who have registered themselves as electing to distribute the required studies and exercises over the period of five years:

Year.	Total.	Course.												
		I	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	XIII.
1st . .	4	..	..	..	..	..	..	..	..	..	..	..	..	..
2d . .	6	1	2	2	..	..	1	..	..	..	..	..	..	..
3d . .	7	1	2	2	..	..	1	..	..	..	1	..	..	..
4th. .	14	6	1	1	..	2	2	..	..	1	1	..	..	..
5th. .	4	2	..	..	1	..	..	1	..	..	..	..	..	..
	35	10	5	5	1	2	4	1	0	1	2	0	0	0

Classification of Special Students.

Our special students can, of course, not be classified systematically; but the following table exhibits the number of such students pursuing certain leading lines of study:

Applied Mechanics . . .	95	Language	117
Architecture	42	Mathematics	142
Biology	24	Mechanical Engineering .	93
Chemistry	100	Mining Engineering . .	15
Civil Engineering . . .	46	Naval Architecture . . .	13
Drawing	125	Physics	159
Electrical Engineering .	19	Political Science	68
English	95	Sanitary Engineering . .	2
Geology	37	Shopwork	73
History	75		

The following is the number of students, either regular or special, pursuing certain leading branches of study, in each of the four years, as follows:

	First Year.	Second Year.	Third Year.	Fourth Year.	Total.
Mathematics . .	318	241	127	42	728
Chemistry . . .	350	154	95	81	680
English	315	242	26	11	594
French	144	77	53	...	274
Physics	...	284	243	162	689
German	70	202	122	...	394
Shopwork . . .	22	107	53	63	245

Residence of Students.

States.	Candidates for Advanced Degrees.	Fourth Year.	Third Year.	Second Year.	First Year.	All regular Students.	Special Students.	Total.
Alabama	..	..	..	..	..	..	..	..
California	..	3	1	1	2	7	2	9
Colorado	..	..	1	1	1	3	4	7
Connecticut	..	2	6	6	11	25	4	29
Delaware	..	..	3	..	1	4	..	4
Dist. of Columbia	..	..	1	2	2	5	2	7
Florida	..	..	..	..	1	1	..	1
Georgia	..	1	..	..	1	2	1	3
Illinois	..	8	6	9	4	27	9	36
Indiana	..	1	..	..	3	4	1	5
Iowa	..	3	1	1	..	5	1	6
Kentucky	..	1	2	..	..	3	1	4
Louisiana	..	..	1	..	..	1	..	1
Maine	..	6	..	4	8	18	7	25
Maryland	..	..	2	..	3	5	3	8
Massachusetts	4	117	124	130	189	564	167	731
Michigan	..	1	2	2	4	9	1	10
Minnesota	..	..	3	1	1	5	5	10
Missouri	..	..	1	2	2	5	6	11
Montana	..	..	..	..	2	2	1	3
Nebraska	..	1	..	..	2	3	..	3
Nevada	..	..	..	..	..	..	1	1
New Hampshire	..	7	3	2	9	21	8	29
New Jersey	..	2	1	2	1	6	6	12
New York	..	9	14	7	12	42	19	61
North Carolina	..	1	..	..	..	1	1	2
Ohio	..	4	7	2	7	20	7	27
Oregon	..	..	..	..	..	..	2	2
Pennsylvania	..	5	3	6	9	23	10	33
Rhode Island	..	2	3	4	13	22	10	32

States.	Candidates for Advanced Degrees.	Fourth Year.	Third Year.	Second Year.	First Year.	All Regular Students.	Special Students.	Total.
South Carolina	..	..	..	..	1	1	..	1
South Dakota	..	..	..	..	1	1	..	1
Tennessee	..	..	..	1	2	3	1	4
Texas	..	1	..	..	1	2	..	3
Utah	..	..	1	2	2	5	1	6
Vermont	..	1	3	5	1	10	2	12
Virginia	..	1	..	..	1	2	..	3
Washington	..	2	..	1	..	3	1	4
West Virginia	..	..	..	..	..	..	1	1
Wisconsin	..	1	..	2	1	4	3	7
Foreign Countries.								
Denmark	..	..	1	..	..	1	..	1
Dutch Guiana	..	..	..	..	..	..	1	1
England	..	..	..	1	..	1	..	1
France	..	..	..	1	..	1	1	2
Germany	..	..	..	1	..	1	..	1
Jamaica	..	..	..	..	1	1	..	1
Japan	..	1	..	..	..	1	1	2
Mexico	..	1	..	1	1	3	4	7
New Brunswick	..	..	1	1	1	3	..	3
Quebec	..	..	1	..	1	2	1	3
Russia	..	..	..	..	1	1	..	1
Turkey	..	1	1	1	..	3	..	3
Total	4	183	193	199	303	882	296	1178

Thirty-eight States of the Union, besides the District of Columbia, are represented on our list of students. Of the total number of 1,178, 731 are from Massachusetts, or 62.1 per cent. of the whole; 127 are from other New England

States; 320 are from outside New England. Of these, 26 are from foreign countries.

A table showing the number of students in each year, from 1893, coming from each State or Territory, and from each foreign country, may not be without interest and instruction:

States.	1893.	1894.	1895.	1896.	1897.	1898.	1899.
Alabama	2	1	..	..	1	1	..
Arkansas	1	..	..	1	1	..	..
California	15	9	8	9	9	11	9
Colorado	5	8	7	7	8	8	7
Connecticut	30	29	27	24	30	26	29
Delaware	4	3	5	5	6	3	4
Dist. of Columbia	7	12	18	17	13	8	7
Florida	3	2	1	..	1	..	1
Georgia	3	2	2	3	4	4	3
Hawaiian Islands	2	..	..	..	..	1	..
Idaho	1	..	1	1	1	..	..
Illinois	39	36	42	45	40	51	36
Indiana	6	3	2	3	7	3	5
Iowa	13	10	12	14	12	7	6
Kansas	1	4	4	3	3	..	..
Kentucky	11	12	11	12	10	10	4
Louisiana	3	3	2	..	1	1	1
Maine	36	38	38	27	24	19	25
Maryland	4	4	9	9	8	8	8
Massachusetts	665	707	721	730	739	719	731
Michigan	7	8	7	6	5	9	10
Minnesota	11	9	5	7	8	11	10
Missouri	17	14	9	11	6	10	11
Montana	2	2	1	3	5	2	3
Nebraska	3	4	2	2	2	1	3
Nevada	2	2	..	..	..	..	1
New Hampshire	32	27	30	26	25	25	29
New Jersey	6	5	5	13	15	13	12
New Mexico	2	1	1	..	..	..	..
New York	52	59	64	69	62	68	61
North Carolina	..	..	..	1	1	2	2
Ohio	45	50	37	28	30	23	27
Oregon	..	1	1	4	3	3	2
Pennsylvania	71	37	36	42	41	34	33
Rhode Island	13	25	21	20	19	23	32
South Carolina	3	3	5	6	4	1	1
South Dakota	..	..	..	..	..	..	1
Tennessee	1	1	1	1	3	3	4
Texas	6	6	3	2	2	1	2
Utah	2	2	5	2	3	5	6
Vermont	5	3	5	7	11	12	12
Virginia	3	2	5	3	4	3	2
Washington	1	3	1	5	4	7	4
West Virginia	1	1	3	2	1	..	1
Wisconsin	11	6	7	6	6	8	7
Wyoming	..	..	..	1	..	..	..
Foreign Countries.							
Belgium	1	1	..	..	..	..	..
Brazil	..	1	1	..	..	..	..
Bulgaria	1	..	..	..	..	..	..
Cape Breton	..	..	..	..	..	1	..
Central America	1	..	1	..	..	..	..
Chile	..	1	1	1	..	..	..
Columbia	..	..	..	..	..	..	..
Cuba	1	1	3	2	1	1	..
Denmark	..	..	..	..	2	1	1
Dutch Guiana	..	..	..	..	..	1	1
England	1	..	2	2	2	4	1
France	1	..	..	1	1	1	2
Germany	2	1	..	..	..	1	1
Guatemala	..	..	..	..	..	..	..
Holland	2	2	..	..	..	..	..
Ireland	1	1	..	..	..	..	..
Jamaica	..	..	..	..	..	..	1
Japan	1	1	2	2	..	1	2
Mexico	1	1	1	3	6	7	7
New Brunswick	1	1	1	2	2	3	3
New South Wales	1	1	1	..	..	..	..
Nova Scotia	..	1	2	1	1	2	..
Ontario	4	4	2	2	..	..	..
Peru	..	..	..	..	..	..	..
Porto Rico	1	1	1	..	..	..	..
Quebec	5	2	2	2	2	1	3
Russia	..	..	..	..	..	..	1
Scotland	2	1	..	..	..	..	..
Spain	1	1	1	..	..	..	..
Trinidad	..	..	..	..	..	..	..
Turkey	..	1	3	1	3	3	3
Venezuela	1	1	1	1	..	..	..
Total	1157	1183	1187	1198	1198	1171	1178

Residence of Massachusetts Students.

It has been said that 62.1 per cent. of our students are from Massachusetts. All the counties of the State except Dukes send students to the Institute. One hundred and eleven cities and towns are on the lists. The first column of

the following table shows the number of cities and towns in each county sending pupils; the second column gives the aggregate number from each county. It appears that Middlesex sends two hundred and twenty-eight and Suffolk two hundred and twenty pupils; Essex comes third, with one hundred and one; Norfolk fourth, with fifty-five.

County.	No. of Towns.	No. of Students.	County.	No. of Towns.	No. of Students.
Barnstable	4	4	Middlesex	30	228
Berkshire	3	7	Nantucket	1	1
Bristol	7	24	Norfolk	15	55
Essex	17	101	Plymouth	9	33
Franklin	4	5	Suffolk	2	220
Hampden	6	26	Worcester	13	27
			Total	111	731

The following is a list of the towns, forty-two in number, which send four or more students to the Institute:

Boston	200	Salem	10	Fitchburg	5
Cambridge	42	New Bedford	9	Hyde Park	5
Newton	39	Gloucester	8	Middleboro	5
Somerville	24	Andover	7	Milton	5
Newburyport	23	Medford	7	Amesbury	4
Brookline	21	Melrose	7	Canton	4
Lowell	21	Winchester	7	Fall River	4
Chelsea	19	Worcester	7	Haverhill	4
Springfield	17	Everett	6	Holyoke	4
Brockton	13	Framingham	6	Pittsfield	4
Lawrence	13	Natick	6	Plymouth	4
Lynn	13	Peabody	6	Waltham	4
Malden	13	Taunton	6	Wellesley	4
Arlington	11	Concord	5		

The following table exhibits for ten years the distribution of the total number of students among two classes: First, those students whose names are found upon the Catalogue of the year preceding; and secondly, those whose names appear first upon the Catalogue of the year to which the statement relates:

Year.	(1) Total No. of Students.	(2) No. of Students in the Catalogue of the previous year who remain in the Institute.	(3) No. of New Students entering before issue of Catalogue.	(4) Of those in column (3) the following number are regular First-year Students.	(5) No. of New Students not of the regular First-year Class.
1890–91	937	572	365	234	131
1891–92	1,011	624	387	258	129
1892–93	1,060	618	442	303	139
1893–94	1,157	701	456	301	155
1894–95	1,183	768	415	271	144
1895–96	1,187	778	409	266	143
1896–97	1,198	758	440	263	177
1897–98	1,198	757	441	277	164
1898–99	1,171	769	402	278	124
1899–1900	1,178	764	414	275	139

Ages of Students on Entrance.

The next table exhibits the ages of our students upon entrance, after taking out three who are repeating the first year, and seventeen persons of unusual ages. These deductions

Period of Life.	1898–99.		1899–1900.	
	Half-year Groups.	Yearly Groups.	Half-year Groups.	Yearly Groups.
16 to 16½ years	2	..	2	..
16½ to 17 "	5	7	3	5
17 to 17½ "	16	..	16	..
17½ to 18 "	32	48	32	48
18 to 18½ "	45	..	57	..
18½ to 19 "	51	96	52	109
19 to 19½ "	54	..	34	..
19½ to 20 "	28	82	40	74
20 to 20½ "	16	..	28	..
20½ to 21 "	10	26	11	39
21 to 22 "	13	13	8	8
	272	271	283	283

leave two hundred and eighty-three as the number of students whose ages have been made the subject of computation.

The results appear in the table above in comparison with the corresponding results of 1898–99.

From the foregoing it appears that the average age on entrance is eighteen years and eleven months.

In this connection are presented the ages, at graduation, of the class leaving us in June. The one hundred and seventy-one members of the class were distributed among the different periods of life as follows:

Under 20½	7
Between 20½ and 21	3
" 21 " 21½	13
" 21½ " 22	9
" 22 " 23	46
" 23 " 24	44
" 24 and over	49
Total	171

The special students this year constitute twenty-six per cent. of the whole body, as against twenty-six per cent. last year and twenty-seven per cent. the year before.

Graduates of Other Colleges.

The number of students who are graduates of this and other institutions is eighty-one. Of these nine are our own graduates, three being candidates for advanced degrees.

Seventy-three are graduates of other institutions, pursuing courses of study with us either as regular or as special students. Seventeen are graduates of Harvard University; four each of Wellesley College and Yale University; three each of Amherst College and Brown University; two each of McGill, Maine, and Vermont Universities, and Dartmouth College; while the following institutions are represented on our list by a single graduate each: Acadia, Denison, DePauw, Johns Hopkins, Minnesota, Princeton, Syracuse, and Wisconsin Universities; Ashville, Beloit, Boston, Central Turkey, Christian Brothers, Colby, Davidson, Delaware, Doane, Hobart, Lafayette, Monmouth, Neuchatel, New

Hampshire, Randolph-Macon, R.I. Agricultural and Mechanic Arts, Robert, Simpson, Smith, St. John's, St. Joseph's, Southern Kentucky, Southwestern Presbyterian, Trinity, Vassar, and Villanova Colleges.

Women as Students at the Institute.

The number of women pursuing courses with us is fifty-three. Of these, five are graduates of colleges. Of the total number, five are regular students of the fourth year; five of the third year; six of the second year; six of the first year. Thirty-one are special students. Of the sixteen regular students of the upper classes, three take Course IV., Architecture; six, Course V., Chemistry; two, Course VII., Biology; four, Course VIII., Physics; one, Course IX., General Studies. Of the special students, fifteen devote themselves to Biology, eight to Chemistry, three to Architecture, two to General Studies, one to Physics, one to Naval Architecture, and one to Drawing.

Statistics of Examinations.

Of the 1,178 students of the present year, 414 were not connected with the school in 1898–99. Of these, 275 were admitted as regular students of the first year upon the basis of their entrance examinations. The 139 remaining comprise (1) those who had previously been connected with the Institute, and have resumed their places in the school; (2) those who were admitted provisionally without examination; (3) those who were admitted by examination as regular second-year or as special students; (4) those who were admitted on the presentation of diplomas or certificates from other institutions of college grade. In addition to the 275 who were thus admitted to the Institute on examination, and have taken their place in the school, 74 were admitted on examination, but have not entered the school.

In the case of the 275 persons who were admitted on examination, and have joined the school, the results of the examinations, embracing both those of June and those of September, were as follows:

Admitted clear	203
" on one condition	49
" on two conditions	18
" on more than two conditions	5
	275

Forty-seven applicants were rejected.

Examinations at Distant Points.

In addition to the entrance examinations held at Boston in July and September, examinations were conducted in July at Albany, Buffalo, Chicago, Cincinnati, Concord (N.H.), Denver, Detroit, Exeter (N.H.), Indianapolis, Kansas City (Mo.), Louisville, Manlius (N.Y.), New York, Philadelphia, Pittsburgh, Portland (Me.), Poughkeepsie, St. Louis, St. Paul, Springfield (Mass.), and Washington.

The following table exhibits the number of persons who have graduated within each of the several courses since the foundation of the school:

Year.	Civil Engineering.	Mechanical Engineering.	Mining Engineering.	Architecture.	Chemistry.	Metallurgy.	Electrical Engineering.	Natural History or Biology.	Physics.	General Course.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	Total.
1868	6	1	6	..	..	..	..	..	..	1	..	..	..	..	14
1869	2	2	..	..	1	..	..	..	..	..	..	..	..	..	5
1870	4	2	2	..	1	..	..	..	..	1	..	..	..	..	10
1871	8	2	5	..	2	..	..	..	..	..	..	..	..	..	17
1872	3	1	5	..	3	..	..	..	..	..	..	..	..	..	12
1873	12	2	3	1	7	..	..	..	..	1	..	..	..	..	26
1874	10	4	1	1	..	..	..	..	..	2	..	..	..	..	18
1875	10	7	6	1	1	..	..	..	1	2	..	..	..	..	28
1876	12	8	7	..	5	1	..	2	3	4	..	..	..	..	42
1877	12	6	8	4	2	..	..	..	..	..	..	..	..	..	32
1878	8	2	2	3	3	..	..	..	..	1	..	..	..	..	19
1879	6	8	3	1	3	..	..	1	1	..	..	..	..	..	23
1880	3	..	3	..	1	..	..	..	..	1	..	..	..	..	8
1881	3	5	6	3	8	..	..	1	..	2	..	..	..	..	28
1882	2	5	5	3	6	..	..	1	1	1	..	..	..	..	24
1883	3	7	5	1	3	..	..	..	..	..	..	..	..	..	19
1884	5	6	13	..	12	..	..	..	..	..	..	..	..	..	36
1885	4	7	8	2	4	..	2	..	..	1	..	..	..	..	28
1886	9	23	7	1	7	..	10	1	..	1	..	..	..	..	59
1887	10	17	8	1	9	..	8	1	1	3	..	..	..	..	58
1888	11	25	4	5	10	..	17	3	1	1	..	..	..	..	77
1889	14	24	5	3	8	..	17	1	1	2	..	..	..	..	75
1890	25	28	3	5	13	..	18	3	2	6	..	..	..	..	103
1891	18	26	4	6	11	..	23	3	3	1	7	..	1	..	103
1892	22	26	4	13	7	..	36	6	1	7	4	6	1	..	133
1893	25	30	5	2	8	..	41	2	..	6	8	..	2	..	129
1894	21	31	4	14	11	..	33	1	3	5	12	3	..	..	138
1895	25	30	3	15	14	..	33	..	2	4	11	4	..	5	144*
1896	25	34	10	24	17	..	48	3	3	7	7	4	3	5	189*
1897	25	40	7	16	20	..	33	2	3	7	12	4	1	9	179
1898	32	41	7	29	26	..	33	3	4	6	9	3	..	7	200
1899	30	38	9	22	21	..	32	2	2	1	9	1		8	172*†
Totals	405	488	168	176	244	1	384	36	32	74	79	25	8	34	2,148
Deduct names counted twice.															12
Net total															2,136

* Deducting names counted twice.
† Including two persons awarded degrees on the date of this report.

THE SOCIETY OF ARTS.

REPORT OF THE SECRETARY.

To the President of the Institute:

SIR: On behalf of the Executive Committee, I have the honor to present the annual report of the Society of Arts for the year May 10, 1898, to May 11, 1899.

The first meeting of the Society of Arts for the present year was held on Oct. 13, 1898. Fourteen meetings have been held, and the following papers have been read: "Bacteria in Milk; including their Rôle in Butter and Cheese Making," by Mr. S. C. Keith, Jr.; "Wool, with Practical Features that Enter into the Forming of a Wool Tariff," by Mr. Henry G. Kittredge; "Metropolitan Water Supply," by Mr. Frederic P. Stearns; "Geology of the Wachusett Reservoir," by Prof. W. Q. Crosby; "Repeated Stresses," by Prof. Jerome Sondericker; "A Description of the Construction and Other Features of the South Terminal Station," by Mr. George B. Francis and Mr. Henry J. Conant; "Modern Methods of Steel Forging," by Mr. H. F. Porter; "The Diesel Motor," by Col. E. D. Meier; "The Construction of the University of Virginia, Old and New," by Mr. Theodore H. Skinner; "An American Railway in Columbia," by Mr. Francis R. Hart; "The Middlesex Fells Observatory," by Mr. George L. Hosmer; "A New Form of Induction Coil," by Mr. T. B. Kinraide; "The Present State of Metallurgy of Lead in the United States," by Prof. H. O. Hofman.

The meeting on December 22 was for the purpose of opening the new Pierce Building to the interested public.

A number of new members have been added during the year. At the close of the year 1897–98 the number of Life Members was 53. Five have died this year, leaving the present number 48.

The number of Associate Members a year ago was 323.

Of these, 1 has died and 6 have resigned, but 17 have been elected, and the present number is 333. The Life Members who have died during the year are Hon. John Cummings, Waldo O. Ross, Henry Davenport, Hon. F. W. Lincoln, and Col. Henry Lee. One Associate Member, Capt. Alfred E. Hunt, of Pittsburgh, served in the war with Spain, and brought back his regiment without the loss of a man, but has just died from the effects induced by exposure in the trying campaign.

The Board of Publication of last year was reappointed, and the "Technology Quarterly" has been conducted as before, with Dr. Bigelow as responsible editor. During the year twenty articles have been published in the "Quarterly," besides the "Proceedings of the Society of Arts" and "Review of American Chemical Research," which have appeared regularly. Of the contributed articles eight are papers that have been read before the Society of Arts, the remaining twelve having been presented by title only. Among the most notable of the latter is an extended paper by Prof. S. W. Holman, entitled "On the Telescope-Mirror-Scale Method; Adjustments and Tests."

At the last meeting of the year, the thirty-seventh annual meeting, Messrs. George W. Blodgett, Desmond FitzGerald, Edmund H. Hewins, Frank W. Hodgdon, and Charles T. Main were reëlected members of the Executive Committee, and Mr. A. T. Hopkins was reëlected Secretary for the year 1899–1900.

Respectfully submitted,

ARTHUR T. HOPKINS,
Secretary.

DEC. 12, 1899.

THE SOCIETY OF ARTS.

REPORT OF THE SECRETARY.

To the President of the Institute:

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Respectfully submitted,

ARTHUR T. HOPKINS,
Secretary.

DEC. 12, 1899.

TREASURER'S REPORT.

STATEMENT OF THE TREASURER.

THE Treasurer submits the annual statement of the financial affairs of the Institute for the year ending Sept. 30, 1899.

Under the will of the late Edward Austin the Institute received, after payment of the United States succession tax of sixty thousand dollars, three hundred and forty thousand dollars, the income from which is to be used for special purposes designated in the will. Edward W. Hooper, Esq., most kindly and generously gave to the Institute the full sum paid by it for legal expenses incurred in connection with the settlement relating to this will and amounting to eighteen hundred dollars.

Augustus Lowell, Esq., has given fifty thousand dollars to constitute, in his own words, the nucleus of a fund, of which the income shall be used for the benefit of the Teaching Staff of the Institute in cases of illness, death, or retirement, subject to such regulations as the Government may from time to time see fit to adopt. The name attached to this gift is simply "The Teachers' Fund." The value of such an endowment is very great. The need of it has been keenly felt, and it is earnestly desired that the hope expressed by Mr. Lowell may be realized and the amount so generously devoted by him to these purposes be increased in the future by gifts from others.

In addition to the large amounts previously paid over by the executors of the will of the late Hon. Henry L. Pierce thirty thousand dollars more have been received.

Similarly the trustees of the J. W. and Belinda Randall Charity have added twenty-five thousand dollars to their previous gift, and the executors of the late Mrs. Julia B. H. James have made a further payment of six thousand dollars. From the Susan E. Dorr estate fourteen hundred and sixty-seven dollars and nineteen cents have been received, and the Ann White Dickinson Scholarship Fund has been increased by five hundred and ninety-four dollars and forty-one cents. Mrs. Wm. B. Rogers has given two hundred dollars for the purchase of periodicals, and from other friends have come gifts amounting in all to eight hundred and sixty-one dollars and thirty-four cents.

There has been an increase in the income for general purposes from stocks and bonds of more than eleven thousand dollars and also a gain in the amounts received from rents and interest, but to offset these the sum paid for salaries has increased about eight thousand dollars, and with the new building general expenses as well as the cost of fuel, water, and electricity have all become greater. In general expenses, there have been included some large items such as furniture and electrical wiring and fixtures. In connection with the transfer of certain departments to the Henry L. Pierce building extensive changes were made in the other buildings and the payments for these were charged to repair account. The result is an adverse balance of nineteen thousand eight hundred and eighty-three dollars and forty-two cents in the current expense account. There has, however, been a net gain on securities sold of nineteen thousand seven hundred and eighty-eight dollars and sixty-nine cents.

The net increase in the property of the Institute for the year is four hundred and thirty-seven thousand one hundred and fifteen dollars and twenty-six cents. It should, however, be noted that of this sum nearly three hundred and ninety-three thousand dollars are for special purposes and not available for general expenses.

Securities Sold or Paid, W. B. Rogers Memoral Fund.

$16,000	Kansas City, Cl. and Springfield R.R. 5s	1925	11,940.00
1,000	Kansas City, Mem., & Birmingham R.R. 4s.	1934	830.00
2,000	Kan. City, Mem., & Birmingham R.R. Inc. 5s.	1934	720.00
42,000	Chi., Burlington & Quincy R.R. Conv. 5s.	1903	58,601.05
1,600	Republican Valley R.R. 6s.	1919	1,600.00
255 Sh.	Detroit, Grand Rapids & Western R.R., Pf.		10,072.50
			$83,763.55

Received.

$25,000	Atchison, Topeka & Santa Fe R.R. Gen. 4s.	1995	24,470.00
7,000	Chesapeake & Ohio R.R. 5s.	1939	8,267.50
38,000	Chi., Junct. & Union Stock Yards 5s. transferred from General Funds	1915	42,022.00
			$74,759.50

Securities Sold or Paid, General Account.

$15,000	Chi., Bur. & Quincy R.R. Conv. 5s.	1903	20,928.95
3,000	Bur. & Missouri R.R. Non-exempt 6s.	1918	3,000 00
2,000	Brookline Gas Co. 5s.	1913	2,110.00
2,000	Lowell, Law. & Haverhill St. Ry. 5s.	1923	2,100.00
29,000	Walter Baker Co. Lt'd. 4½s.	1903	29,000.00
38,000	Chi. Junc., & Union Stock Yards 5s. transferred to Rogers Fund	1915	42,022.00
25,000	Illinois Steel Conv. 5s.	1910	26,250 00
55 Sh.	Chi., Bur. & Quincy R.R.		6,545.00
55 "	Chi., Rock Island & Pacific R.R.		5,885.00
½ "	Pepperell Manf. Co., New		115.50
15 "	Consolidated Gas Co., New York		2,745.00
7 "	Lowell Gas Co.		1,891.75
7 "	Lawrence Gas Co.		805.00
5 "	First National Bank, Baltimore		500.00
25 Rights	Boston Real Estate Trust		307.36
55 "	New England Tel. & Tel. Co.		151.25
			$144,356.81

Securities Bought or Received as Legacies, General Account.

25 Sh.	Boston Real Estate Trust		25,005.00
$25,000	Chi. Terminal & Transfer Co. 1st 4s.	1947	22,987.50
25,000	Illinois Steel Co. Conv. 5s.	1910	24,950.00
25,000	Illinois Steel Co. Non-conv. 5s.	1913	24,290.00
250,000	New York Revenue 3½s.	1899	250,000.00
43,000	Chesapeake & Ohio R.R. 5s.	1939	50,770.00
50,000	Chi. Junc. & Union Stock Yards Inc. 5s.	1907	50,000.00
			$448,002.50

GEORGE WIGGLESWORTH, TREASURER, *in account with*
GENERAL STATEMENT OF RECEIPTS AND DISBURSEMENTS

Dr.

Cash balance Sept. 30, 1898		110,567.63
From Augustus Lowell for Lowell Courses	6,000.00	
" " " " C. Kastner's salary	2,500.00	
" " " " School of Design	500 00	
		9,000.00
RECEIPTS FOR CURRENT EXPENSES.		
Income of funds for salaries	4,304.00	
" " " " scholarships (students' fees)	8,257.25	
" " " " Joy " [1898, 50.00]	250.00	
" " " " Swett "	400.00	
" " " " Savage "	400.00	
" " " " W. B. Rogers, 1898, etc.,	652.75	
" " " " Library	480.00	
" " " " general purposes	23,643.98	
" " Rogers Memorial Fund	10,877.63	
" " Charlotte B. Richardson Fund	1,495.15	
" " Rotch Prize Fund	400.00	
" " Rotch Architectural Fund	1,000.00	
Letter Box Fund	75.00	
Students' fees	207,118.00	
State Scholarships	4,000.00	
United States Act of 1862	5,717.56	
United States Act of 1890	8,333.34	
Gift of State of Massachusetts	25,000.00	
Biological Fund, 1898	143.50	
Laboratory supplies and breakages	9,546.57	
Rents, per Table (page 92)	16,115.81	
Gifts	2,861.34	
Interest	12,890.74	
Boston University	1,150.00	
Sale printed Lecture Notes	2,463.60	
		347,576.22
GIFTS AND BEQUESTS FOR SPECIAL PURPOSES.		
Increase James Savage Fund	126.10	
" Dalton Graduate Chem. Sch'p Fund	221.28	
" Willard B. Perkins Fund	243.20	
" Susan Upham Fund	49.84	
" James H. Mirrlees Fund	7.34	
" Letter Box Fund	18.25	
Teachers' Fund	50,000.00	
Edward Austin Fund	340,000.00	
Susan E. Dorr Fund [add'l 1,467.19]	1,718.01	
Ann White Dickinson Fund ["]	594.41	
		392,978.43
GIFTS AND BEQUESTS FOR GENERAL PURPOSES.		
Henry L. Pierce Legacy, additional	30,000.00	
James Fund, additional	6,000.00	
J. W. and Belinda Randall Fund, additional,	25,000.00	
		61,000.00
SECURITIES SOLD OR PAID. GENERAL FUND, page 83.		144,356.81
" " " Rogers Memorial Fund		83,763.55
SUNDRIES.		
Income credited to Bond Premium Acct.	2,429.00	
Income credited to Rogers Bond Premium Acct.	578.00	
Boston Art Students' Association, on acc't	666.67	
Students' Notes paid	155.00	
Students' deposits	150.00	
		3,978.67
		$1,153,221.31

MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

FOR THE YEAR ENDING SEPT. 30, 1899.

Cr.

Paid for Lowell Courses	6,000.00	
" " Charles Kastner's salary	2,500.00	
" " Expense Lowell School of Design	500.00	
		9,000.00
EXPENSES.		
Salaries, per Table (page 92)	239,920.62	
" paid from Gifts	458.00	
Fellowship paid from Swett Fund	400.00	
" " " Savage "	400.00	
Prizes, Rotch Funds	400.00	
Repairs, per Table (page 93)	33,678.83	
General Expenses, per Table (page 93)	23,183.31	
Fire Insurance	2,626.35	
Biological Instrument Department	143.50	
Fuel	7,181.73	
Water	2,370.30	
Gas	2,133.70	
Electricity	1,431.08	
Printing and Advertising	3,057.67	
" Lecture Notes	1,681.38	
" Annual Catalogues and Reports	2,470.06	
Rents paid Boston & Albany R.R. Co.	180.00	
" " Natural History Society	200.00	
Laboratory Supplies and Libraries, per Table (page 92)	39,337.38	
Society of Arts	777.01	
Interest paid A. Lowell, Trustee	1,000.00	
Mech. Eng. & Applied Mechanics Department, Improvements	4,395.31	
Omaha Exposition	33.41	
		367,459.64
[Expenses more than Income, $19,883.42]		
SECURITIES BOUGHT OR RECEIVED AS LEGACIES.		
General Account (page 83)		448,002.50
Rogers Memorial Fund		74,759.50
Henry L. Pierce Building, Trinity Place, on acct.		52,992.99
Boiler and Power House, Trinity Place		22,341.74
Fire Repairs, Engineering Building and contents		16,462.63
SUNDRIES.		
Notes Receivable	100,000.00	
Funds of 1898, used	455.81	
		100,455.81
Cash balance, Sept. 30, 1899		61,746.50
		$1,153,221.31

The following account exhibits the property held by the Institute, as per Treasurer's books, Sept. 30, 1899:

INVESTMENT OF THE W. B. ROGERS MEMORIAL FUND.

$30,000.00	Burlington & Mo. River R.R. 4s. .	1910	25,787.50
27,000.00	Kansas City Belt R.R. 6s.	1916	27,000.00
6,000.00	New York & New England R.R. 6s.	1905	6,000.00
3,800.00	Republican Valley R.R. 6s. . . .	1919	3,800.00
4,000.00	Cin., Ind., St. Louis & Chicago R.R. 6s.	1920	4,000.00
2,000.00	Ottawa, Oswego & Fox River R.R. 8s.	1900	2,000.00
2,000.00	Kansas City, Fort Scott & Gulf R.R. 7s.	1908	2,000.00
1,000.00	Lincoln & Northwestern R.R. 7s. .	1910	1,000.00
1,000.00	Atchison & Nebraska R.R. 7s. . .	1908	1,000.00
35,000.00	Fort Street Union Depot 4½s. . . .	1941	34,825.00
24,000.00	Rome, Watertown & Ogdensburg R.R. 5s.	1922	24,000.00
37,500.00	Detroit, G. Rapids & Western R.R. 4s.	1946	37,500.00
25,000.00	Atchison, Top. & S. Fe R.R. 4s . .	1995	24,470.00
7,000.00	Chesapeake & Ohio R.R. 5s . . .	1939	7,000.00
38,000.00	Chi. Junc. & Union Stock Yards 5s .	1915	38,000.00
	Advance to Bond Premium account .		10,941.84
	Bonds and Stocks		249,324.34

INVESTMENTS, GENERAL ACCOUNT.

$11,000.00	Bur. & Mo. River (Neb.) R.R. 6s., non-exempt	1918	11,000.00
2,000.00	Bur. & Mo. River (Neb.) R.R. 6s., exempt	1918	2,000.00
6,000.00	Chicago, Burlington & Quincy R.R. 4s.	1922	5,100.00
3,000.00	Chicago, Mil. & St. Paul R.R. 7s .	1905	3,000.00
4,000.00	Chicago, Burlington & Northern R.R. 5s.	1926	4,000.00
2,000.00	Kansas City, Fort Scott & Gulf R.R. 7s.	1908	2,000.00
3,000.00	Hannibal & St. Joseph R.R. 6s. . .	1911	3,000.00
6,000.00	West End Street Ry. 5s	1902	6,000.00
35,000.00	Fitchburg R.R. 5s.	1903	35,000.00
65,000.00	Boston & Maine R.R. 4½s.	1944	65,000.00
26,000.00	Am. Dock & Improvement Co. 5s. .	1921	26,000.00
3,000.00	Illinois Central R.R. 4s.	1951	3,000.00
26,000.00	New York & New England R.R. 6s.	1905	26,000.00
8,000.00	Chi. Junc. & Union Stock Yards 5s .	1915	8,000.00
5,000.00	Dominion Coal Co. 1st. 6s. . . .	1913	5,000.00
2,000.00	New England Tel. & Tel. Co. 6s. .	1907	2,000.00
2,000.00	New York & New England R.R. 7s.,	1905	2,000.00
100,000.00	West End Street Ry. 4s	1917	100,000.00
50,000.00	Utah & Northern R.R. 1st. 7s. . .	1908	50,000.00
121,000.00	Walter Baker Co. Lt'd. 4½s . . .	1903	121,000.00
25,000.00	Chi. Terminal & Transfer Co. 1st. 4s.	1947	22,987.50
25,000.00	Illinois Steel Co., non-conv. 5s . .	1913	24,290.00
43,000.00	Chesapeake & Ohio R.R. 5s . . .	1939	43,000.00
50,000.00	Chi. Junc. & Union S. Yards inc. 5s.	1907	50,000.00
250,000.00	New York Revenue 3½s	1899	250,000.00
	Advances to Bond Premium account,		26,385.43
	Bonds		895,762.93
	Amount carried up		$1,145,087.27

Amount brought up $1,145,087.27

STOCKS.

SHARES.					
198	Boston & Albany R.R.	par	100	40,683.00	
194	Morris & Essex R.R.	"	50	14,690.00	
40	New York & Harlem R.R.	"	50	5,000.00	
85	Pittsburg, Fort Wayne & C. R.R.	"	100	12,880.00	
100	N.Y., New Haven & Hartford R.R.	"	100	17,000.00	
50	Boston & Maine R.R. common	"	100	8,300.00	
25	Boston & Providence R.R.	"	100	6,625.00	
50	Chi., Milwaukee & St. Paul R.R. Pf.	"	100	7,000.00	
50	Fitchburg R.R. Pf.	"	100	4,800.00	
90	Pullman's Palace Car Co.	"	100	10,200.00	
12	Cocheco Manufacturing Co.	"	500	6,000.00	
56	Hamilton Woollen Co.	"	100	5,390.00	
59	Everett Mills	"	100	5,310.00	
31	Great Falls Manufacturing Co.	"	100	3,472.00	
6	Manchester Mills	"	100	660.00	
2	Dwight Manufacturing Co.	"	500	1,600.00	
1	Merrimack Manufacturing Co.	"	1000	1,015.00	
17	Pepperell Manufacturing Co.	"	100	2,789.50	
10	Lowell Bleachery	"	100	975.00	
27	Essex Co.	"	50	3,780.00	
158	Pennsylvania Coal Co.	"	50	23,160.50	
40	Cambridge Gas Light Co.	"	100	7,000.00	
55	Old Boston National Bank	"	100	5,510.50	
15	Merchants' National Bank	"	100	2,220.00	
25	New England National Bank	"	100	3,875.00	
25	Atlantic National Bank	"	100	2,875.00	
10	National Union Bank	"	100	1,240.00	
25	National Bank of the Republic	"	100	3,625.00	
40	The Molsons Bank, Montreal	"	50	3,000.00	
37	Nat. Mechanics Bank, Baltimore	"	10	706.70	
5	First Nat. Bank of Baltimore	"	100	793.30	
64	Boston Real Estate Trust	"	1000	68,909.64	
1	Boston Ground Rent Trust	"	1000	900.00	
50	American Bell Telephone Co.	"	100	12,750.00	
55	New England Tel. & Tel. Co.	"	100	6,604.69	
					301,339.83

INVESTMENT OF THE JOY SCHOLARSHIP FUND.

Massachusetts Hospital Life Insurance Co. .	5,000.00	
Deposits in Savings Banks	4,123.70	
		9,123.70

INVESTMENT SWETT SCHOLARSHIP FUND.

Massachusetts Hospital Life Insurance Co.	10,000.00
Amount carried up	$1,465,550.80

Amount brought up			1,465,550.80
REAL ESTATE.			
Rogers Building		200,000.00	
Walker "		150,000.00	
Land on Garrison Street	50,840.00		
Workshops " "	30,000.00		
		80,840.00	
Land on Trinity Place	76,315.69		
Engineering Bldg. A, Trinity Place,	90,000.00		
		166,315.69	
Gymnasium Building		7,967.85	
Engineering Building B		57,857.10	
Lot No. 2, Trinity Place		137,241.60	
Henry L. Pierce Building, Trinity Place		152,875.46	
Boiler and Power House, Trinity Place		22,341.74	
Clarendon St. Land and Building		142,762.94	
House No. 34 Commonwealth Ave.		30,000.00	
Real Estate, Massachusetts Ave., Cambridge		16,154.38	
			1,164,356.76
Equipment, Engineering Building		16,555.24	
" Workshops		20,628.56	
			37,183.80
SUNDRIES.			
Notes Receivable		378,500.00	
Boston Art Students' Association		10,999.99	
Students' Notes		1,250.50	
Cash Balance, Sept. 30, 1899		61,746.50	
			452,496.99
			$3,119,588.35

The foregoing property represents the following Funds and Balances, and is answerable for the same.

The income of the following is used for the general purposes of the Institute:

William Barton Rogers Memorial Fund	250,225.00	
Richard Perkins Fund	50,000.00	
George Bucknam Dorr Fund	49,573.47	
Martha Ann Edwards "	30,000.00	
Nathaniel C. Nash "	10,000.00	
Sidney Bartlett "	10,000.00	
Robert E. Rogers "	7,680.77	
Albion K. P. Welch "	5,000.00	
Stanton Blake "	5,000.00	
McGregor "	2,500.00	
Katharine B. Lowell "	5,000.00	
Samuel E. Sawyer "	4,610.87	
John W. and Belinda Randall Fund	75,000.00	
James Fund	146,500.00	
		651,090.11
Amount carried up		$651,090.11

Amount brought up		651,090.11
The income of the following is used towards paying salaries:		
Nathaniel Thayer, for Professorship of Physics	25,000.00	
Jas. Hayward, for Professorship of Engineering	18,800.00	
William P. Mason " Geology	18,800.00	
Henry B. Rogers, for General Salaries	25,000.00	
George A. Gardner, " "	20,000.00	
		107,600.00
SCHOLARSHIP TRUSTS.		
Richard Perkins Fund	53,209.82	
James Savage Fund	13,678.55	
Susan H. Swett Fund	10,182.95	
William Barton Rogers Fund	10,615.98	
Joy Fund	9,123.70	
Elisha Thatcher Loring Fund	5,329.39	
Charles Lewis Flint Fund	5,253.93	
Thomas Sherwin Fund	5,000.00	
Farnsworth Fund	5,000.00	
James H. Mirrlees Fund	2,803.53	
William F. Huntington Fund	5,208.33	
T. Sterry Hunt Fund	3,221.46	
Elisha Atkins Fund	5,000.00	
Nichols Fund	5,000.00	
Ann White Vose Fund	60,726.82	
Ann White Dickinson Fund	40,594.41	
Dalton Grad. Chem. Fund	5,753.09	
Willard B. Perkins Fund	6,323.20	
		252,025.16
OTHER TRUSTS.		
Charlotte Billings Richardson Industrial Chemistry Fund		37,378.78
Susan Upham Fund		1,295.81
Susan E. Dorr Fund		7,138.60
William Hall Kerr Library Fund		2,000.00
Charles Lewis Flint Library Fund		5,000.00
Rotch Architectural Library Fund		5,000.00
Rotch Architectural Fund		25,000.00
Rotch Prize Fund		5,200.00
Rotch " Special " Prize Fund		5,200.00
Edward Austin Fund		340,000.00
Teachers' Fund		50,000.00
Letter-box Fund, balance		82.12
MISCELLANEOUS.		
Notes Payable	20,000.00	
Students' Deposits	300.00	
John Foster Legacy, 1898	10,000.00	
Henry L. Pierce Legacy, 1898	780,000.00	
John W. Carter Legacy, 1898	6,250.00	
M. I. T. Stock Account	809,027.77	
		1,625,577.77
		$3,119,588.35

Comparative Statement of Funds, etc.

	Sept. 30, 1898.	Sept. 30, 1899.
Trusts for general purposes	620,090.11	651,090.11
" " Salaries	107,600.00	107,600.00
" " Scholarships	251,145.14	252,025.16
" " Library	7,000.00	7,000.00
Charlotte B. Richardson Ind. Chem. Fund	37,378.78	37,378.78
Susan Upham Fund	1,245.97	1,295.81
Susan E. Dorr Fund	5,420.59	7,138.60
Rotch Architectural Library Fund	5,000.00	5,000.00
Rotch Architectural Fund	25,000.00	25,000.00
Rotch Prize Fund	5,200.00	5,200.00
Rotch "Special" Prize Fund	5,200.00	5,200.00
Moses Kimball Legacy	5,000.00	
Benj. P. Cheney "	10,000.00	
John Foster "	10,000.00	10,000.00
Henry L. Pierce "	750,000.00	780,000.00
John W. Carter "	6,250.00	6,250.00
Susan G. Coolidge Devise	14,500.00	
Edward Austin Fund		340,000.00
Teachers' Fund		50,000.00
Letter-box Fund	63.87	82.12
Biological Instrument Fund	143.50	
Students' Deposits	150.00	300.00
Notes Payable	20,000.00	20,000.00
Fire Insurance, Engineering Building	16,462.63	
M. I. T. Stock Account	779,622.50	809,027.77
	$2,682,473.09	$3,119,588.35
Increase,		
Consisting of:		
Bequests for Special Purposes, etc. (See page 84)	392,978.43	
Gifts and Bequests for General Purposes. (See page 84)	61,000.00	
Students' Deposits	150.00	
Net gain on Securities sold	19,788.69	
		473,917.12
Less Funds of 1898, used	455.81	
" Fire Insurance, Engineering Building, expended	16,462.63	
" Expenses more than Income	19,883.42	
		36,801.86
		$437,115.26

INCOME FROM GENERAL INVESTMENTS, AND APPLICATION THEREOF.

Applied to Salaries	4,304.00	From Dividends, Bank Stocks	1,294.90
" " Scholarships	8,257.25	" State Tax returned on Bank Stocks	238.30
" " " James Savage Fund	400.00	" Bonds	28,366.28
" " Charlotte B. Richardson Fund	1,495.15	" Dividends, Railroad Stocks	5,735.06
" " Rotch Prize Funds	400.00	" " Coal and Gas Stocks	1,622.57
" " Rotch Architectural Fund	1,000.00	" " Manufacturing Stocks	1,495.00
" " Library	480.00	" Telephone Stocks	1,078.35
" " General Purposes	23,643.98	" Real Estate Stocks	3,477.50
" " Increase of Funds	898.58		
" " Advances to Bond Premiums	2,429.00		
	$43,307.96		$43,307.96

INCOME FROM WILLIAM BARTON ROGERS MEMORIAL FUND, AND APPLICATION THEREOF.

Paid Massachusetts Institute of Technology	10,877.63	Received Income from Railroad Bonds	11,455.63
Credited to Advances Bond Premiums	578.00		
	$11,455.63		$11,455.63

DETAILS OF SOME ITEMS IN TREASURER'S CASH ACCOUNT.

Rents.

Huntington Hall, for Lowell Lectures		3,500.00	
Lowell School of Design		1,800.00	
Chauncy Hall School, for Gymnasium		100.00	
Land and Building, Clarendon St., on account		9,250.00	
34 Commonwealth Avenue, 1 year	2,200.00		
Less Annuity under Will,	1,000.00		
" Tax	390.90		
	1,390.90		
		809.10	
Use of Rooms and Gymnasium		1,165.39	
		16,624.49	
Less Tax and Repairs, Cambridge		508.68	
			16,115.81

Department Supplies.

Civil Engineering	3,972.21	
Mechanical Engineering	2,825.80	
Applied Mechanics	1,683.32	
Mining	2,553.49	
Architecture	2,576.02	
Chemistry	10,193.08	
Physics	6,714.69	
Biology	1,786.01	
English	969.91	
Modern Languages	114.83	
Geology	1,001.42	
Naval Architecture	758.06	
Drawing	109.80	
Mathematics	641.73	
Military	68.17	
Periodicals	1,937.86	
Workshops	1,430.98	
		39,337.38

Salaries.

Instruction	191,129.25	
Administration	22,422.59	
Labor	26,368.78	
		239,920.62

General Expenses.

Furniture		6,076.43
Electrical Wiring and Fixtures		3,250.16
Postage		2,298.48
Legal Fees		1,892.13
Janitors' Supplies		1,541.77
Stationery and Office Supplies		1,266.85
Engine Room Supplies:		
Oil	332.71	
Sundries	324.62	
Waste	69.32	
		726.65
Entrance Examinations		611.05
Express		601.21
Washing		555.31
Diplomas		433.03
Shades		422.44
Clocks, for Time Service		390.00
Books, Supplies, etc., for General Library		299.96
Sundries		295.55
Telephone & Telegraph Co.		267.84
Ice		266.05
Motor, Carpenter Shop		235.00
Lowell School of Design		212.64
High Service Pipe		206.67
Bicycle Shed		196.30
Gymnasium		193.90
Blue Books		193.59
Locks, Students' tables, Mech. Eng.		165.97
Removing Ashes		147.00
Telephone Line		91.92
Type-writing Machine		90.25
Union Safe Deposit Vaults		75.00
Glass		60.33
Street Watering		48.98
Graduation Exercises		43.85
Western Union Telegraph Co.		27.00
		23,183.31

Repairs.

Department Improvements:		
Civil Engineering	432.42	
Mechanical Engineering	570.55	
Mining	777.32	
Architecture	85.35	
Chemistry	2,618.93	
Physics	1,183.96	
Biology	15.91	
English	7.50	
Modern Languages	30.63	
Geology	359.57	
Naval Architecture	90.28	
Drawing	198.50	
Workshops	1,488.61	
		7,859.53
Rogers Building		14,485.73
Fire Escapes		2,873 26
Walker Building		2,795.03
Eng. Building, A and B		2,104.35
Steam Fitting		1,127.33
Walk to Entrance Eng. Building		1,000.00
Roofing Vaults Walker Building		573.56
Roofing Vaults Rogers Building		436.80
Gymnasium		391.21
Boiler Room		32.03
		33,678.83

BOSTON, December 7, 1899.

An examination of the accounts of the Treasurer of the MASSACHUSETTS INSTITUTE OF TECHNOLOGY for the year ending September 30, 1899, has been made by Mr. E. A. Stone, an accountant employed by this committee. We have also verified the evidences of personal property held by the Institute.

The report of Mr. Stone is hereto annexed.

JAMES P. TOLMAN,
CHARLES C. JACKSON,
WILLIAM L. PUTNAM,
Members of the Auditing Committee.

BOSTON, December 7, 1899.

To the Auditing Committee of the
Massachusetts Institute of Technology:

GENTLEMEN: I have completed the examination of the Treasurer's accounts for the year ending September 30, 1899, and find them to be correct. I have also verified the bank balances. The trial balance corresponds with the ledger balances. The vouchers for all items paid out are accounted for. I have also examined the payments for the weekly pay-roll, and find them to be correct. The amounts charged to the students agree with the Secretary's records, and the sums received therefor are also duly accounted for.

Yours truly,
EDWIN A. STONE,
Accountant.