MASSACHUSETTS INSTITUTE OF TECHNOLOGY

ANNUAL REPORT

OF THE

PRESIDENT AND TREASURER

DECEMBER 9, 1903

BOSTON
GEO. H. ELLIS CO., PRINTERS, 272 CONGRESS STREET
1904

CONTENTS.

Members of the Corporation.

President.
HENRY S. PRITCHETT.

Secretary.[1]
FRANCIS H. WILLIAMS.

Treasurer.
GEORGE WIGGLESWORTH.

WILLIAM ENDICOTT.
HOWARD A. CARSON.
CHARLES J. PAINE.
CHARLES FAIRCHILD.
DAVID R. WHITNEY.
ALEXANDER S. WHEELER.
JAMES P. TOLMAN.
HOWARD STOCKTON.
NATHANIEL THAYER.
CHARLES F. CHOATE.
HIRAM F. MILLS.
PERCIVAL LOWELL.
CHARLES MERRIAM.
THORNTON K. LOTHROP.
CHARLES C. JACKSON.
SAMUEL M. FELTON.
DESMOND FITZGERALD.
SAMUEL CABOT.
FRANCIS BLAKE.
CHARLES W. HUBBARD.

THOMAS L. LIVERMORE.
A. LAWRENCE ROTCH.
JOHN R. FREEMAN.
GEORGE A. GARDNER.
WILLIAM H. LINCOLN.
J. B. SEWALL.
CHARLES L. LOVERING.
A. LAWRENCE LOWELL.
JAMES P. MUNROE.
WILLIAM L. PUTNAM.
CHARLES G. WELD.
EBEN S. DRAPER.
ROBERT S. PEABODY.
ELIHU THOMSON.
ELLIOT C. LEE.
JAMES P. STEARNS.
LUCIUS TUTTLE.
FREDERICK P. FISH.
FRANCIS L. HIGGINSON.
CHARLES A. STONE.

W. MURRAY CRANE.

On the Part of the Commonwealth.

HIS EXCELLENCY, JOHN L. BATES, *Governor.*
HON. MARCUS P. KNOWLTON, *Chief Justice of the Supreme Court.*
_____, *Secretary of the Board of Education.*

[1] Correspondence should be addressed to Dr. H. W. Tyler, Secretary of the Faculty.

Committees of the Corporation.

Executive Committee.

HENRY S. PRITCHETT. } *Ex Officiis.*
GEORGE WIGGLESWORTH. }

HOWARD STOCKTON. THOMAS L. LIVERMORE.
FRANCIS H. WILLIAMS. A. LAWRENCE LOWELL.
FREDERICK P. FISH.

Finance Committee.

WILLIAM ENDICOTT. NATHANIEL THAYER.
DAVID R. WHITNEY. CHARLES F. CHOATE.
CHARLES C. JACKSON. JAMES P. STEARNS.

Committee on the Society of Arts.

HOWARD A. CARSON. GEORGE A. GARDNER.
HIRAM F. MILLS.

Auditing Committee.

CHARLES C. JACKSON. JAMES P. TOLMAN.
WILLIAM L. PUTNAM.

Committee on Nominations.

THORNTON K. LOTHROP. GEORGE A. GARDNER.
DAVID R. WHITNEY. HOWARD A. CARSON.
FRANCIS H. WILLIAMS.

Trustees of the Museum of Fine Arts.

HENRY S. PRITCHETT. A. LAWRENCE ROTCH.
FRANCIS BLAKE.

Visiting Committees.

Department of Civil Engineering.

HOWARD A. CARSON. DESMOND FITZGERALD.
CHARLES F. CHOATE. JOHN R. FREEMAN.
LUCIUS TUTTLE.

Departments of Mechanical Engineering and Applied Mechanics.

HIRAM F. MILLS. JAMES P. TOLMAN.
FRANCIS BLAKE. EBEN S. DRAPER.
ELLIOT C. LEE.

Departments of Mining and Geology.

THOMAS L. LIVERMORE. JAMES P. TOLMAN.
CHARLES FAIRCHILD. CHARLES L. LOVERING.
JAMES P. STEARNS.

Department of Architecture.

ROBERT S. PEABODY. ALEXANDER S. WHEELER.
A. LAWRENCE ROTCH. FRANCIS L. HIGGINSON.
JOHN R. FREEMAN.

Department of Physics.

FRANCIS BLAKE. A. LAWRENCE ROTCH.
CHARLES W. HUBBARD. ELIHU THOMSON.

Department of Electrical Engineering.

ELIHU THOMSON. FREDERICK P. FISH.
FRANCIS BLAKE. CHARLES A. STONE.
PERCIVAL LOWELL.

Departments of Literature, History, and Political Economy.

CHARLES C. JACKSON. J. B. SEWALL.
A. LAWRENCE LOWELL. CHARLES L. LOVERING.
JAMES P. MUNROE. JAMES P. TOLMAN.

Department of Modern Languages and English.

JAMES P. MUNROE. SAMUEL CABOT.
CHARLES C. JACKSON. J. B. SEWALL.

Department of Mathematics.

PERCIVAL LOWELL. WILLIAM L. PUTNAM.
HOWARD STOCKTON. CHARLES F. CHOATE.

Departments of Chemistry and Chemical Engineering.

SAMUEL CABOT. ELLIOT C. LEE.
HIRAM F. MILLS. CHARLES W. HUBBARD.
ELIHU THOMSON. W. MURRAY CRANE.

Department of Biology.

JOHN R. FREEMAN. CHARLES G. WELD.
FRANCIS BLAKE. FRANCIS H. WILLIAMS.

Department of Naval Architecture.

CHARLES J. PAINE. WILLIAM H. LINCOLN.
HOWARD STOCKTON. CHARLES G. WELD.

PART I.

REPORT OF THE PRESIDENT.

To the Members of the Corporation of the Massachusetts Institute of Technology: —

The reports of the administrative officers, which I have the honor to present at this time, refer to the school-year beginning October 1, 1902, and ending September 29, 1903. For your convenience, and for greater clearness, the printed statement has been divided into five parts, as follows:

I. Report of the President;
II. Reports of the Dean and heads of Departments;
III. List of publications by members of the Instructing Staff during the year;
IV. Statistics and Report of the Registrar;
V. Report of the Treasurer.

GENERAL POLICY OF THE INSTITUTE.

This is the fourth annual report that I have had the pleasure to address to your body. During the three years that have elapsed since my first report, marked changes have come about in the Institute, and in the conduct of its work. In this interval, the student body has grown from about twelve hundred to approximately sixteen hundred; and, although the increase in tuition which took effect at the beginning of the present year (1903–04) has brought about a small decrease in the entering class, the large increase in preliminary examinations for next year indicates that there has been no real break in the growth of numbers.

During these three years I have endeavored, in co-operation with the Executive Committee and the Faculty, to proceed along three general lines of progress.

First of all, the effort has been made to improve the means of instruction; to discuss with the members of the Faculty,

not only questions of detail, but the fundamental questions of the education which the Institute is to offer. The effort has been made to keep the old spirit of work and of energy, but to adapt as fast as may be the machinery of instruction to present day needs. This effort has resulted practically in a reorganization of executive officers, and in additions and changes in the Instructing Staff and modifications of the Courses.

A second consistent policy of procedure to which the Executive Committee has committed itself, with your endorsement, has been the effort to improve the facilities of instruction and to make them the best possible. The creation of the Department of Electrical Engineering and the erection of its splendid new laboratories, the new building which houses the Department of Naval Architecture and the laboratory of chemical research, the establishment of a Graduate School of Engineering Research, all mark steps taken, not by reason of additional endowment, but without it, and in the faith that the Institute of Technology must occupy a foremost place in technical education.

A third effort, and one vitally connected with the wish to bring to the Institute new men and to improve its facilities, has been the effort to increase the income. Our income has grown in three years from $347,132 in 1900 to $436,808 in 1903, an increase of nearly ninety thousand dollars, equivalent to the interest on something like two and a quarter millions of dollars. This income has come almost entirely from the growth in student fees due to the increased number of students. Our expenses in the meantime have grown faster than our income, so that the deficit of the last year is larger than for some years past, and serves to emphasize the fact that in technical education increase of expense keeps pace with increase in numbers; and that such education, in the best sense, can be kept up permanently only by a generous grant from the State, or by a correspondingly large income from private endowment. Where the Institute of Technology is to find this endowment is one of the serious problems.

The reasons which impel men of large fortunes to give their money to institutions of learning are varied. Few such gifts have as yet come to the Institute; but I can scarcely believe that any man interested in the industrial progress of America could find a more fruitful field for his money than that which the Institute offers.

How far these general lines of policy may prove to be correct, the future will show. One result has been an increase in instructors and in facilities, and the treasurer in his report has called attention to the fact, which we must frankly face, that the expenditures of the last year have outrun the receipts by a considerable margin. Nevertheless, I cannot but believe that the policy which the Executive Committee has pursued, with your approval, is the true one. The Institute of Technology will fail of its real purpose if it fails to stand at the front of technical education. The Executive Committee feels that it has pursued the right policy in its effort to keep the institution there, and that the question of future income is one which must be dealt with, not by it alone, but by the Corporation as well.

LEGACIES AND GIFTS OF THE YEAR.

In the Treasurer's Report will be found in detail a statement of the benefactions which have come to the Institute during the past year.

The largest of these gifts are those from Mrs. William L. Putnam, Mrs. T. J. Bowlker and Miss Amy Lowell, of $10,000 each, for the purpose of erecting a permanent laboratory of electrical engineering, to bear the name of Mr. Augustus Lowell. This sum has also been further augmented during the year by a gift of $3,000 from Mr. Charles C. Jackson and of $3,000 from a friend. These sums, added to the gifts of Professor Percival Lowell, Professor A. Lawrence Lowell, Mr. George Gardner and Mrs. W. S. Fitz, make in the aggregate $68,000 given for this purpose.

A very interesting and very unusual gift is that of $5,000

for the Sewage Experiment Station. This is the second gift of this amount from a friend of the Institute and of science who desires that the pressing municipal sanitary problems of this and other American cities may be put in a fair way for solution. This generous donor prefers to remain anonymous.

Gifts aggregating $5,000 have been received for the support of the Research Laboratory of Physical Chemistry. These gifts are most welcome not only for the direction they have taken, but also for the enthusiasm and devotion of which they are only one evidence. Of this amount $3,000 is the gift of Professor Arthur A. Noyes, of the class of 1886, Director of the Laboratory, and $1,000 the gift of Assistant Professor Willis R. Whitney, of the class of 1890. The remaining $1,000 is from the fund founded by the late William E. Hale, of Chicago, for the promotion of scientific research. The establishment of this fund is in large measure the result of the scientific work of George E. Hale, Director of the Yerkes Observatory, of the Class of 1890. The officers of the Carnegie Institution have shown their appreciation of the value of the work of the research laboratory thus established by the appropriation of $2,000 for the work which Professor Noyes is prosecuting. No gifts, of whatever magnitude, will ever be more welcome to the Institute or more stimulating to its work than those which come from its own sons.

Four other gifts, amounting in all to $6,000, have been received as a nucleus of a fund for the establishment of dormitory life or such other student aid as may minister to the betterment of the social life of students. Of this amount Mrs. Edward M. Cary gave $3,000, the estate of Mrs. Mary Hemenway $1,000, Mrs. Henry Pickering $1,000, and a friend $1,000. This fund has been given to be used in the discretion of the President. I cannot but hope it may form the nucleus of a sum large enough to enable us in the near future to begin at least some practical measure for furnishing to students rooms at moderate prices, and under conditions which may be stimulating to manly, wholesome social life.

During the year $10,050 has been paid in on the subscriptions to the Walker Memorial Fund. The funds now in the hands of the Treasurer for that purpose amount to $83,466.70.

THE YEAR'S CHANGES.

The past year has been one of great activity in all directions. It has witnessed few changes in the membership of the Corporation and of the Faculty. The membership of the Corporation has been increased during the past year by the election of the Hon. W. Murray Crane, a citizen whom Massachusetts delights to honor. It has lost by death one member, the Hon. Frank A. Hill, secretary of the Board of Education, who, as such, was for many years a member *ex officio* of this body. Mr. Hill was chairman of the Visiting Committee on the Departments of Literature, History, and Political Economy, and took a genuine and hearty interest in the progress and welfare of the Institute.

The membership of the Faculty has changed by the resignation of Professor Linus Faunce, Professor Hough and Professor Locke, and by the accession to the Faculty of C. L. Adams as Assistant Professor of Drawing, H. W. Gardner as Assistant Professor of Architecture, F. P. McKibben as Assistant Professor of Civil Engineering, C. M. Spofford as Assistant Professor of Civil Engineering, and Samuel C. Prescott as Assistant Professor of Biology. During the present year Professors Bardwell, Bartlett, and Skinner have leave of absence.

THE GRANT OF LAND BY THE LEGISLATURE.

At the beginning of the last school year, the Executive Committee, in view of the crowded condition of the laboratories, felt compelled to recommend to the Corporation some step looking to the acquisition of more room. The first, and the most natural movement in this direction was evidently to

secure the title to the land on Boylston Street on which the Institute buildings now stand; for, with this land in our possession in fee simple, the pressure for space could be relieved, either by building over the whole tract, or, if it seemed wiser, by a sale of this land and removal to another site. In accordance, therefore, with your instructions, the Executive Committee presented this matter to the General Court in January by a petition praying for a title in fee simple.

The successful outcome of that effort is known to you. The General Court has conferred upon the Institute its title to the land in question. In the opposition which was called out in connection with this action there was made, from time to time, an intimation that the action of the authorities of the Institute in this matter was taken in disregard of the rights of others. While this effort to make out of the question a moral issue seems to me wholly unwarranted, it deserves to be put on record that the Executive Committee, in inaugurating this action, tried to approach the question in a fair and just spirit. The original Act under which the use of this land was conferred upon the Institute would seem plainly to indicate that the Commonwealth reserved to itself the right to use the space now left open for the benefit of the educational institutions established in that Act. Believing this to be the case, the Executive Committee has taken only the action which it felt compelled to take in justice to the interests of the Institute, and with the entire conviction that any rights of the abutters which were contravened under this action were such as rested upon purely legal considerations, and not moral ones.

I have to report to you that the legal questions involved seem in a fair way for settlement in the near future. I have been given to understand that a suit will be brought immediately by the abutters, to test the correctness of their interpretation of the law. A prompt and final decision of this matter is hoped for, and will be welcomed alike by the authorities of the Institute and by the owners of abutting property.

It is evident that, until this question has been decided, the

problem of greater facilities or of a possible new site must wait, since no practical action could be taken by this body looking to the furtherance of either of these solutions of the problem of our crowded condition until the legal questions thus raised have been quieted.

THE NEW BUILDINGS.

The Institute built, during the summer of 1902, the large one-story building known as the Lowell Building, which houses the Department of Electrical Engineering. During the summer of 1903 we have built still another building of two and one-half stories, which houses the Department of Naval Architecture, a research laboratory of physical chemistry, and the division of mineralogy, an important part of geology and mining engineering, for all of which the building is most admirably adapted.

While these buildings are in a sense temporary, they are adapted to use for a number of years to come, and have enormously relieved the pressure for space, as well as added facilities for instruction. In fact, with the beginning of this year the student body is better housed than it has ever been in the history of the Institute.

RESEARCH WORK IN THE INSTITUTE.

The most far-reaching and important changes which have marked the past year are the distinctive efforts now being made toward the prosecution of scientific research. The first is the organization of a School for Engineering Research, whose plan and scope have been fully presented in a special pamphlet printed for that purpose. The plan contemplates provision for research in applied science and in engineering directions, for a very small number of well-equipped men who are capable of executing pieces of research of real value and importance, and who shall have such freedom of work that

they may throw themselves with devotion into what they undertake. This is the first effort in any technical school in this country to offer research work distinctive from that of the college, and directed toward engineering subjects. While this school will offer an opportunity for earning the degree of Doctor of Engineering, it is intended that the conferring of the degree shall be a minor feature of the work, and that the few men who are admitted to this work shall be men who are aiming at research and not degrees. For the present year the only candidate who has been admitted is Professor Harold B. Smith, head of the Department of Electrical Engineering in the Worcester Polytechnic Institute.

A second and extremely promising effort at research is the Research Laboratory of Physical Chemistry, established under the direction of Professor Noyes, and in large part made possible by the generosity of himself and of his colleague, Professor Willis R. Whitney. It may not be generally known that in and about Boston are grouped a number of well-known men in physical chemistry; and the inauguration of this department, made possible originally by the gifts of its own professors, has been still further helped by grants from the Carnegie Institution and from the William E. Hale Fund.

The third research effort is that now going on in the work of the Sanitary Research Station, established last summer at the corner of Massachusetts Avenue and Albany street, which was made possible by the gift of a friend who prefers to remain anonymous. The work going on there deals not only with the problems of research, but also with the diffusion of knowledge by means of attractive pamphlets furnishing elementary sanitary instruction.

These three efforts mark a distinct step, not so much in the aim as in the progress of the Institute, and in the progress at the same time of technical education in this country. In taking a step under which the Institute plainly marks out its intention to offer facilities for research, as well as for undergraduate work, a definite effort is made to retain a position of leadership in technical education.

THE PLACE OF RESEARCH IN NATIONAL DEVELOPMENT.

In American institutions of learning one hears, of late years, much talk concerning research and the need for its existence; and in response to this general sentiment there has developed a series of graduate schools in all our principal universities. It is not over-stating the matter to say that in most respects these graduate schools, which now contain between six and seven thousand students, do not indicate any such increase in research work and in the growth of the research spirit as their numbers might imply. I am not sure that there has resulted even any definite idea as to what research is; and I am inclined to believe that the fundamental question itself, what constitutes research and what is the spirit which must exist in an individual and in an institution in order that research may flourish, is one to which American institutions need to devote themselves. Without going into a discussion of what research is, it is worth while to point out some of the difficulties which lie in the way of the development of research in our institutions, and which make it even yet a question of doubt whether our universities will ever become as efficient centers of research as those of some other countries.

The fundamental distinction which one finds in comparing our institutions with those of Europe is to be found in the difference between our elementary instruction and that given in our higher schools, universities, and technical schools. The education of the European boy in the school which leads up to the university or to the technical school is simpler and more thorough, so that, when he comes into the technical school or the university, he is a better grounded man in the fundamentals of education, and he enters into an institution where, in virtue of this fact, the entire method and spirit are changed. He no longer finds himself face to face with required daily recitations; he is practically freed from the burden of examinations, and he enters into a relation with his teachers which only men can have with each other.

No one who has not been a teacher can realize how enormous is the burden thus lifted from the shoulders of the Faculty and student alike. In the Institute of Technology practically one-eighth of the whole school year is given up to formal examinations. Under our system of instruction the Faculty is trying to carry through the courses a considerable proportion of men who are either incompetent or who do not care for the work. American institutions are almost the only ones in any country which undertake to force into the mind of an adult man a course of instruction which he does not care to have. The great activity in research in European institutions is due, first of all, to the spirit now alive there, which makes research a test of a man's success and of his efficiency; but it is due, to no small degree, to the fact that European teachers are relieved of this enormous burden which American teachers have upon their shoulders.

Looking at the German institutions, one feels that as research institutions they have great advantages over ours in these three respects. First, because research itself is a part of the ideal of the professor's life, and the spirit of research a part, and the most vital part, of the educational spirit. Secondly, their freedom from the burden of instruction which our teachers bear, and the opportunity thus afforded to give free play to the research effort. Finally, the fixity of place and the guarantee of a retiring salary, which removes the ever-present problem of support in old age.

How important is the development of the research spirit as a part of national progress we are only just beginning to realize. We may confidently say that it will count more and more in the future in this national progress, and the problem of developing it wisely and of turning it to the solution, not alone of theoretical questions, but of practical questions of national life, is becoming each decade a more real question for civilized nations. In America we have still the intellectual habits of a pioneer people. The American is energetic, resourceful, and superficial. He can make a little knowledge go farther than the citizen of any other country. Resourceful-

ness and nervous energy were great factors in the pioneer days, and they are great factors still; but they become relatively less effective as civilization advances. They will not last in competition with careful training and thorough knowledge. Our pioneer period has gone by, and one of the problems before the nation is the development of a patient, devoted, intelligent spirit of research. In order to develop this spirit an environment favorable to it must be created in our institutions of learning.

THE NEED OF A PENSION SYSTEM.

In this connection I venture to call your attention to the need in American institutions, and in our own institution, of a retiring system for professors and instructors. Mr. Augustus Lowell, for so many years a leading member of this board, and one of the most far-sighted men who have served this institution, gave $50,000 during his life-time as a Teachers' Fund, the interest of which should serve as the beginning of a fund for the payment of pensions to those who have worn themselves out in the service of the Institute. Later on, when he came to make a final gift to the Institute, he could think of no wiser use than to add another $50,000 to this fund; and I wish to say that to my thinking he could have made no wiser disposition of such a sum. I wish to urge upon your body the need of increasing this fund to a sum which will enable the Institute to guarantee to men of certain length of service a life pension.

Any man who knows American colleges and universities is familiar with the common experience of many of the abler young men who come up through our institutions, spend a year or two abroad, equip themselves well for the work of research, and settle down into the position of an instructor or assistant-professor in some institution, full of enthusiasm and ready to consecrate their lives to research work. Scientific men are human like other men. After a few years the investigator marries, the problem of family support becomes urgent, col-

lege pay is small, and, while it may pay current expenses, it offers no opportunity to lay up for the future. The candidate for research looks about for means of turning the grindstone; and a man who has started with flying colors and a buoyant heart for a fine career in research ends by becoming a fair teacher and a patient drudge. This is the history of most men who start in American institutions to become investigators. Tenure of office in all our American institutions, except in our greatest and strongest ones, is more or less uncertain. College presidents and college trustees, like business firms, are becoming more and more averse to accepting a new man who has passed his fiftieth year. I have known, in the past five years, men of excellent standing in science, who found it almost impossible, when turned out of one place, to secure work elsewhere. The in-breeding in our colleges, by which graduates are coming more and more to look for the places of instructors and professors, increases this tendency. Any plan which will enable the institution to offer to a professor or to an instructor a certainty of retired pay with the coming of age or of ill-health would go far to remove from his path as an investigator an obstacle which turns aside most Americans who enter upon research.

LOWELL INSTITUTE SCHOOL FOR INDUSTRIAL FOREMEN.

The ideal educational system for a progressive country would be one in which, instead of trying to run all men through the same mould, the schools should be so diversified as to meet the needs and the ideals and the aspirations of all classes of citizens. We have, in the United States, made but little progress toward this ideal. It is very difficult for our educators to outgrow the theory that there are certain educational specifics which, if taken in sufficient quantities, are suited to all sorts and conditions of men.

One of the neglected fields of education is that which has to do with men who stand between the unskilled worker and the

engineer. Most citizens of the United States necessarily leave the public school by the time they are fourteen. Once harnessed to the problem of earning a living, they find their opportunities for improvement in school necessarily limited to those which may be had in afternoons, in holidays, and in evenings; and such schools, if they are to serve those whose chief problem is that of earning a living, must be very closely adapted to serve the immediate needs which they have in view, although they may always carry with this purpose the wider one of upbuilding the character and the intellect.

While the Institute has felt it to be its chief duty to extend its work upward, so as to provide for the work of research, it has been glad, as well, within the last few months, to ally itself with the effort to reach down to serve the needs of men who wish to improve themselves for the occupation in which they earn a living. This effort has been consummated by cooperation with Professor A. Lawrence Lowell, the trustee of the Lowell Institute, who has established an evening school for foremen, which is conducted by Institute teachers in Institute rooms and laboratories. In this school stationary engineers, motormen, mechanicians, electrical workers, and other who are ambitious to improve their theoretical knowledge of practical matters, and thereby to fit themselves for better places, are given elementary instruction in those fundamental subjects which directly serve their needs.

This school is under the direction of Professor C. F. Park. For the present year about 160 men have entered its classes. These were all men engaged in practical occupations, such as draftsmen, electrical helpers, machinists, pattern makers, and the like. About one half found themselves, after a month of study, unable to continue, and the school now consists of about 80 men who are engaged most earnestly in its work.

THE SUMMER SCHOOL.

Until the season just passed the summer school of the Institute had been conducted by the independent efforts of members

of the Instructing Staff, with the co-operation of the executive officers and of the Executive Committee. In 1902 the work was assumed as a regular part of the work of the Institute, students being registered as for the regular work. The result has been in every way satisfactory, and has served to put the summer school upon a far better basis financially and in its relation to students.

Two hundred and forty-five students attended the regular summer courses, two hundred and sixteen of whom were from the Institute. By far the larger part of these latter were taking these courses either to make up deficiencies or to anticipate work in the regular term. How far the Institute should go in serving this end is not entirely clear.

A more interesting feature of the work is the presence of men, in increasing numbers, from other colleges, as well as the evidence of the fact that a very good majority of the students attending have done excellent work. Midsummer has not been considered a favorable time for study, but whatever disadvantages the weather may have imposed seem to have been more than counterbalanced by the fact that the student is generally taking but one subject, and can therefore throw himself heartily into the work. This fact is not without significance in comparison with the regular term-work of the Institute.

In addition to the Summer Courses at the Institute, three summer schools were conducted, which offered work supplementary to regular Institute instruction. These were the School in Geodetic and Hydraulic Surveying, at Machias, Maine, the School in Metallurgy, which inspected and studied various metallurgical plants, and a Summer School in Architecture which studied in France and Italy.

ADMINISTRATION.

The internatal administration of the Institute has been largely modified in the past two years by an increase in the number of general executive officers, and a differentiation of

their duties. This reorganization has included changes in the duties of the Secretary and of the Bursar, the appointment of the Dean, the Registrar, the Recorder and the Medical Adviser. The result has been a far more satisfactory administrative system, with regard both to the work itself and to its relations to the student needs. In the administration of an institution of learning it is never to be forgotten that the institution exists for the education of men, and that it is administered successfully when it becomes a live center of intellectual and moral influence. The machinery of administration must be arranged with reference to promoting this end.

REPORTS OF DEPARTMENTS.

I have alluded at this time more briefly to the needs and progress of the separate departments for the reason that the second part of this publication contains the report of the Dean and of those in charge of the departments, and of important divisions of the work of the Institute not formally designated as departments. For these statements of the departmental problems, made in the language and over the signatures of those most qualified to speak, I ask the careful consideration of the members of the Corporation. In the reports of the Dean and of the Medical Adviser will be found statements concerning problems of the student life which, while less easily defined than those of technical instruction, are nevertheless most far-reaching and important. These statements, together with the statistical exhibit and the Treasurer's Report which follow, serve to tell a story of progress and of work which I trust may commend to citizens of Massachusetts the work for which the Institute stands, and serve to bring to it in generous measure the financial assistance it so urgently needs.

HENRY S. PRITCHETT

DECEMBER 12, 1903.

PART II.

REPORTS OF DEPARTMENTS.

REPORT OF THE DEAN.

In accordance with the recently revised rules of the Faculty, the Dean is to be the general consulting officer for all students, and he is to co-operate with the President in all matters relating to discipline and the general welfare of the student body; he is to be chairman of the Committee of Advisers, and he is to have a general oversight of the first-year instruction.

A year and a half of experience indicates plainly the desirability of having a general consulting officer. The chief work of the office has been in connection with students who have voluntarily sought advice in connection with Institute work. The number of students sent to the Dean by Faculty vote or by the Registrar averages about 30 a month; the number who come voluntarily for consultation is much larger.

The number of advisers for new students this year is 60; the average number of students assigned to any one adviser is 7. The Committee of Advisers met new students in the library of the Rogers Building, September 28 and 29, 1903. This was done in order to facilitate the work of registration and to enable graduate students to consult with the heads of departments. There was a more definite organization this year, and the work of registration was completed more expeditiously than usual.

The Dean and the Committee of Advisers gave an informal reception on Friday, October 23, to new graduate students. In this list were also included students, not graduates, who had entered the Institute from other colleges. The reception was held at the Technology Club, and there were over 150 persons in attendance.

A card catalogue of all the students at the Institute is kept in the Dean's office. It is intended that these cards should show particularly a student's interest in the various social, literary, and professional societies, his connection with class

organizations, and his record in athletics. All reports of illness are entered on these cards, which also serve as an index to correspondence and personal memoranda.

A circular letter is sent, soon after the beginning of the term, to preparatory schools, inquiring about students who have been admitted. These replies and the card catalogue are found useful in considering the marks of first-year students at the intermediate examinations of the first term.

A room registry of about 220 rooms suitable for students has been kept in the office, and has been freely used by the new students.

Last spring an attempt was made to organize something of an employment bureau for undergraduates, and about 50 students obtained positions for the summer through this office.

Reports with reference to the Department of Drawing, to the Gymnasium, and to the Institute Exhibit at the St. Louis Exposition, are appended.

1. Drawing.

Professor Faunce's connection with the Department of Drawing terminated in May, 1903, and the department was placed under the general direction of the Dean. Mr. C. L. Adams was promoted to the grade of Assistant Professor, and was asked to take direct charge of the instruction. During the summer a new programme of instruction was arranged by the Dean and Professor Adams. Two new instructors, Mr. E. S. Foljambe and Mr. J. R. Putnam, were engaged. Both of these men are graduates of the Institute in the class of 1901, and have had practical experience as draftsmen.

Professor Adams was prepared at the beginning of the term to inaugurate a new system of instruction, with new sets of printed notes. The elementary principles of Descriptive Geometry are studied at the beginning of the course. Instruction in the use of drawing instruments and practice in mechanical drawing is taken up incidentally in connection with the solving of problems. The class is divided into three sections, assigned to two-hour periods of work twice a week.

The first hour of the period is used for a lecture by Professor Adams. Students take notes, copying diagrams from the blackboard. The sketches made in the first hour are used in the second hour to furnish data for the mechanical drawing. This method was necessitated by the changes in this year's programme, and it has proved to be a more interesting method of instruction than the use of the text-book.

The second-year descriptive geometry is being taught by Messrs. Kenison and Bradley, and is a continuation of the instruction of last year. The students seem to be interested in their work, the machinery of instruction is running smoothly, and the new instructors have proved most efficient.

2. GYMNASIUM.

Dr. Skarstrom resigned his position of instructor in the Gymnasium in May, 1903. Mr. Winfield C. Towne, A.B., was appointed to take his place. Mr. Towne is a graduate of Bowdoin College. He entered Bowdoin in the fall of 1899, and, along with his regular college course, made a study of gymnastics; he made his various class football and track teams, and also the 'varsity football and the Worcester track teams. He was a member of the dumb-bell, broad-sword and fencing squads, being leader of the latter. During his Sophomore year he was made an assistant in the Sargent Gymnasium. During his last two years he was assistant to Dr. F. M. Whittier, A.M., (Director of the Sargent Gymnasium, Lecturer on Hygiene, and Professor of Bacteriology and Pathological Histology in the Bowdoin Medical School). During this time he was assistant instructor in the gymnasium, having entire charge of the Freshman classes.

Mr. Towne has devoted the first month of the school year to making physical examinations and measurements of students who present themselves for Gymnasium instruction. The regular class-work began, as formerly, November 9. The students have shown much interest in their Gymnasium work. Mr. Towne will carry out a programme which is, in general, the same as that of most of our American colleges.

3. Committee on Massachusetts Institute of Technology Exhibit at Louisiana Purchase Exposition, St. Louis, Missouri.

The Institute of Technology has been granted a space of one thousand square feet on one of the main aisles of the Educational Building. Detailed plans for the installation of the exhibit were made by Professor H. W. Gardner, and have been accepted as satisfactory by the Committee in St. Louis. Instructors have been appointed by the different departments of the Institute to collect material for the exhibition. Professor W. H. Lawrence and Professor L. Derr are now engaged in taking photographs of new pieces of apparatus, new laboratories, and new buildings. The exhibit will probably be ready by March 1, and must be installed and ready for inspection April 25, 1904.

Statistics of Illnesses for the School Year 1902–1903.

Senior Class.

Whole number of Senior Class, specials and regulars, 290.

Number of fourth-year students who were ill during the year 1902–03, 15.

Of this number, nine were graduated and received the degree from the Institute.

Of those who were ill, two were sent to the Massachusetts General Hospital, one with typhoid fever, and one for a second operation for appendicitis. The other 13 cases were of rather trivial character.

Fourth-year student who died, May 1, 1903, Alfred W. Bruton, Course VI., '03, drowned by canoeing accident.

Junior Class.

Whole number of Junior Class, specials and regulars, 360.

Number of third-year students who were ill during the year 1902–03, 38.

Of those who were ill, seven cases were treated at hospitals; two each at Massachusetts General Hospital, City Hospital, Boothby Hospital, and one case at unknown hospital.

Classified by diseases, there were the following cases: 1 appendicitis, 5 typhoid fever, 1 diphtheria, 8 grippe, 1 scarlet fever, 3 tonsillitis, 3 bronchitis, 1 mumps, 2 operation, 1 nervous condition, 2 cold on lungs, 1 water on knee, 1 accident to eye, 1 injury by accident, and 7 cases of illness unknown.

Of the cases treated at hospitals, there were two deaths: Eliot Granger, appendicitis, Massachusetts General Hospital; R. A. Lauffer, typhoid fever, Boothby Hospital, Nov. 5, 1903.

Sophomore Class.

Whole number of Sophomore Class, specials and regulars, 462.

Number of second-year students who were ill during the year 1902–03, 42.

Of those who were ill, three were sent to the Massachusetts General Hospital, two ill with rheumatism, one with typhoid fever.

Classified by diseases, there were the following cases: 4 tonsillitis, 1 influenza, 2 bronchitis, 1 appendicitis, 1 measles, 4 grippe, 2 fever, 1 diphtheria, 1 cold, 1 burned, 1 German measles, 2 rheumatism, 1 trouble with eyes, 1 malarial fever, 1 operation on hand, 3 typhoid fever, and 15 cases of illness unknown.

There were two deaths among the members of this class: F. W. McConnell, Course II., '05, died Jan. 7, 1903, typhoid fever; H. R. Sweetser, Course V., '05, drowned June 15, 1903, off Misery Island.

Freshman Class.

Whole number of Freshman Class, specials and regulars, 479.

Number of first-year students who were ill during the year 1902–03, 54.

Of those who were ill, one case was treated at the Homœopathic Hospital.

Classified by diseases, there are the following cases: 5 tonsillitis, 2 mumps, 3 grippe, 1 cold on lungs, 2 appendicitis, 1 severe intestinal trouble, 1 quinsy, 1 rheumatism, 1 abscess on foot, 2 measles, 5 typhoid fever, 1 pleurisy, 2 pneumonia, 1 operation, 1 abscess in ear, 2 trouble with eyes, 1 jaundice, 1 sprained leg, and 21 cases of illness unknown.

There were two deaths among the members of this class: Francis A. Falvey, '06, died January 14, 1903, appendicitis; Thomas B. Watson, '06, severe intestinal trouble.

TOTAL.

	No. in Class.	*No. Ill.*	*No. treated in Hospitals.*	*No. of Deaths.*
Fellows and Graduates of M. I. T.	17			
Fourth Year, 1903	290	15	2	1
Third Year, 1904	360	38	7	2
Second Year, 1905	462	42	3	2
First Year, 1906	479	54	1	2
	1,608	149	13	7*

REQUIRED TO WITHDRAW.

	Courses.									
	I.	II.	III.	IV.	V.	VI.	X.	XI.	XIII.	Total.
January, 1903:										
Third Year	2	3	2	–	–	1	1	1	–	10
Second Year	–	6	–	1	–	–	–	–	–	7
First Year	1	–	–	–	–	–	–	–	–	1
										18
June, 1903:										
Third Year	4	1	–	–	–	1	1	–	–	7
Second Year	2	5	–	–	2	4	–	–	2	15
First Year	21	–	–	–	–	–	–	–	–	21
										43
Total for the Year	30	15	2	1	2	6	2	1	2	61

ALFRED E. BURTON.

* Of this number, two were the results of accidents.

REPORT OF THE MEDICAL ADVISER.

Office hours have been held in the Pierce Building once a week until the middle of November and since then twice a week. The following table gives the number of office visits made and the number of students seen: —

Total number of office visits made	254
Total number of different students seen	156
Greatest number of students seen per hour	7
Least number of students seen per hour	2
Average number of students seen per hour	5
Number of students making more than one visit	33
Largest number of visits for one student	6

The time set apart for medical visits has been fully utilized. Almost all of the students seen were men; not more than three or four women came for advice. Four-fifths of the students found it necessary to come only once,— usually for the treatment of some acute and promptly curable condition. Many of those making several visits in succession were surgical cases which required dressings. The Institute is not a place for invalids, and it was natural to find that only an exceptional man needed frequent medical advice.

The average number of students seen per hour was five. This is as large a number of men as can be satisfactorily seen in one hour, as this allows only an average of ten or twelve minutes per student. The number of students seen would have averaged less than five per hour had it not been for occasional students who simply came to ask for the name of a specialist whom they might consult. Frequently in surgical cases, and where minor operations were performed, much more time was required per man. When the office hour was held only once a week, there were always several men left over at the end of the hour who could not be seen within the appointed time. Since the office hours have been held twice a week, there are only occasional days when students are left over.

The severity of the illnesses varied much. Some diseases,

such as pulmonary tuberculosis or gonorrheal ophthalmia, necessitated leaving the Institute permanently. Several men suffering with typhoid fever walked into the office for advice and were promptly put to bed in a hospital. A few wounds or crushed hands came from the shops. Most of the illnesses, however, were acute and promptly curable.

A considerable number of healthy men, after reading newspaper advertisements or quack circulars, were very apprehensive about their health, and were greatly pleased to find that there was no cause for alarm. I was glad to find that men were willing to consult me freely on all matters relating to their physical condition.

A considerable number of students were recommended for admission to the hospitals for the treatment of such diseases as typhoid, pleurisy, measles, etc. The Massachusetts General Hospital was used for most cases in preference to the City Hospital because the Institute has free beds at the former hospital and because the cost of treatment there for out-of-town students appeared to be less.

I have tried so far as possible to keep in touch personally with all students who were being treated in the hospitals.

In addition to the work at the Institute office, I have seen about twenty-five sick men at my private office, and have examined twenty-five men for track teams. I have been called to attend a small number of men at their houses. The small number of these last cases is not surprising when we consider the scattered residence of the students and the natural inclination to call a doctor who is near by.

On account of the prevalence of small-pox in Boston, notices were posted urging all students who had not been successfully vaccinated within five years to be vaccinated again, and several office hours were set apart for this purpose. Only a small number of students availed themselves of this opportunity, possibly because most of them had been vaccinated during the epidemic of the previous year. There were no cases of small-pox among the students.

A small typhoid epidemic appeared among the Institute

students and others taking their meals at a local restaurant. Fourteen Institute men were infected with typhoid and there was one death. As soon as the outbreak was discovered, all of the students taking their meals at this restaurant were privately warned of the condition of things and no more typhoid cases developed. The Boston Board of Health investigated the matter and concluded that the epidemic originated from two servants in the restaurant who were ill with typhoid.

The following table gives a rough classification of the cases treated: —

Surgical	36
Stomach and Bowels	16
Genito-urinary	15
Nose and Throat	17
Eyes	17
Skin	22
Specific infectious diseases	9
Heart	4
Lungs	9
Ear	4
Miscellaneous	26

An informal lecture on "The Hygiene of Student Life" was given by Professor Sedgwick, and a talk on personal hygiene by the Medical Adviser. I think in future this series of lectures should be extended somewhat. The Medical Adviser might cover the following topics briefly in two or three lectures, namely:

Bathing
Clothing
Exercise
Sleep
Food
Care of the eyes
Use of tobacco and alcohol
Minor ailments, such as constipation, colds, headaches, etc.
Emergencies.

In addition to the lectures and actual work of caring for sick students, many letters of parents have been answered, advice given to instructors about necessary isolation in case of infectious diseases, and at present an inquiry is being made about the health at graduation of the last senior class, to determine the effect of the Institute course upon their general health and fitness for mental and physical work.

The cost of equipment of the Medical Adviser's office has been as follows: for permanent articles, such as instruments and glassware, forty-seven dollars; and for supplies, such as gauze, cotton, bandages, chemicals, etc., twelve dollars and twenty cents. All the permanent equipment and more than one-half of the stock of supplies is on hand at present. It is evident that the yearly cost of supplies will be very small.

FRANKLIN W. WHITE, M.D.

THE GRADUATE SCHOOL OF ENGINEERING RESEARCH.

For the purpose of encouraging and promoting advanced study and especially investigations of engineering problems of practical importance, announcement was made shortly before the summer vacation that the Institute stood ready to organize a special department of its graduate work to be known as the Graduate School of Engineering Research.

After careful consideration by the Faculty, a committee of that body, called the Council of the Graduate School of Engineering Research, was appointed; four fellowships carrying a stipend of $500 and free tuition were made available for candidates of the highest grade; and a circular was issued drawing attention to the opportunities afforded at the Institute for work of this character, and laying down the conditions of entrance and promotion. In order to emphasize still further the technical character of the undertaking, it was voted by the Faculty that the degree of Doctor of Engineering should be conferred upon candidates fulfilling certain prescribed conditions.

During the summer a considerable number of inquiries from young men desiring to enter the school was received, but nearly all were found to be inadequately prepared for admission to a graduate school of engineering research. Only one candidate has thus far appeared whose qualifications appeared to the Council to be adequate and satisfactory.

It does not seem likely that there will be for the present more than a very small number of candidates for admission to an advanced or research school of this kind, because only a very small fraction of the graduates even of our best technical schools are prepared to meet the exacting requirements properly laid down for work of this character, while the graduates of universities and colleges of the ordinary type are as a rule still less qualified. Another consideration which weighs heavily with prospective candidates is the financial problem, inasmuch as qualified candidates must have spent at least four years in expensive preparation, and, at the end of such a period of outlay, many find their financial resources exhausted. For this reason I consider it extremely important that every possible encouragement in the form of fellowships and graduate scholarships should be held out to prospective candidates.

The principal difficulty, however, with which an undertaking of this kind must contend is the attractiveness and real importance, from a scientific as well as a professional standpoint, of actual practice in engineering enterprises and undertakings. It is now, and must always remain, a fair question whether a young man who has completed a laborious and extended course of study in a technical school or university should not, for his own best development, and for the sake of the cause in which he is interested, connect himself at once after graduation with some large practical engineering enterprise, for the sake of gaining actual practice in the field; and this, as I conceive, will always be the principal drawback to the success of an undertaking of this character, judged by its number of students.

I am persuaded, nevertheless, that the existence of oppor-

tunities of the kind offered in our Graduate School of Engineering Research is of great consequence, not only to the Institute, as an engineering school of the highest rank, but also in its effect upon young engineers, and upon the engineering arts and industries themselves. It is only by aiming at the highest that we shall ever achieve the greatest success and if, as seems certain, the Institute is destined by its already leading position to attract more and more graduate students, and to become more and more a graduate school, there can be no question that everything should be done which can be done, to enlarge and improve our facilities, and to encourage young men to undertake advanced studies and investigations in engineering and industrial lines, as well as in the sciences of which engineering is simply the intelligent application.

W. T. SEDGWICK,
Secretary of the Council.

COURSES I. AND XI.—CIVIL ENGINEERING AND SANITARY ENGINEERING.

The number of students in this department, and the number of students in other departments taking work in this department have increased to such an extent that a considerable addition to the teaching force has been found necessary. Mr. Spofford and Mr. McKibbin have been promoted to be Assistant Professors, and three new assistants have been added. Further additions to the staff are even now necessary, if complete instruction is to be offered in the School of Engineering Research. Moreover, the problem of arranging the field work in civil engineering, which, to be effective, must be done continuously and at a distance from the school, is a very serious and difficult one. Some years ago the solution adopted was to devote each afternoon to this work. This plan, however, involved too much loss of time going to and from the work, and the modification now in force was made of devoting three entire days each week to field work, two for

the second year in surveying and one for the third year in advanced surveying and railroad location. This enables each class to have one day each week. The only alternative to the present arrangement seems to be to concentrate the field work in the summer vacation, but this has so many objections, financial and practical, that it has never been attempted or, indeed, seriously considered. With the present arrangement, however, no considerable increase in the number of students can be allowed, without diminishing the efficiency of the instruction, nor will an increase in the number of inexperienced and young assistants solve the problem. It is a grave mistake to intrust the earlier classes entirely or largely to inexperienced teachers, reserving the experienced teachers for the higher branches. For the best results, it would, perhaps, be better to reverse the arrangement, if that were the only alternative. The satisfactory arrangement of the work becomes increasingly difficult as the number of students increases, and can be accomplished only by adding to the staff not simply inexperienced assistants, but also instructors and assistant professors.

The space at the disposal of the department is becoming very cramped, in view of the increase in the number of students, and will imperatively require enlargement if the increase continues. The space occupied has not been increased since 1898, when the Henry L. Pierce building was built, although the number of students that can be classed as belonging to the department has increased some 30 per cent. within the same period, not to mention the even larger increase in students of other Courses who take work in surveying. Moreover, the engineering library is now so crowded that it is little more than a store-room for books. There are but two large tables available in it for students, and not more than thirty or forty students can by any possibility be accommodated there at one time. The time has arrived when the space available for the Civil Engineering Department and the library should be increased.

The equipment of the department is being gradually added

to as occasion requires. During the past year the gauging station on the Charles River at Newton Upper Falls, which had been injured by the floods, has been rebuilt in a more substantial manner and has been made use of by the State Board of Health for gauging purposes. A Doble regulating nozzle has been added to the equipment of the hydraulic laboratory. Further additions to the equipment are needed, and it would be desirable if larger appropriations could be authorized for this purpose.

The demand for graduates in civil engineering has continued almost unabated. A larger number than the entire class graduated last June, which numbered thirty-one, could have been placed in positions before the close of the term, while since that time many additional positions have been available. I cannot remember a year since my connection with the Institute began in which the demand for graduates of the Civil and Sanitary Engineering Courses has not exceeded the supply, even during the dull years from 1893 to 1897. With the excellent records which our graduates are making, it is probable that the demand will continue to exceed the supply. Mention may be made of the very gratifying result of the recent examination held for the position of assistant civil engineer in the Navy, at which nine candidates presented themselves. Of this number four were passed; of these four, the three highest were graduates of our Civil Engineering Department in the class of 1900.

Professor Allen was in July last elected President of the Society for the Promotion of Engineering Education for the ensuing year.

It may be of interest to state that, out of about two hundred students in the three upper classes in Civil and Sanitary Engineering, sixty-five worked at engineering occupations, while forty were employed in non-engineering occupations, during the summer just past, the total amount earned by these students being over $16,000.

SUMMER SCHOOL IN CIVIL ENGINEERING.—The sixteenth session of the summer school of the Civil Engineering Depart-

ment was held during the past summer at East Machias, Maine. Twenty-four students were in attendance. Nine of these students were from the third-year class, and fifteen from the second-year class. The second-year students paid $25 tuition and by this work anticipated the field work of the third year.

The school was in charge of Professors Burton and Robbins, assisted by Professor Barton, Mr. Sweet, and Mr. Hosmer, together with Mr. Morse, Mr. Davis and Mr. Howard of the class of 1903.

A plane table survey, based on a base-line measurement and system of triangulation, was made of the village of East Machias, covering over a square mile of territory. The scale of the survey was 1 to 5,000, with a contour interval of 10 feet. Elevations were referred to mean sea level, determined by means of a tide-gauge set up near the mouth of the East Machias River. The plane table survey was connected with the general system of triangulation on the Atlantic Coast by occupying the United States Coast and Geodetic Stations at Howard Mountain and Indian Hill, and measuring angles to triangulation stations in East Machias. These lines of sight were long enough to require the use of heliotropes for signalling.

A profile was made of the East Machias River, and hydraulic measurements were taken by means of floats and meters, thus procuring data for an estimate of the water power.

Geological sections were surveyed with a transit and stadia.

Astronomical observations were made for the determination of latitude, meridian, and time. This school was the largest and most successful summer school which has been held by the Civil Engineering Department up to the present time.

GEORGE F. SWAIN.

COURSE II.—MECHANICAL ENGINEERING.

The number of students for whom instruction is provided by the Departments of Mechanical Engineering and Applied Mechanics has, within the last few years, undergone a very large increase; partly on account of the growth of the Institute itself; partly on account of the fact that instruction in some of the subjects taught in these departments has been added in two of the four-year Courses in which it was not formerly included, and that in another case additional instruction had to be given; partly because work had to be provided for graduate students of certain departments; and partly for other reasons.

The number of students to whom instruction is given in applied mechanics is four hundred and seventy-five; while the number who receive instruction in mechanical engineering subjects is six hundred and twenty-eight.

In the case of the Engineering Laboratories, which are called upon to provide instruction for about three-fourths of all those who graduate from the Institute, no important addition has been made to the apparatus for the last four years.

In consequence of these facts, it follows that, in order to keep up with the times, we are in great need of a very considerable amount of additional apparatus, not only to enable us to pursue investigations along new lines of very great importance from an engineering standpoint, but also to provide for our regular laboratory classes the amount of instruction required. This would involve the addition of apparatus of kinds that we do not possess, and the duplication of some that we have. Indeed, in certain portions of the work, we have already been obliged to decrease the amount of laboratory instruction given to each student. The above stated needs have been yearly explained in detail, in the recommendations made to the Budget Committee, and it is hoped that the Executive Committee may soon see its way clear to supply them. Moreover, if an amount of additional apparatus adequate to

the needs of the departments is provided, an increase of space will also be requisite.

In accordance with our usual custom, a considerable amount of investigation is always in progress, partly by means of the regular laboratory work, and partly by means of thesis work. As examples of investigations which have been carried on in whole or in part, during the last school year, and during the last summer, the following may be mentioned: —

1. Experimental investigations of the strength, and other resisting properties of full-sized re-enforced concrete beams, and of full-sized re-enforced concrete columns. This work formed the subject of two theses, and the results thus far obtained were published in the *Proceedings of the American Society of Civil Engineers* for 1903, Vol. 50, p. 483 *et seq.*

2. A forty-hour test of a 3700-horse-power unit of the Lincoln Wharf Power Station of the Boston Elevated Railroad was made as part of the regular laboratory work, the opportunity having been furnished through the kindness of the officials of the road. An opportunity for performing such laboratory work outside the Institute cannot always be obtained.

3. The following plant tests have been made as thesis work, viz.:

(*a*) A series of tests of the steam plant at the mills of the Amoskeag Manufacturing Co., at Manchester, N.H.

(*b*) A twenty-four hour test on the high duty pumping station at New Bedford.

(*c*) A twenty-four hour duty test on the Brookline high service pumping station.

(*d*) A test on the Westinghouse Parsons steam turbine at Hartford, Conn.

(*e*) A series of tests on a De Laval steam turbine.

4. Tests, partly as thesis work, and partly as regular laboratory work, on the quantity of air flowing through orifices of different sizes. Orifices have been calibrated thus far up to a diameter of two inches, and up to a pressure of three hundred and fifty pounds.

5. Experimental determinations of the pressure and temperature curve of sulphurous acid gas have been made as thesis work, this research having a special value as applying to the waste heat engine. These results were presented to the American Society of Mechanical Engineers at the meeting of December, 1903.

6. Two eighteen-hour and two eight-hour road tests of a heavy compound freight engine were made upon one of the most modern locomotives of the Boston and Maine Railroad.

7. An investigation of the effect of bends, and of different lengths of piping, upon the indicator card, were made by means of a high-speed passenger locomotive on the Boston and Maine Railroad.

8. An investigation has been begun, and is being continued as thesis work, upon the strength of a series of connecting rods, which have been furnished by the Baldwin Locomotive Works.

9. Some work has been done by means of a thesis upon the question how to avoid the presence of moisture and consequent freezing in the various parts of the air-brake equipment of freight trains.

In consequence of the large number of students, and the consequent increase in the amount of instruction required in almost all parts of the work of the departments, it became necessary to increase the instructing force by five additional assistants.

GAETANO LANZA.

COURSE III.— MINING ENGINEERING AND METALLURGY.

The changes to be noted in this department are chiefly rearrangement of and additions to the working appliances, to meet the needs of the increasing number of students. For example, in the ore-dressing laboratory : the round table has been remodeled — a trommel has been introduced, a new Wilfley table has been designed, and a Wilfley slimer, presented by

Mr. Wilfley of Denver, has been installed. In the metallurgical laboratory the furnaces have been completely equipped with tools. Some electrical furnaces for research work in heat are being erected in the heat laboratory. In the metallographical laboratory a second microscope has been added. The museum has been enriched by a complete set of products of the concentrating, smelting, and electrolytic plant of the Anaconda Copper Company, collected and presented by Mr. C. D. Demond, class of '93.

The library has at last completed its set of the leading Belgian periodical, the *Revue Universelle des Mines, de la Métallurgie*, etc., and has added a new bookcase to keep up with its growth.

In regard to next year's work, it will be impossible to do justice to the larger classes in assaying without some provision for additional room.

Metallographic work is now distributed over three separate parts of the Institute, while these different branches ought to be combined to form a single unit and thus encourage the undertaking of advanced research work. In the same manner our furnaces for advanced research work in heating ores, metals, and metallurgical products have to be placed in the heat laboratory, while they ought to be in a special place in our department where the research is being planned and worked out.

The mining department needs double its present floor space whenever a new building can be provided.

The summer school of metallurgy was held this year in western New York and Ohio. The metallurgy of copper, iron, and steel, and the manufacture of coke in by-product ovens were made the subjects of study at Syracuse and Buffalo, N.Y., and at Cleveland, Ohio. On the way to Syracuse a side trip was made to Mineville, near Lake Champlain, N.Y., and several days were spent there in studying the celebrated iron ore deposits and the recently installed magnetic concentration plants.

ROBERT H. RICHARDS.

COURSE IV.—ARCHITECTURE.

The department opened this year most favorably, both in the quality and in the increased number of students. The Graduate Course is filled, and it has been found necessary to add another instructor in design to the regular staff. It has been our good fortune to secure for this position Mr. Allen H. Cox, a former student of the Institute, and later of the Paris Beaux Arts. With Mr. Putnam, another of our men, he won in the recent competition for the new library building of the Boston Athenæum. Mr. Cox will continue to practice his profession, but will devote the afternoons to the Institute. The opportunity to obtain the services of one so able and enthusiastic, who brings with him a good knowledge of both theory and practice, is a rare one, and the department is to be congratulated on its accession. An assistant is also greatly needed to aid in the several courses in construction, perspective, stereotomy, etc. The preparation and correction of plates increases so much the labor of the instructor, that it leaves him too little time to give to the improvement or extension of his course. Another recitation room furnished with blackboard, and tables to which the students could take their drawing boards, would add greatly to the effectiveness of instruction, and would also relieve the class-room of a disturbing element, when occupied as it has to be very often by both those taking and not taking a specified course. It must besides be accepted that the department becomes more and more administrative, and in consequence assistance should be allowed to relieve its increasing routine work.

The increased number of students adds comparatively few to the general average of graduates. This is due largely to the fact that so many come to us who already hold a college degree, that the value of another is not considered of enough importance to warrant the necessary work along sometimes uncongenial lines to win it. In fact they come to us as to a graduate school, and specialize their work. With the special

student from the office, the case is different, as his time as a rule is too limited for him to hope for the degree, and he devotes himself to design or construction according to his taste. The results from both regular and special students might be better if the mathematical preparation for professional work were made less burdensome.

Through the continued generosity of Mr. Guy Lowell, the department was enabled, at the end of the last term, to offer attractive money prizes for sketches and more serious work, to be made during the summer vacation, with the result that an interesting exhibit has been held, and the prizes awarded. The end hoped for was not fully accomplished. As usual the busiest men responded the best.

This year the summer school was held in Europe with Professor Gardner in charge. The party of five landed at Naples and travelled slowly, studying and sketching, through Italy to Paris, and returned home by the way of Liverpool. The results are far better than when the class was much larger, with more divided interests.

How the Year Book shall be published in the future is a question that calls for careful consideration. At present this is done through the Architectural Club, an organization within the department, and much time and energy is devoted to making the work a success. It is the sincere hope of the department that the Year Book may be continued, without advertisements, but under the protection of the Institute and supported by its generosity.

FRANCIS W. CHANDLER.

COURSES V. AND X.—CHEMISTRY AND CHEMICAL ENGINEERING.

The removal of the laboratories of physical chemistry to the new building, Engineering C, has made it possible to restore to the laboratory of analytical chemistry on the fourth floor of the Walker Building the space partitioned off some years ago, and this change has provided sufficient desk room

in analytical chemistry for the present year and apparently for the immediate future. It has also released a much-needed private laboratory for the use of Professor Norris. The advantages to the department as a whole from this gain in space are, however, in some measure offset by the disadvantages which accrue from the present distribution of the various chemical laboratories and lecture rooms, which comprise parts of four buildings, three of which are at a considerable distance from the chemical library, as well as from the main base of supplies, and it is obvious that a recombination of these branches of the departmental work in one, or at most two, buildings will, when that shall become possible, add to our efficiency.

The need is still felt for more and adequate accommodations for certain members of the instructing force and for a suitable room for the storage and exhibition of the growing collections of raw materials and chemical products which have been presented to the Institute. While no effort is spared at present to give all possible effect to these valuable aids to instruction, much of the benefit which would accrue from a properly classified exhibit in a room set apart for the purpose, and accessible at all times to students for inspection, is necessarily sacrificed under present conditions.

The transfer to less restricted quarters of the laboratory devoted to instruction in the application of optical instruments to methods of chemical analysis is in the highest degree desirable, and would contribute much to the success of the work in this field, as it has been developed by Mr. G. W. Rolfe.

Since last year the instruction in theoretical chemistry has been greatly improved and extended by an increase in the number of lectures given upon the subject, and especially by the introduction of an illustrative laboratory course as an accompaniment to the lectures. This development has been made possible by the appointment of an instructor who devotes all his time to the subject and by the equipment of new laboratories for physico-chemical work. These are located in the newly erected building on the corner of Trinity Place and

Stanhope Street in immediate connection with the Research Laboratory of Physical Chemistry. One room with ample accommodation for seven students is devoted to the undergraduate work, being used during the first term for the regular laboratory work above referred to, which is taken in sections by all fourth-year chemical students, and during the second term for the thesis work of those students who elect physico-chemical investigations. Another laboratory is provided for graduate students, two of whom are this year taking advanced courses in physico-chemical study and research. Taking into consideration the provision made for instruction on the physical side of the subject in connection with the Department of Physics, it is believed that the facilities for work in physical chemistry now offered by the Institute are unsurpassed.

As a consequence of the increased entrance requirements in modern language, which diminished the complexity of the subdivisions of the entering class, it has become possible to divide this class into two large sections with reference to their previous experience in chemistry. This, in turn, has made it possible to offer a somewhat more advanced course of lectures and laboratory work in inorganic chemistry to those students who have already spent some time in the study of this science in the secondary schools, in which the knowledge of the subject already acquired is utilized. The opportunity thus afforded to adapt the instruction to the needs of both the beginner and the student of some experience is proving to be of great advantage. It is proposed to strengthen the course further by the addition of one recitation hour each week in the second term.

The instruction in the Laboratory of Industrial Chemistry has been much strengthened during the past year under the direction of Professor Walker. The primary purpose of the course is now to point out, and emphasize by laboratory practice, the particular classes of problems which are involved in the successful and economical conduct of chemical operations upon a technical scale. While the problems which it is pos-

sible to assign necessarily lack some of the essential features of those met with in a large chemical works, they still properly serve as types of such problems, and involve the same power of observation and reasoning as the latter. By means of a series of conferences the individual student is enabled, before the work is undertaken, to present for approval his reasons for the selection of a particular procedure or his choice of apparatus, due account being taken of the cost of materials, fuel, and labor involved; and on the completion of his work his recorded results, with his conclusions as to his success or failure, are submitted for criticism.

Similar conferences are held with groups of students, or with the entire class, upon problems to the solution of which each has contributed some experimental data. A report, accompanied by drawings or sketches of apparatus, and containing critical comments upon some special process, is required from each student, and the interest evinced and the care taken in connection with these reports is gratifying evidence of the practical character and efficiency of the instruction.

It is expected that a Summer Course of Industrial Chemistry will be held next June, and arrangements are already being completed for visits to a variety of chemical manufacturing plants.

The Course in Chemical Engineering has been so modified as to permit the completion of the work in carpentry and wood turning in the second year, instead of in the fourth year, as formerly. In the senior year a course of lectures upon the chemical resistance of materials will be given by Professor Walker, which, for the present year, will be given in connection with the instruction in applied chemistry. The course of instruction in the latter subject is also undergoing extensive revision.

Additional time will soon be released for the lecture course in organic chemistry of the third year, by the transfer of the course in industrial electricity to the fourth year, and, for the current year, pending a permanent alteration of the course, the time formerly given to instruction in technical machin-

ery will be devoted in part to laboratory practice with dynamo machinery, and in part to thesis work. The topics formerly included in the course on technical machinery are now adequately covered in other courses.

H. P. TALBOT.

RESEARCH LABORATORY OF PHYSICAL CHEMISTRY.

Shortly before the close of the last school year the Institute received offers of gifts amounting to $5,000 from three different sources — $1,000 from the William E. Hale Research Fund, and the remainder from two members of the Institute Faculty, to be used in maintaining through the following year a Research Laboratory of Physical Chemistry, in case the Institute was able to equip such a laboratory and assist in its maintenance. In order to take advantage of this opportunity for developing advanced study and research work, the Executive Committee voted to establish the proposed Research Laboratory and to make provision for it in the new building erected on the corner of Trinity Place and Stanhope Street. The second story of that building was designed and equipped for the purpose in view, and the laboratory was opened for work on the twentieth of September. It consists of seven small laboratories, each of which affords ample accommodation for two workers, and of a number of other rooms for general purposes, weighing, photographic work, optical measurements, pure-water distillation, storage of chemical and physical apparatus, and the holding of seminar meetings. A well-equipped shop in which a skilled instrument maker is regularly employed adjoins the laboratory, and in close connection with it is a chemical lecture-room and the new students' laboratory for undergraduate work in theoretical chemistry to which reference has been made in the report of the Chemical Department.

The laboratory staff for this year consists of eight research associates and assistants working under the direction of Professors A. A. Noyes, W. R. Whitney, and H. M. Goodwin.

Two graduate scholars studying for advanced degrees are also working upon researches in the laboratory. The following investigations are already in progress: The Electrical Conductivity of Aqueous Solutions at High Temperatures (up to 306° and higher) — three separate researches carried on by Dr. W. D. Coolidge, Dr. H. C. Cooper, and Mr. A. C. Melcher; the Conductivity of Fused Salts by Mr. R. Haskell; Electrical Transference Determinations with Nitric Acid by Mr. Y. Kato; the Migration and Coagulation of Colloids by Dr. J. C. Blake; the Equilibrium in Solution between Milk Sugar and its Hydrate by Mr. C. S. Hudson; the Dissociation-Relations of Sulphuric Acid at Various Temperatures by Mr. M. A. Stewart; and the Hydrolysis of Ammonium Sulphide determined by Vapor-Pressure Measurements by Mr. C. F. Sammet. The researches upon the conductivity of aqueous solutions and upon transference are being assisted by two grants of $2,000 each made to Professor Noyes by the Carnegie Institution. An extensive article describing the progress of the former research up to date has just been published. Besides these physico-chemical investigations, work is being continued with the assistance of Mr. C. S. Bryan, Jr., in developing a new system of qualitative analysis including nearly all the metallic elements. The members of the laboratory staff are giving a number of advanced lecture courses and are carrying on seminars on physico-chemical subjects, which are attended by all those connected with the laboratory. An announcement of those courses is made in the Programme of the Research Laboratory which has been issued by the Institute.

A. A. NOYES.

COURSE VI.— ELECTRICAL ENGINEERING.

The greater part of the machines and apparatus ordered for the Augustus Lowell Laboratory has been received and installed and is now in operation. The generating plant, comprising about 1200 horse-power of different types of

engines and dynamos, is used for lighting and power purposes in the various buildings of the Institute and also supplies for laboratory experiments current of any required amount and at any desired voltage. A condenser and cooling tower have been installed and will add to the economy of operation of the plant. The equipment of the department, though increased by the purchase of a number of measuring instruments and instruments of precision, is still severely taxed during the progress of thesis work and a considerable addition in instruments is needed.

The changes in the Course suggested and approved last year have already been inaugurated in the second and third years, but a further period of two years must elapse before the scheme is in full operation for the fourth year as well. There results from these changes a very considerable increase in the amount of time devoted to electrical instruction, especially to theoretical electricity, and a corresponding decrease has resulted in the time given to mechanical engineering subjects.

During the past year, in addition to excursions to local power stations and manufacturing plants, students of the fourth year visited the works of the General Electric Company at Schenectady and a small party inspected some of the large electrical stations in New York City. Although the thesis work was on the whole satisfactory, the results obtained show evident need of a greater allotment of time to this work, both from the standpoint of achievement and also to give the students opportunity for proper assimilation of the results which they obtain. It is hoped that in the ultimate arrangement of the Course the second term of the fourth year may be so planned as to allow this opportunity.

An important feature has been inaugurated this year in connection with the work in the Laboratory of Dynamo Electric Machinery. Each student is required to submit before performing any particular experiment a clear statement of the problem, a sketch of the apparatus to be used, and a brief explanation of the methods to be employed. This preliminary

sketch is examined and commented upon by the laboratory instructors in consultation with the student, and it is believed that the efficiency of the instruction will in this way be much increased. Of course this involves a very considerable addition to the work of the instructing staff. The instruction in the laboratory is also being brought into very much closer relation with that in theoretical electricity, and the introduction of a system of laboratory conferences, in which the bearing of the work on engineering practice is discussed, cannot but prove of the greatest benefit to the students.

The Journal Meetings begun last year are to be continued and the collaboration with the department of English is to be carried out along the same lines as during the year just past.

The importance of electrical engineering instruction, both lectures and laboratory work, in the scheme of other departments is fully recognized, and this department is now giving instruction in the laboratory to students in naval architecture, mechanical and mining engineering, and electro-chemistry. The handling of this increased body of students in the laboratory, together with the additional work involved in the new plan of instruction, should be met by an increase in the instructing staff of this department.

A considerable number of lectures has been given to the students of the department during the past year by distinguished engineers not connected with the Institute.

LOUIS DUNCAN.

COURSE VII.—BIOLOGY.

The activity of this department in research and publication, referred to last year, has been continued, the younger members of the staff, especially, deserving honorable mention in this connection (see list of publications beyond).

Professor Hough, who came to the Institute in 1893 as Instructor in Biology, and was soon after promoted to an assistant professorship, has resigned in order to accept the

Associate Professorship of Biology in Simmons College and to organize its Biological Department. His resignation was accepted with great regret. In his place has been appointed as instructor one of his former pupils, Dr. Percy G. Stiles, a graduate of the Biological Department of the Institute in the class of 1897, afterwards Assistant in Biology with us, and more recently a graduate student, Fellow, Assistant, and Doctor of Philosophy from the Johns Hopkins University. Dr. Stiles brings with him a good reputation as a teacher and investigator.

Mr. Samuel Cate Prescott, for some years a successful instructor in the Department of Biology, has been appointed Assistant Professor of Industrial Biology. To him, with the assistance and coöperation of Mr. William Lyman Underwood, lecturer in the Biological Department, belongs the credit of working out for the first time the bacteriological aspects of the canning industry. By their investigations Messrs. Prescott and Underwood have contributed materially to the improvement of the practical processes of canning and preserving foods. Professor Prescott has also discovered, and made known in a series of published papers, a remarkable similarity between the common intestinal bacteria and certain lactic acid bacteria, a discovery of the very first importance in the interpretation of sanitary bacteriological analyses of water and sewage.

Mr. Underwood, who is chairman of the Board of Health of Belmont, Mass., and an unpaid member of the instructing staff of this department, having made himself an authority on the mosquito nuisance and its control, especially in connection with the drainage of marshes, low-lands, clay pits, etc., has published extensively on that subject during the year. He has also recently made the important discovery, in Maine, of a large mosquito, hitherto unknown, which has been named in his honor *Eucorethra underwoodi*, by the experts of the Division of Entomology of the United States Department of Agriculture.

Dr. Weysse, instructor in Zoölogy, visited the Bermuda

Islands during the long vacation and brought home much valuable zoölogical material by which his classes will henceforward benefit.

Owing to the growth of the research work of the department and the need of better adjustment to changed conditions, the large room heretofore used as a third-year laboratory has been turned into a research laboratory and thoroughly equipped for advanced students carrying on investigations. This has involved an exchange by which the third-year classes are cared for in the former research laboratory,— an exchange which has already proved advantageous and wise. Excellent accommodations are now available in the new research room for fourteen investigators, and this amount of space is needed for graduate or special students, thesis workers and, especially, for the younger members of the staff, who have no other suitable place for their own investigations. New and larger incubators and other pieces of apparatus, especially designed for our work by Professor Prescott, have been placed in the bacteriological laboratory and in the research room.

The equipment of the department has been much improved during the year by the addition of a number of high-power microscopes of the latest pattern. More of the same kind are still greatly needed.

A Sanitary Research Laboratory and Sewage Experiment Station, made possible by the generosity of a friend of the Institute who prefers to remain anonymous, was opened on April first in modest but convenient and suitable quarters, rented for the purpose on Albany Street near the corner of Massachusetts Avenue. This site was selected chiefly because of its proximity to one of the largest of the sewers of the City of Boston, entrance into which was kindly permitted by the officers of the Sewer Department. Mixed sewage from a very large population is thus always accessible, and through a pump run by an electric motor can be obtained for experimental purposes in sufficient quantity at any hour, day or night. The property rented was formerly a large stable having connected with it a spacious yard and a small

two-story office building. The stable has been converted into a tank room, the hay loft overhead into a second tank room and a place for the storage of sewage — necessary in certain experiments,— and the office building into two laboratories, one chemical, the other biological. Some three months were required for the necessary alterations and the installation of the first experiments, but good progress has already been made and the facilities now offered for students and investigators of sewage and sewage disposal are such, it is believed, as no other educational institution possesses.

Professor Sedgwick was appointed Director of the new Laboratory and Station, Professor Porter, Consulting Engineer, Professor Talbot, Consulting Chemist, and Mr. C.-E. A. Winslow, Instructor in Sanitary Biology, Biologist in Charge. Most of the labor and responsibility of fitting up and organizing the laboratory, and making its work effective, has fallen upon Mr. Winslow. Mr. Earle B. Phelps, a graduate of the Institute in 1899 and since that time one of the staff of investigators at the Lawrence Experiment Station of the State Board of Health of Massachusetts, was appointed Research Chemist and Bacteriologist. Mr. Phelps has given his whole time to the work since February 1st, and at the recent meeting of the American Public Health Association, in Washington, presented a paper on some of the first results of his investigations of the chemistry of sewage, with a criticism of the analytical methods commonly employed. Mr. Winslow gave his entire summer to research work at the new laboratory, and Professor Prescott and several students have worked there for shorter periods Mr. G. R. Spalding has been appointed laboratory assistant, and Miss A. F. Rogers, a research assistant.

Conformably to the expressed wishes of the donor, plans have been made for the publication of a series of popular pamphlets, or leaflets, having for their object the wider dissemination of the elementary truths of sanitary science expressed in the simplest language, and it is expected that the first of these pamphlets will soon appear.

Professors Sedgwick and Hough have nearly ready for the press a work on physiology and hygiene to which they have devoted much of their vacation time for the last three years. Professor Sedgwick is also engaged in a study of the practical efficiency of the Chicago Drainage Canal and the streams into which it flows as a means of sewage purification, while acting as one of the principal advisers of the State of Missouri in its suit for an injunction, against the State of Illinois and the Sanitary District of Chicago, in the Supreme Court of the United States,—a controversy of national importance in sanitary science. Professor Prescott and Mr. Winslow will soon publish a short treatise upon the Bacteriology of Water, to which subject they have given special attention for several years; and Dr. Weysse has in the press of the Macmillan Company a Synoptic Text Book of Zoölogy, based upon methods of instruction gradually developed in work with classes in general zoölogy at the Institute.

W. T. SEDGWICK.

COURSE VIII.—PHYSICS.

The past year has been largely one of transition. The space vacated by the removal of the laboratory of electrical engineering to the Lowell Building was appropriated to the laboratories of heat measurements, physical chemistry, and electro-chemistry, together with a few rooms for research. But the great amount of time necessarily consumed in the transfer of the heavy dynamo machinery prevented much use of the space in question throughout the past year. The last of the apparatus has been removed, however, since the present school-year began, and the various rooms are or will shortly be in condition for use.

The Physico-chemical Laboratory has been transferred from Room 2 on the Clarendon Street side of the Walker Building to Room 6 on the opposite side. To it have been added two small rooms specially fitted for conductivity work,

a large dark room for vacuum tube work and the study of dielectric constants, a store-room, and a room for physical research.

The Electro-chemical Laboratory is now opened for the first time, its establishment having become imperative on account of the students in the Electro-chemical Option of Course VIII. It occupies the space vacated by the Laboratories of Physical Chemistry and Heat Measurements, together with a small section of the chemical packing room. The laboratory is 92 feet long by 30 feet wide and is divided into two parts: the first, 62 × 30, is designed and equipped for electro-chemical measurements and analysis, while the second, 30 × 30, is fitted up for technical work. The equipment of the former laboratory has been made as complete as possible with the view of offering every facility for rapid and accurate work. Each student is provided with an especially designed five and one-half foot desk with sink, suction, and gas at one end, and a large porcelain thermostat at the other. The thermostat is electrically heated and regulated, and is provided with stirrer and rotator for saturating solutions. On the front of each desk are provided four independent circuits of 2, 12½, 25, and 110 volts repectively, each wired to deliver current up to ten amperes. A large rheostat of corresponding capacity at the side of each desk is also wired directly to this switch-board. A shaft driven by an electric motor runs along the back of each desk above the switch-board and furnishes power for stirring, etc.

The desk equipment for each student is also very complete. Besides the necessary chemical equipment, a complete set of electro-chemical apparatus is provided. This includes for each student a three-scale Weston portable voltmeter, a Weston milli-voltmeter with separated shunt for reading currents, copper, silver, gas and soluble-anode voltameters, transference apparatus, complete Kohlrausch conductivity apparatus, Lippmann electrometer, potential and resistance box, normal and half electrodes, etc. The whole class is thus able to work at the same time on the subjects that are concurrently discussed

in the lectures. Specially designed constant temperature closets for electro-chemical analysis are also provided. Although ten desks were equipped the present year, (three more than were needed to accommodate the regular students in the Course), the demand for places has already exceeded the supply, owing to the unexpected number of graduate students who have elected the work.

The laboratory for applied electro-chemistry has been equipped with the view of providing all necessary facilities for illustrating typical electro-chemical processes on a fairly large scale, and for research work. The equipment includes a double current motor-generator of 25 kilowatts capacity, capable of furnishing 1000 or 2000 amperes at 25 and 12½ volts respectively. This generator supplies current for the students' desks and for electrolytic processes requiring large currents. It also serves to charge the large storage battery which has been installed for use in processes requiring large currents at very constant voltage. For processes taking place in electric furnaces at very high temperatures, but not involving electrolysis, the laboratory is further equipped with a special step-down transformer of 50 kilowatts capacity designed by Professor Derr of this department. This transformer is so constructed that several furnaces can be run simultaneously, thus enormously increasing its availability for experimental work.

The laboratory is equipped with a number of electric furnaces of various types, including those of Moissan and Borchers, and others especially constructed for experimental work. The necessary electrical instruments for measuring heavy currents and energy are also provided.

The removal of the Electrical Engineering Department has given for the first time the room needed for the development of the Laboratory of Heat Measurements as originally planned. It is now possible so to install the equipment now at hand as to have apparatus for instruction and research available in practically all fields of heat measurements.

The original plans for the laboratory, made over fifteen years ago, have steadily been developed. Beginning with a modest equipment of one or two pyrometers, a fuel combustion bomb, and several standard thermometers and comparators, located in a very small room of the laboratory, it has three times outgrown its quarters, only now to find ample space in the former dynamo room. The equipment now comprises what is without doubt the most complete collection of standard apparatus for heat measurements in existence for purposes of instruction and entirely sufficient for any purpose. In addition there is a large amount of original apparatus for instruction and research, especially of a technical nature.

The number of students taking a course in heat measurements has increased from a half dozen in 1893 to about 200 in 1903. In 1893 a small part of the time of one assistant sufficed for the instruction then given, but now the major portion of the time of Professor Norton and the entire time of one assistant are hardly sufficient for that purpose.

The laboratory has become a standardizing laboratory in many lines of heat work, and has acquired a wide reputation for certain of this work. The cramped quarters hitherto occupied have prevented a more rapid growth in this direction, and it is believed that the present relief will be a great help in such work.

The supply of electrical power, 35 kilowatts for electric furnaces, and the possibility of further supply in 15 kilowatt units leave little to be desired at present in the line of further facilities for high electric temperature furnaces.

The most urgent need at present is a small refrigerating machine for use in connection with the measurements of conductivity and specific heats of materials used in modern cold storage practice.

The special facilities of the laboratory have made it possible to do much work in the last year in research for the Insurance Engineering Experiment Station, of which one of the members of the department is the engineer. The results

of several of these researches have been published during the year.

The laboratories of Heat Measurements and of Electrochemistry are supplied with alternating current from a plant located in the former laboratory, which consists of a 30-kilowatt, 1100-volt, Thomson-Houston, single-phase alternator, belt-driven by a 50-horse-power, Thomson-Houston, direct current, 220-volt motor. The 1100-volt leads from the alternator are carried directly to both laboratories, for connection with the large transformers there used. A full complement of transformers is also provided, for supplying current at 125 cycles and 110 or 220 volts to the various laboratories and lectures.

The alternator is mounted upon the pier formerly occupied by the engine of the old dynamo plant, and the motor on the floor near by, the two making a compact and smoothly-running plant. The current actuating the motor is furnished from the plant in the Laboratory of Electrical Engineering.

The Optical Laboratory has been greatly developed during the past three years and now furnishes large facilities for undergraduate and graduate work which is carried on in immediate connection with lecture-room instruction. The equipment includes a Pulfrich refractometer, a Zeiss microscope with all accessories for a complete experimental study of the optics of the microscope; a Littrow spectroscope with echelon for spectrum investigations; an Abbé focometer for the determination of focal lengths and apertures of lenses and lens systems; Weber and Munsell photometers for photometric studies; a Koenig spectro-photometer; a Lippich-Landolt half shade polarimeter; and a Michelson interferometer with the necessary adjustments for the determination of wave-length, index of refraction, and other physical constants.

The equipment of the Laboratory of General Physics has been materially increased, chiefly in the way of duplication, in order to provide for the unusually large classes of the second and third year.

The department is in great need of a small plant for the

production of liquid air and other gases. The absence of this has rendered it impossible hitherto to study many important physical problems. Such a plant has come to be regarded as a usual adjunct to a properly equipped physical laboratory.

A considerable portion of the apparatus formerly located in the Electrical Laboratory, comprising that of a more purely technical character, has been removed to the Standardizing Laboratory of the Department of Electrical Engineering. A number of advanced electrical experiments of a physical character have been introduced.

So far as room is concerned, one of the principal inconveniences under which the department at present labors is the want of an apparatus room, in which the very large collection of apparatus belonging to it can be properly arranged so as to be easily accessible. At present this has to be stored in several rooms, so closely packed as to forbid suitable classification, and liable, moreover, to breakage in removing and replacing it. Another serious need is that of more room for the use of the instructing staff for purposes of consultation and the like. The increase in the number of instructors during the past six or eight years has caused an increasing employment of certain of the laboratory rooms, especially the acoustic laboratory, for the purpose referred to, which is, of course, detrimental to their proper use.

Co-operation in a most important study of the proposed lighting of the new buildings of the Boston Museum of Fine Arts is made possible because of special work done in the Physical Department in the past five years in the study of the problems of interior lighting. A most elaborate series of experiments on a full-sized gallery is to be carried out on a scale never before attempted, with a view to determining the best possible lighting for the exhibits in the new Museum. The physical investigation is under the care of one of the staff of the department, working jointly with the Museum committee and the architects.

CHAS. R. CROSS.

COURSE XII.— GEOLOGY.

INSTRUCTING STAFF.— The two new instructors, Dr. Johnson and Mr. Shimer, have taken up their several lines of work and are rapidly becoming familiar with our facilities in the field and laboratory. It would be entirely practicable next year for Dr. Johnson to take charge of the course in general geology, now conducted by Dr. Jaggar. Dr. Jaggar is handicapped by being obliged to give his lectures in Huntington Hall, far away from his own collections, and at an inconvenient distance from ours. Dr. Johnson could divide the class into sections, so as to be able to use the departmental lecture-room and our entire equipment. Dr. Jaggar also co-operates with us in the work in experimental geology; and it appears desirable that the latter arrangement should be continued, at least for the present, since Harvard offers laboratory facilities in this subject which it would not be wise for us to duplicate, the idea being rather to supplement their equipment.

In the division of labor in the Geological Department, it has been arranged that Dr. Johnson will have charge of nearly all the work with the Civil and Sanitary Engineers, besides giving the instruction in geological surveying and areal geology and co-operating in the field work of the Mining Engineers.

Dr. Shimer assumes the work in historical geology, paleontology and physiography, including climatology, besides assisting in the field work and the laboratory work in lithology, especially with large classes. He also has charge of the paleontological collections and of the department library.

Dr. Warren, as heretofore, has sole charge of the work in mineralogy, both elementary and advanced, and in petrography, and Professor Barton will continue to give the instruction in geology to the Boston University students.

ROOMS AND EQUIPMENT.— The most important change of the past year to be noted under this head is the transfer of the mineralogical laboratory and collections to the new build-

ing, Engineering C. Dr. Warren finds that the new laboratory is admirably adapted to the work in mineralogy; and the small room adjoining the main laboratory has been fitted up to serve as an office for members of the instructing staff, and also as a research laboratory. The equipment in instruments and apparatus for mineralogical investigation is fairly complete andis available for the use of a limited number of graduate, students.

The room vacated by Dr. Warren (13 Pierce) relieves some what the congestion in economic geology, and gives greater laboratory facilities for experimental and research work in geology.

VACATION SCHOOLS.— But little has been accomplished the past year in this direction. Last winter I visited the lead mines of southeastern Missouri and the Economic Collections of the National Museum with one student (Mr. Loughlin) and in July I conducted a party of four students in economic geology on an eight days' excursion through the valley of the Hudson, northern New Jersey and northeastern Pennsylvania.

RESEARCH AND PUBLICATION.— During the past year I have been employed by the U.S. Geological Survey in the investigation of the Geology of the Boston Basin, of the Water Resources of Long Island, and of the ground waters of Massachusetts and Rhode Island; and this work has enabled me to provide instructive employment during the summer for several of our students.

In addition to this work for the Survey, I made a special study of the local geology in its relations to the proposed Charles River Dam and my report on this work has been reprinted in the Technology Quarterly. During August and September I was engaged in studying the mining geology of Alaska, visiting the Klondike and Nome Districts.

Dr. Johnson was also employed during the summer in work for the U.S. Geological Survey on Long Island; and Mr. Shimer was engaged at Columbia University in an investigation of the paleontology of Trilobite Mountain, near Port Jervis, N.Y.

, Dr. Warren has given considerable time to mineralogic and petrographic investigation; and Mr. Loughlin has prepared his thesis on the Building Stones of Boston for publication; and this excellent piece of work in economic geology will appear in an early number of the Technology Quarterly.

A Geological Journal Club with thirty members and weekly meetings has been organized and is doing good work.

W. O. CROSBY.

COURSE XIII.—NAVAL ARCHITECTURE.

The Department of Naval Architecture was moved this fall into the new building, Engineering C, where it has good accommodations, consisting of a commodious and well-lighted drawing-room large enough to provide for the probable future growth of the department; another drawing-room adequate for the needs of the U.S. naval constructors, with an adjoining room used for a private lecture room and office; also one good-sized lecture-room and a small class-room. The books belonging to the department, and also the periodicals provided for it, are kept in the general engineering library as has been the habit; this was a good arrangement when the department was housed in the engineering building, but its new location is so distant that the library is practically inaccessible both to the instructing staff and to the students. The difficulty is inadequately met by placing a few books and periodicals in the offices leading from the drawing-rooms. It is much to be desired that the students of the department may have a reading room where they may consult books and periodicals belonging to the department and read their own text-books. The only provision now possible has been made by placing tables in the drawing-rooms, with chairs and reading lamps. It is further desirable that there may be a storeroom where apparatus and other material belonging to the department can be kept when not in use.

Through the kindness of Dr. Weld the department has

been provided with a shop for making ship models, with ten benches that can accommodate twenty students at once, with machinery for preparing material, namely, a planer, a band saw, and a grinder, and with a supply of hand tools. Dr. Weld has also supplied material for making models and has provided instruction by a competent model maker. About forty students received instruction in model making last year, including some of the assistant naval constructors who are taking instruction at the Institute. The work is optional on the part of the students and they have shown an appreciation of the advantages offered. During a visit of the Chief Constructor at the Institute, he expressed much interest in the work of the model shop and a hearty commendation of the methods of work. The shop, as now arranged, is located at the Mechanical Laboratories on Garrison Street, and consists of a main room for the machinery and benches, which is sixty feet long and twenty feet wide, and an annex forty feet long and ten feet wide, half of which is used as a varnishing room and half as a stock room. It may not be out of place to say that the primary object of teaching model making is to give an adequate conception of the form of the ship which the student is designing and which he has represented by the ship's lines he has drawn. These lines may have faults that the drawing-room instructor has already pointed out, or there may be defects that are not easily discovered. In any case the model is first cut to the lines as drawn, and afterwards changes are made if expedient; thereafter ship's lines have a different meaning to the student who can interpret from them the true form of the ship. It is now the custom of ship designers, and especially of yacht designers, to have models made, and in ship-yards models are habitually used for laying out the shell plating. Advantage will be taken at the Institute of models made in the shop, for this purpose.

The department has acquired this year four additional mechanical integrators and an additional integraph, also an electric ship's log, all of which have been presented by General Paine. In all, the department now has seventeen in-

tegrators and two integraphs, which will ensure that every student will have the advantage of these important adjuncts at any time. The department has, also, a computing machine and several large slide rules. The electric log has been obtained to facilitate tests on ships at sea, a feature of the work of the department that has frequently been mentioned. The large provision of mechanical aids for computation has been sought partly that students might become familiar with them, but mainly with an idea of using to the best advantage the time that the students have assigned for ship calculations. Such calculations, when carried out numerically in a complete manner, are long and tedious and call for much practice if facility is to be attained. Even if the student could properly devote so much time to the computations, there would be danger that the fundamental principles, which are of prime importance for him, would be obscured by the mass of numerical computations. Our object has been to retain enough routine work to give proper training, and to get results which are sufficient for the purposes of instruction without undue expenditure of effort. To this end much time and thought have been given to the reduction of the labor of ship calculations without sacrificing certainty and accuracy in the results of such calculations. This has been done especially by Mr. Leland, who has devised methods of determining displacement and stability which are as good as those used in the ship-yards and require only a fraction of the time. These labor-saving devices have been of the greatest assistance in preparing and arranging the material in the possession of the department, drawings and other data, for use in teaching design. Such work is essential for the proper teaching of any kind of construction or engineering work, and is especially so for naval architecture, for which comparatively little systematic information is available.

Late in the spring a request was received from the Chief Constructor of the Navy Department that the Institute should receive five additional midshipmen and that special arrangements should be made so that they might this fall join

the class that entered a year ago. These young men as they arrived were given such work as they could do, and then, as soon as the regular work of the Institute was closed and instructors were available, special classes were formed for them in mathematics, applied mechanics, electricity and in the theory and practice of ship design. These young men are now taking the work of the senior year of Course XIII. A in a satisfactory manner. The reason for this extraordinary course was the great need of the corps of Naval Constructors for additional men as soon as they can be prepared. It was expected that the detail of additional officers to the senior class of Course XIII. A might leave us without a junior class in that Course this year, but very recently the Chief Constructor has secured the detail of three officers for whom special arrangements are requested, in order that they may be formed into a regular junior class. We have further the assurance that a class of four will be sent next fall, thus keeping up a sequence which is much to be desired.

C. H. PEABODY.

MATHEMATICS.

The work of the department has been conducted during the year along the lines indicated in the last report. Conferences of members of the department have been held at intervals, with discussion of matters of general interest and participation by members of related departments, with a view to a clearer appreciation of mutual interests. The entrance requirement in algebra has been made considerably more effective by an increase of the time allowance from two to three and one-half hours, and the division of the examination into two parts. The papers have also included problems of a practical character, as well as purely algebraic questions. The first-year course in algebra has been revised in subject-matter and sequence of work, and now includes the greater part of what was formerly given under theory of equations in

the second term. The combination of instruction by lectures and by recitations in analytic geometry and calculus has been continued with satisfactory results, and with some consequent reduction in the size of recitation sections.

At the end of the year, Professors Bartlett and Skinner were granted leave of absence for a year, and Professor Bartlett is now engaged in study and visits in Germany, paying special attention to mathematical work in the Polytechnics. Dr. Haskins has accepted appointment as instructor at Yale University, with attractive opportunities in the line of mathematical research. These changes have made it necessary to appoint three new instructors for the present year.

Professor Bailey has taken charge of the Runkle Library during Professor Bartlett's absence, Mr. George, of the course in Least Squares.

In addition to the usual course, lectures are given the present term on Potential by Dr. Mason and on the Calculus of Variations by Professor Woods, Dr. Mason, and Mr. Miller.

The American Mathematical Society held its summer meeting at the Institute August 31st and September 1st, and the usual colloquium was held during the remainder of the week, Professor Woods giving three lectures on "The Connectivity of Non-Euclidean Space."

H. W. TYLER.

MODERN LANGUAGES.

The instruction in modern languages, in the four principal courses of my department (French I., II. and German I., II.), is carried on in accordance with the views expressed by members of the Visiting Committee and with the general plan and principles indicated in the new edition of the Annual Catalogue.

An innovation, which is likely to be of some importance, is tests to be written by second, third and fourth-year students of the courses French II. and German II. once in every term; to be corrected by the instructors of the Modern Lan-

guage Department in regard to the actual rendering of the meaning of the original; and to be criticised by members of the English Department in regard to English form and expression. It is to be hoped that this arrangement will increase considerably the efficiency of the two courses French II. and German II., and will tend to improve the English style of the students, as well as their capacity for reading intelligently scientific books written in French or in German.

The new conditions regarding the entrance requirements have naturally affected the size and number of sections of the courses in elementary French and German (I.). There are now four sections of French I. with 106 students; seven sections of French II. with 179 students; nine sections of German I. with 219 students; and twelve sections of German II. with 335 students. It has not been deemed necessary this year to engage an assistant to help us in our work in German as we were obliged to do last year.

A great many students have been able to fulfil the new entrance requirements in languages, and have passed off French I. and German I. in their entrance examination. It appears, however, that the secondary schools, at present, are less well prepared to do the elementary work in German than in French.

The method of instruction in the optional advanced courses of French and German (III.) and in the Spanish classes necessarily differs from that followed in French I., II., and in German I., II., where the language taught is principally considered but a tool in regard to professional work. It gives me great pleasure to call attention to the fact that the courses in Spanish, which are expected to transmit to the students a thorough practical (reading, speaking, and writing) knowledge of Castilian, and the advanced course in French (III.), which pursues a similar aim in connection with the study of the literature and "cultural" life of France, seem to be very popular among students, and are in a flourishing condition. There are 16 students in French III. (in charge of Professor Rambeau); there are four students in the course of German Sight Read-

ing (in charge of Professor Dippold); there are five students in German III. (in charge of Professor Vogel), with aims similar to those of French III.; there are 48 students in Spanish I., three students in Spanish II. (both courses in charge of Mr. Erhardt), and seven students in Spanish III. (in charge of Professor Rambeau). Many members of the class in French III. belong to the Department of Architecture; the courses Spanish II. and III. are taken principally by students of Naval Architecture.

The Department will offer, in the second term, also optional courses in French Literature and in French Sight Reading. The demand for Italian has not been sufficiently large to warrant the formation of an Italian class.

A. RAMBEAU.

ECONOMICS.

Political economy is taken by all students of the school in the third year (students in Course X. on account of a crowded schedule in the third year take it in the fourth year). Forty-five exercises in all are given; thirty in the first term, and fifteen in the second. Originally, thirty exercises were given in the second term, but upon the introduction of the course in business law, fifteen exercises were withdrawn to provide for this subject. On account of the limited amount of time allowed, the course must be restricted in character, and in no way can it be regarded as comprehensive. We, however, lay stress upon the practical portions of the subject, giving no more attention to theory than is necessary to secure an orderly arrangement. Special stress is laid upon the descriptive matter of money and banking; at least one-third of the time is given to these and related subjects. About six exercises are devoted to railway economics, and four more to the trust question.

During the first term one exercise a week is devoted to a lecture, and in the second term all of the exercises are by lecture. The second exercise during the first term is a dis-

cussion, and, in order to make this as valuable as possible, the class is divided into sections; this year into eight, so that there is opportunity to engage students in discussion; students also answer certain questions in writing at this exercise and these papers are carefully read by Mr. Doten. After a number of these papers have accumulated, the students who appear to need special attention are requested to meet Mr. Doten in personal conference to talk over deficiencies or to straighten out misunderstandings.

Any amount of time could be spent to advantage in personal conferences, and, whatever arrangements may be made in the future in regard to the Department of Economics, I hope that a generous provision will be made for the enlargement of this part of our work.

In addition to the general course in political economy, a special course is given to students in Course VI. in the fourth year on economics of corporations; this is a lecture course of fifteen exercises; no time is given to students for preparation. The topics included are: development of corporations, forms of securities issued, analysis of a corporation account, restrictions in Massachusetts upon issue of securities, position of quasi-public corporations concerned with the industrial application of electricity, taxation of corporations, street railway franchises and control of electric lighting.

A third brief course consisting of fifteen exercises on vital statistics is given to students of Course VII., fourth year. The main object of this course is the interpretation of registration reports and census mortality statistics.

I should like to call attention to the desirability of securing special instruction in accounting. I believe that such a course would be useful for a large number of students at the Institute who are likely to have close relations with the business side of manufacturing and transportation industries. I hope that such a course can be provided for in the department of economics when the new courses are substituted in the place of modern languages in the third year.

DAVIS R. DEWEY.

ENGLISH.

The English Department has during the year continued work along the lines indicated in the Report of last year. This has included the extension of first-year English through the second term, and a large increase of written matter from the various departments connected with the special work of each. The first-year English of the second term combined composition with special preparation for second-year English Literature. Readings were given to the classes, and an effort was made to develop greater intelligence in reading and in comprehending literature. The written work given in connection with the subjects taken up in other courses, much of it coming in the later years of student life, is proving a valuable means of training, especially that which is intimately connected with technical instruction. The students have responded admirably to this requirement and have shown in connection with it much interest and appreciation. The English Department corrected last year 368 translations, 260 memoirs from the students in Mining Engineering, 39 from students in Electrical Engineering, 31 from those in Civil Engineering, 27 from students in Architecture, and 16 reports of Colloquiums. Many of these were of from five to ten pages, and a number were of a greater length still. The only change in the force during the year has been that made necessary by the resignation of Mr. R. G. Valentine, the appointment of Mr. C. H. L. Johnston as assistant. In connection with the work of the department it is of interest that the use of books and periodicals in the General Library seems constantly to increase.

ARLO BATES.

HISTORY.

The instruction in history is of three kinds: first, that given to all regular students of the Institute; second, that given as required subjects to students of certain Courses; third, optional subjects in those Courses.

Under the first head are included United States history and European history since 1815. In United States history about one-half of the time is devoted to an advanced study of certain selected topics, with special reference to the political, industrial, and social development of the country, leading up to the study, occupying the other half of the time, of the United States of today and of its government, together with some attention to municipal government.

In the European history so much ground needs to be covered that the main stress is confined to a consideration of the governments, politics, and international relations, of the leading European nations, with enough of the history of each country to make clear the origin and meaning of existing institutions.

The principal object of these two courses is to enlarge the student's knowledge of the world of the last one hundred years and of today, to broaden his intellectual horizon, to stimulate his interest in the practical problems of public life; in a word, to provide a training for good citizenship.

Of the subjects required in particular Courses, the most important is the history of European civilization and art, designed especially for students in Architecture. This is so valuable in itself, so well presented, and so fully illustrated with lantern slides, that it might profitably be taken by many students to whom it is not now open; and indeed a somewhat abridged treatment of the subject will be offered as a third-year option in the time set free by the change in entrance requirements in modern languages.

All of the foregoing subjects are likewise taken by students in the General Course who also have, either as required or as optional studies, courses covering the most important features of mediæval and modern history.

In the time to be set free in the third year, it is proposed to offer, in addition to the outlines of European civilization and art already referred to, courses in the history of important epochs and also courses of a specially practical nature, such as national government, municipal government, coloni-

zation and colonial problems, and the elements of international law.

Closely allied with the subject of history is that of government, and in this field instruction is given in comparative politics, municipal government, and international law.

Large use is made of specially prepared maps and diagrams; particular pains are taken to make the instruction in history as valuable as possible for engineering students, and to meet their special needs as completely as can be done in the limited amount of time available for the study of the subject.

CHARLES F. A. CURRIER.

MECHANIC ARTS.

The total number of students receiving instruction in the Mechanical Laboratories is three hundred and eighty-two. Some take instruction in more than one class, the numbers in the several subjects given this term being as follows:—

Carpentry and Wood Turning, II. and X.	110
Joinery and Pattern Work, VI.	38
Forging, II. and XIII.	114
Machine-tool Work, II. and XIII.	88
Metal Turning, VI. and VIII.	48
Pipe Fitting, XI.	4
Total in classes	402
Students taking work in two or more classes and counted more than once	20
Total number of students	382

The total number of students taking work in the mechanic arts since 1897–98 is as follows:—

1897–98	210	1901–02	294
1898–99	231	1902–03	347
1899–00	238	1903–04	382
1900–01	272		

SUMMER SCHOOL.— The total number of students attending the summer school in mechanic arts was smaller than usual last summer, no classes in carpentry, wood-turning, or pattern making being held on account of the very small number of applicants.

The numbers of students attending the various classes last June were as follows: —

Forging, Mr. Lambirth	15
Metal Turning, Mr. Smith	2
Chipping and Filing, Mr. Smith	8
Machine-tool Work, Mr. Smith	14
Total	39

The numbers attending the summer school since June, '98, are as follows: —

June, '98	48	June, '01	29
" '99	61	" '02	55
" 1900	52	" '03	39

CHANGES AND ADDITIONS TO EQUIPMENT. MACHINE-TOOL LABORATORY.— Seven engine lathes and a centering machine have been added to the equipment of the Machine-tool Laboratory. Two old engine lathes have been sold and replaced by new machines. It is now possible to accommodate classes of thirty students in machine-tool work instead of twenty-three as formerly, but, even with this increased equipment, several students had to be refused admission to the classes this year. An additional planer and drill press are very much needed to carry on the work successfully.

FILING LABORATORY.— To make room for the increased equipment of the Machine-tool Laboratory, the Filing Laboratory was transferred to a room on the second floor of the laboratory building, which necessitated the purchase of an additional tool-grinder. This laboratory is now arranged, as formerly, to accommodate classes of thirty-two students.

WOOD-WORKING AND FORGING LABORATORIES.— In the Wood-working Laboratory two old sets of planes have been

replaced by the best modern tools. The Forging Laboratory has had its equipment thoroughly repaired and all is now in fair condition, considering its twenty years' use. A renewal of this equipment to bring it up to date is very desirable. Both departments are, with the present arrangement of the work, easily caring for all of the students applying.

Instruction rooms, similar to that of the Machine-tool Laboratory, are very much needed in both departments and I earnestly recommend that such rooms be provided as soon as can be.

With the possible exception of the Machine-tool Laboratory, where probably two or three more lathes and some other general tools might well be added to accommodate two to three more students, it is believed that the classes are as large as they should be to be successfully cared for by our present staff. The foundry work might well be developed and made more important than now, being a short course and optional only. The laboratory facilities are now taxed to their utmost and, should the numbers continue to increase, more room will be needed.

The instructing staff now numbers four instructors and five assistants.

PETER SCHWAMB.

THE LIBRARIES.

The total number of the additions to the Library during the year 1902–3 has been 4,768, of which 1,501 were received by purchase, 916 from the binding of periodicals and books received in parts (not previously counted), and 2,351 were gifts. The net increase in the size of the library during the academic year 1902–1903, after deducting losses and books counted twice, amounts to 3,941 volumes, 961 pamphlets, and 195 maps. The distribution and cost of these is shown in the following table: —

TABLE OF THE NET ACCESSIONS FOR THE YEAR 1902–03, WITH THE COST OF THE SAME AND THE TOTAL CONTENTS OF THE LIBRARIES OF THE INSTITUTE, SEPT. 30, 1903.

LIBRARIES.	Net Increase.				Total Contents.	
	Volumes.	Pamphlets.	Maps.	Cost.	Volumes.	Pamphlets and Maps.
General	183	388	1	$202.56	5,449	4,475
English	243	4		205.26	3,111	44
Military Science	7	0		9.90	322	7
Walker Memorial Library,	225	0			225	0
Totals General Library,	658	392	1	$417.72	9,117	4,526
Architecture	192	5		547.40	3,328	233
Biology	102	68		202.24	2,781	562
Chemistry	363	38		771.85	9,059	1,708
Electrical Engineering	645	21		663.71	645	21
Engineering	719	126	1	1,171.96	11,579	4,180
Geology	125	99	192	128.66	2,409	1,404
History and Economics	412	60		288.58	11,637	3,447
Mathematics	83	10		154.57	1,315	208
Mining	233	61		342.20	3,468	567
Modern Languages	98	2	1	101.78	1,079	27
Physics	268	79		530.36	7,187	942
Margaret Cheney Reading Room	43				668	13
Totals	3,941	961	195	$5,320.83	64,272	17,838

With these additions the total contents of the library becomes 64,272 volumes and 17,838 pamphlets.

The number of serial publications received regularly by the Institute during the year 1902–1903 was 930, not including a large number of official reports and bulletins, school catalogues, and the like, which are also received regularly and duly recorded and catalogued. The following table shows the distribution of the serials, exclusive of most of the official reports: —

TABLE OF PERIODICALS AND OTHER SERIAL PUBLICATIONS RECEIVED DURING THE YEAR 1902–03.

LIBRARIES.	Number Received.					Estimated Cost.			
	Gifts.	Charged to Department.	Periodical Account.		Totals.	Department Accounts.	Periodical Account.		Totals.
			Exch.	Subs.			Exch.	Subs.	
General	40	18	15	26	99	$56.22	$30.00	$78.89	$165.11
Architecture	7	10	3	34	54	40.32	6.00	160.98	207.30
Biology	7	10	18	34	69	42.44	36.00	205.30	283.74
Geology	12	3	3	6	24	19.75	6.00	27.21	52.96
Chemistry	15	36	16	30	97*	116.46	32.00	155.78	304.24
Electrical Engineering	4	16	7	6	33	65.29	14.00	31.15	110.44
Engineering	28	57	68	61	214	160.01	136.00	254.55	550.56
History and Economics	55	48	2	42	147	77.64	4.00	138.74	220.38
Mathematics	—	1	—	17	18	.74	—	66.54	67.28
Mining	9	13	31	22	75	34.49	62.00	95.61	192.10
Modern Languages	—	2	—	18	20	3.12	—	96.11	99.23
Physics	13	11	23	21	68	44.85	46.00	96.02	186.87
Walker Memorial Library	12	—	—	—	12	—	—	—	—
Totals	202	225	186	317	930	$661.33	$372.00	$1,406.88	$2,440.21

There were added to the general catalogue during the year 4,776 cards, making the total number of cards in the catalogue 60,607. The orders for new books amounted to 1,244 items, and there were issued for binding 1,227 orders. In five of the libraries the circulation of books for home use during the year was as follows: —

General library	1,423	volumes
Engineering library	1,183	"
Chemical library	1,665	"
Mining library	1,577 †	"
Biological library	325	"

These statistics of circulation show an increase in the use of the books except in the Chemical Library where there is a slight decrease.

Through the generosity of a graduate of the Institute there has been established a library of books on athletics, out-door sports, personal hygiene, and kindred subjects, to be placed in

* Not including experiment station reports.
† This number includes books used in the library.

the Walker Memorial. This collection of books, which at the end of the fiscal year numbered 225 volumes, is kept at present in the General Library. The donor has also subscribed for 12 periodicals similar in character to the books, which are placed with the other periodicals in the General Library. Other gifts which deserve special mention are 42 large photographs of Rocky Mountain scenery given for the geological collection by Mrs Rogers, who has also continued her annual gift of periodicals; from Mrs. E. D. Cheney a set of the works of Charles Lamb, the works of Emerson, the Poets of Transcendentalism by G. W. Cooke, and the poetical works of John Keats; from Mr. J. B. Millet, 12 beautifully illustrated volumes on the history, arts, and literature of Japan and China; from Mr. Paul Gerhardt, Theatres, their Safety from Fire and Panic, Wasserstrassen u. Eisenbahnbau, 4 volumes, and five other German works on railroads; from Mr. Spaulding Bartlett, *Journal of the Society of Chemical Industry*, 7 vols., *Färber-Zeitung*, 4 vols., *Journal American Chemical Industry*, 2 vols., and *Deutsche Färber-Zeitung*, 1 vol. Other valuable gifts have been received from Mr. Timothy T. Sawyer, Mr. Thomas W. Lawson, Professor Talbot, *The Technology Review*, Mrs. Henry Draper, Miss Helen M. Winslow, and from the United States Government through the courtesy of our representatives in the Senate and House of Representatives. A bust of the distinguished civil engineer, Loammi Baldwin (1745–1807), has been placed in the Engineering Library through the generosity of the sculptor, Mr. Baldwin Coolidge.

ROBERT P. BIGELOW.

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 8, 1902, to May 22, 1903.

The first meeting of the Society of Arts for the present year was held on October 9, 1902. Fourteen meetings have been held, with an average attendance of one hundred and eighty-four.

During the past year the unusual interest in the meetings of the Society which has been shown in the past few years has continued. An effort has been made to have the addresses given before the Society cover a wide range of subjects. As a consequence, nearly all the students in the Institute have had an opportunity to hear a man who is an authority in the subject in which they are preparing themselves for the future.

The following papers have been read: —

"Long Distance Electric Railroading." Professor Louis Duncan, Director of the Department of Electrical Engineering of the Institute.

"The Identification of our Woody Plants in Winter." Mr. John G. Jack, of the Arnold Arboretum.

"The Art of Lithography." Mr. George H. Bartlett, Principal of the Massachusetts Normal Art School.

"The Designing of Small Racing Yachts." Mr. W. Starling Burgess.

"A Substance with Remarkable Optical Properties, and a Screen Transparent to Ultra Violet Light Only." Professor R. W. Wood, of Johns Hopkins University.

"The Coast Survey and its Work." Mr. O. H. Tittmann, Superintendent of the United States Coast and Geodetic Survey.

"The Reclamation of the Arid Public Lands." Mr. F. H. Newell, Chief Engineer, United States Geological Survey.

"Martinique and Mt. Pelée." Mr. George Kennan.

Exhibition of Some New Apparatus for Illustrating Certain Electro-Magnetic Phenomena. Professor Louis Derr, of the Institute.

"Government Architecture." Mr. J. Knox Taylor, Supervising Architect, Treasury Department.

"The Composition of Sewage with Relation of Problems of Disposal." Mr. George W. Fuller, Sanitary Expert, New York City.

"The Charles River Dam." Mr. R. H. Dana.

"Some Problems to be Solved in the Building of the Perfect Steam-propelled Automobile." Mr. Francis E. Stanley.

"A Reconnaissance in the Rocky Mountains of British Columbia." Mr. Howard W. DuBois, Mining Engineer, Philadelphia.

At the beginning of the year the Associate Membership was three hundred and sixty-seven. Of these members, three have died, eight resigned, and six have been elected, making the present membership three hundred and sixty-two. There are thirty-seven Life Members.

The *Technology Quarterly* has appeared regularly during the year under the editorship of Dr. Bigelow, with the advice and counsel of the Publication Committee. There have appeared in all twenty-eight articles besides the Proceedings of the Society. A new feature introduced this year is a series of Book Reviews, which, it is hoped, will add interest to the *Quarterly*, and will further extend the influence of the Institute and members of the Instructing Staff. We are also indebted for valuable contributions to members of our Alumni, namely, Gerard H. Matthes, William Lincoln Smith, G. C. Whipple, and Earle B. Phelps.

At the forty-first annual meeting of the Society, which was held on May 22, 1903, the following named gentlemen were elected officers of the Society for the year 1903–1904. Executive Committee: George W. Blodgett, Edmund H. Hewins, Charles T. Main, James P. Munroe, and A. Lawrence Rotch. Secretary: James F. Norris.

Respectfully submitted,

J. F. NORRIS, *Secretary.*

JANUARY 30, 1904.

PART III.

TITLES OF PAPERS PUBLISHED BY MEMBERS OF THE INSTRUCTING STAFF.

CHEMISTRY AND CHEMICAL ENGINEERING.

H. P. TALBOT.— Secondary School Chemistry from the College Stanpdoint. *Proceedings of the National Educational Association*, 1903, p. 877.

A. A. NOYES.— A System of Qualitative Analysis Including Nearly All the Metallic Elements. Part I. Preparation of the Solution. *Technology Quarterly.*

A. A. NOYES.— Interpretation of the Scheme of Qualitative Analysis with the Help of the Ionic Theory and the Mass-Action Law.

Report of Fifteenth Meeting of National Educational Association of Chemistry Teachers. 1903.

W. H. WALKER.— Concentration Changes in the Electrolysis of Brine. *Proceedings of the American Electrochemical Society*, Vol. 3, p. 177.

W. H. WALKER.— Electrolytic Production of Bleaching Liquor. *Electrochemical Industry*, Vol. I. p. 439.

W. H. WALKER.— Electrometallurgy of Gold. *Proceedings of the American Electrochemical Society*, Vol. 3, p. 47.

A. H. GILL and C. G. TUFTS.— Does Cholesterol Occur in Maize Oil? *Journal of the American Chemical Society.* Vol. 25, p. 251.

A. H. GILL and C. G. TUFTS.— Sitosterol, a Possible Test for Maize Oil. *Journal of the American Chemical Society*, Vol. 25, p. 254.

A. H. GILL and C. G. TUFTS.— Does Cholesterol Occur in Olive Oil? *Journal of the American Chemical Society*, Vol. 25, p. 498.

A. H. GILL and C. C. JOHNSON.— A Comparison of Various Tests Applied to Paints Used for the Protection of Iron. *Technology Quarterly*, Vol. 16, p. 32.

A. H. GILL.— A Short Handbook of Oil Analysis. Third Edition. 8vo. pp. 159.

W. R. WHITNEY.— The Electrolysis of Water. *Journal of Physical Chemistry*, Vol. 7, p. 190.

W. R. WHITNEY.— The Corrosion of Iron. *Journal of the American Chemical Society*, Vol. 25, p. 394.

W. R. WHITNEY — Free Ions in Aqueous Solutions. *Transactions of the American Electrochemical Society*, Vol. 3, p. 101.

HENRY FAY, A. W. HIGGINS, and F. W. COBURN.— A Study of the Relations between the Microstructure, the Heat Treatment, and the Physical Properties of Axle Steel. *Technology Quarterly*, Vol. 16, p. 4.

JAMES F. NORRIS and LLORA R. CULVER.— The Action of Zinc on Triphenylchlormethane. *American Chemical Journal*, Vol. 29, p. 120.

JAMES F. NORRIS and D. R. FRANKLIN.— The Action of Zinc on Benzoyl Chloride, *American Chemical Journal*, Vol. 29, p. 141.

JAMES F. NORRIS and W. C. TWIEG.— The Condensation of Carbon Tetrachloride with Chlorbenzene by Means of the Friedel and Crafts Reaction. *American Chemical Journal*, Vol. 30, p. 392.

JAMES F. NORRIS.— The Action of Zinc on Triphenylchlormethane (Second Paper). *American Chemical Journal*, Vol. 29, p. 609.

F. J. MOORE.— Some Derivatives of p-Sulfocinnamic Acid. *Journal of the American Chemical Society*. Vol. 25, p. 622.

ELLEN H. RICHARDS.— Alum in Water. A. H. Low's modification of the logwood test. *Technology Quarterly*, December, 1902.

ELLEN H. RICHARDS.— Notes on the Potable Waters of Mexico. *Transactions of the American Institute of Mining Engineers*, Vol. 32.

ELLEN H. RICHARDS.— Water supplies of south-eastern Alaska. *Technology Quarterly*, December, 1903.

ELLEN H. RICHARDS.— Water Supplies in the Black Hills of South Dakota. *Technology Quarterly*, December, 1903.

A. G. WOODMAN.— The Determination of Atmospheric

Carbon Dioxide by the Walker Method. *Journal of the American Chemical Society*, Vol. 25, p. 150.

GEO. W. ROLFE and H. W. GEROMANOS.— Notes on Hydrolysis of Starch by Acids. *Journal of the American Chemical Society*, Vol. 25, p. 1003.

GEO. W. ROLFE and I. T. HADDOCK.— The Presence of Maltose in Acid-Hydrolyzed Starch Products. *Journal of the American Chemical Society*, Vol. 25, p. 1015.

M. S. SHERRILL.— Ueber die Komplexbildung und einige physiko-chemische Konstanten der Quecksilber-Haloide. *Zeitschrift für physikalische Chemie*, Vol. 43, p. 705.

J. W. BROWN.— Der katalytische Beschleunigung der Oxydation von Naphtalin und Anilinsulfat mittels heisser Schwefelsäure. Dissertation. Heidelberg, Germany. 1903.

R. B. EARLE (with C. LORING JACKSON).— On Certain Derivatives of Picric Acid. *American Chemical Journal*, Vol. 29, p. 212.

R. B. EARLE (with C. LORING JACKSON).— On Colored Substances Derived from Nitro Compounds. *American Chemical Journal*, Vol. 29, p. 89.

R. B. EARLE (with C. LORING JACKSON).— On Symmetrical Dinitrobenzolsulphonic Acid. *American Chemical Journal*, Vol. 29, p. 216.

R. B. EARLE (with JULIUS STIEGLITZ).— The Beckmann Rearrangement (III. and IV.) *American Chemical Journal*, Vol. 30, pp. 399 and 412.

RESEARCH LABORATORY OF PHYSICAL CHEMISTRY.

A. A. NOYES and W. D. COOLIDGE.— The Conductivity of Aqueous Solutions at High Temperatures. 1. Description of the Apparatus. Results with Potassium and Sodium Chloride up to 306°. *Proceedings of the American Academy of Arts and Sciences*, Vol. 39, pp. 163–219, 1903. *Zeitschrift für physikalische Chemie*, Jubelband, 1903.

J. C. BLAKE.— Untersuchung und Vergleichung einiger isomorphen Trifel Thiocyanate, *Zeitschrift für Krystallo-*

graphic, Vol. 37, pp. 103–109; The Colors of Allotropic Silver, *Am. Jour. Sci.*, Vol. 16, pp. 282–288; On Colloidal Gold: Adsorption Phenomena and Allotropy, *Am. Jour. Sci.*, November, 1903; Note on the Composition of Bredig's Silver Hydrosols, *Am. Jour. Sci.*, November, 1903; The Behavior of Colloidal Gold in Solution toward the Electric Current and toward Electrolytes, *Am. Jour. Sci.*, December, 1903.

C. S. HUDSON.— Ueber die Multirotation des Milchzuckers. *Zeitschrift für physikalische Chemie*, Vol. 44, pp. 487–494, 1903; Die gegenseitige Löslichkeit von Nikotin und Wasser, *Zeitschrift für physikalische Chemie*, Vol. 46, 1903.

Some additional publications are included in the list of those of the Chemical Department.

BIOLOGY.

W. T. SEDGWICK (with THEODORE HOUGH),—What Training in Physiology and Hygiene may we Reasonably Expect of the Public Schools? *Science*, N.S., Vol. 18, No. 455, pp. 353–360, September, 1903.

W. T. SEDGWICK (with C.-E. A. WINSLOW).— On the Relative Importance of Public Water Supplies and Other Factors in the Causation of Typhoid Fever. *Transactions of the American Public Health Association*, Vol. 28, 1902.

THEODORE HOUGH.— On the Correlation of the Work of Physical Training with Instruction in Personal Hygiene. Published by the Boston Normal School of Gymnastics, Boston, 1903.

THEODORE HOUGH (with W. T. SEDGWICK).— What Training in Physiology and Hygiene may we Reasonably Expect of the Public Schools? *Science*, N.S., Vol. 18, No. 455, pp. 353–360, September, 1903.

S. C. PRESCOTT.— On Certain Precautions Required in Making and Interpreting the So-called "Colon Test" for Potable Waters. *Public Health*, Vol. 28, pp. 413–419. *Medicine*, Vol. 9, No. 1, 1903.

S. C. PRESCOTT.— Further Evidence of the Apparent

Identity of Bacillus Coli and Certain Lactic Acid Bacteria. *Science*, Vol. 17, No. 427.

S. C. PRESCOTT.— The Importance of Science and Investigation in the Development of the Canning Industry. *American Grocer*, Vol. 69, No. 34. *The Trade*, Vol. 25, No. 27. *Canner and Dried Fruit Packer*, Vol. 14, Special Number, February, 1903.

S. C. PRESCOTT (with W. L. UNDERWOOD and others).— Science and Experiment as Applied to Canning. 1 Vol., pp. 172 Chicago, 1903.

R. P. BIGELOW.— Articles on "Ovum," "Parthogenesis," "Reduction-Division," "Reproduction," and "Reversion," in the *Reference Handbook of the Medical Sciences* (Revised Edition), Vol. 6, William Wood & Co., New York, 1903.

R. P. BIGELOW (with ELEANOR P. RATHBUN).— On the Erosion of the Shell of *Littorina litorea*. *Science*, N.S., Vol. 17, No. 430, March 27, 1903, p. 494.

R. P. BIGELOW (with ELEANOR P. RATHBUN).— The Variations of Some Acquired Characters. *Science*, N.S., Vol. 17, No. 430, March 27, 1903.

R. P. BIGELOW (with ELEANOR P. RATHBUN).— On the Shell of *Littorina litorea* as Material for the Study of Variation. *American Naturalist*, No. 435, March, 1903, pp. 171–183.

A. W. WEYSSE.— The Perforation of a Vein by an Artery in the Cat. *American Naturalist*, Vol. 37, No. 439, 1903.

C.-E. A. WINSLOW (with A. G. WOODMAN and P. HANSEN).— A Study of Self-purification in the Sudbury River. *Technology Quarterly*, Vol. 15, No. 2, June, 1902.

C.-E. A. WINSLOW (with Miss M. P. HUNNEWELL). A Study of the Distribution of the Colon Bacillus of Escherich and of the Sewage Streptococci of Houston in Polluted and Unpolluted Waters. *Journal of Medical Research*, Vol 3, No. 3, December, 1902.

C.-E. A. WINSLOW (with W. T. SEDGWICK). On the Relative Importance of Public Water Supplies and Other Factors in the Causation of Typhoid Fever. *Transactions of the American Public Health Association*, Vol. 28, 1902.

C.-E. A. WINSLOW.— The War against Disease. *Atlantic Monthly*, January, 1903.

. C.-E. A. WINSLOW.— Reviews of Vital Statistics. *Quarterly Publications of the American Statistical Association*, Vol. 8, March, 1903.

C.-E. A. WINSLOW.— The Case for Vaccination. *Science*, N.S., Vol. 18, No. 447, July, 1903.

C.-E. A. WINSLOW (with C. P. NIBECKER). The Significance of Bacteriological Methods in Sanitary Water Analysis. *Technology Quarterly*, Vol. 16, No. 3, September, 1903.

W. L. UNDERWOOD.— The Canning Industry in New England. 25th Anniversary Number of *The Trade*, Baltimore, Md.

W. L. UNDERWOOD (with S. C. PRESCOTT and others).— Science and Experiment as Applied to Canning. 1 vol., 172 pp. Chicago, 1903.

W. L. UNDERWOOD.— The Mosquito Nuisance and How to Deal with It. A pamphlet illustrated with 12 photographs taken from life. Prepared for the Board of Health of Belmont, Mass. Boston, 1903.

W. L. UNDERWOOD.— A New Mosquito. *Science*, N.S., Vol. 18, No. 449, Aug. 7, 1903.

W. L. UNDERWOOD.— Mosquitoes and Suggestions for their Extermination. *Popular Science Monthly*, Vol. 63, No. 5, p. 454, September, 1903. Illustrated with 15 photographs taken from life.

W. L. UNDERWOOD.— The House Fly as a Carrier of Disease. Illustrated by photographs from life. *Country Life in America*, Vol. 4, No. 2, p. 158, June, 1903. Republished for popular distribution by George Francis Peabody, Esq., of New York, after having been rewritten, enlarged, and simplified. *Literary Digest*, Vol. 27, No. 17, p. 543, Oct. 24, 1903.

G. W. FIELD.— A Report upon Certain Biological Problems connected with the Proposed Charles River Dam. Report of Committee on Charles River Dam, Appendix No. 6, Boston, 1903.

P. G. STILES (with GRAHAM LUSK).— On the Formation

of Dextrose in Metabolism from the End-products of a Pancreatic Digest of Meat. *American Journal of Physiology*. Vol. 9, No. 6, August, 1903.

P. G. STILES (with GRAHAM LUSK).— On the Action of Phlorhizin. *American Journal of Physiology*, Vol. 10, No. 1, September, 1903.

P. G. STILES.— Theories of Sleep. *Popular Science Monthly*, September, 1903.

FREDERICK A. WOODS.— The Correlation between Mental and Moral Qualities. *Popular Science Monthly*, October, 1903.

GEOLOGY.

W. O. CROSBY.— The Hanging Valleys of Georgetown, Colorado. *Technology Quarterly*, Vol. 16, pp. 41–50; *American Geologist*, Vol. 32, pp. 42–48.

W. O. CROSBY.— A Study of the Geology of the Charles River Estuary and Boston Harbor, with special reference to the building of the proposed dam across the tidal portion of the river. *Technology Quarterly*, Vol. 16, pp. 64–92.

W. O. CROSBY.— Structure and Composition of the Delta Plains formed during the Clinton Stage in the Glacial Lake of the Nashua Valley. (To be continued.) *Technology Quarterly*, Vol. 16, pp. 240–254.

D. W. JOHNSON.— The Geology of the Cerrillos Hills, New Mexico: Part I. The General Geology of the Cerrillos Hills. *School of Mines Quarterly*, April and July, 1903.

Part II. The Paleontology of the Cerrillos Hills. *School of Mines Quarterly*, January, 1903.

Part III. The Petrography of the Cerrillos Hills. *School of Mines Quarterly*, October, 1903. (In press.)

D. W. JOHNSON.— Jurassic Fossils from Durango, Mexico. *American Geologist*, December, 1902.

D. W. JOHNSON.— Block Mountains in New Mexico. *American Geologist*, March, 1903.

H. W. SHIMER.— Fall Excursions of the Geological De-

partment, Columbia University. *American Geologist*, Vol. 31, January, 1903.

H. W. SHIMER.— Columbia University Summer School on Lake Champlain. *American Geologist*, Vol. 32, August, 1903.

H. W. SHIMER.— Columbia University Geological Department; an Excursion to Northeastern New Jersey. *American Geologist*, Vol. 32, October, 1903.

H. W. SHIMER.— Mammalian Adaptation to a Fossorial Life. *American Naturalist*.

C. H. WARREN.— Mineralogical Notes. 1. Native Arsenic from Arizona. 2. Anthophyllite with the Fayalite from Rockport, Mass. 3. Cerussite and Phosgenite from Colorado. *American Journal of Science*, Vol. 166, pp. 337–344.

C. H. WARREN.—Notes on Blowpipe Analysis with determinative tables. Printed by the Institute.

MECHANICAL ENGINEERING.

G. LANZA.— Plan for Timber Tests; published in a circular issued in 1903 by the Bureau of Forestry, U.S.A.

G. LANZA.— Timber Tests — Discussion. *Proceedings of the American Society of Civil Engineers*, August, 1903, Vol. 29, p. 669 *et seq.*

G. LANZA.— Tests of Full Sized Re-enforced Concrete Beams and Columns — Discussion. *Transactions of the American Society of Civil Engineers*, 1903, Vol. 50, p. 483 *et seq.*

G. LANZA.— Train Resistance — Discussion. *Proceedings of the American Society of Mechanical Engineers*, 1903.

G. LANZA.—Timber Tests — Discussion. *Proceedings of the American Society for Testing Materials*, 1903.

J. SONDERICKER.— Graphic Statics with Application to Trusses, Beams and Arches. Published by John Wiley and Sons, New York.

E. F. MILLER.— Pressure Temperature Curve of Sulphurous Acid. Presented to the American Society of Mechanical Engineers, December, 1903.

S. H. WOODBRIDGE.— The Relation of Air to Vital Energy. Published by the Commissioner, State Board of Education.

S. H. WOODBRIDGE.— Some of the Whys and the Whats of Ventilation. Published in the *Health Bulletin.*

MINING ENGINEERING AND METALLURGY.

R. H. RICHARDS.— Ore-Dressing. 1200 pages. Published by the *Engineering and Mining Journal.*

R. H. RICHARDS.— Progress in Gold Milling during 1902. *The Mineral Industry*, Vol. 11, p. 296.

R. H. RICHARDS.— Revision of the Literature on Ore-Dressing in 1902. *The Mineral Industry*, Vol. 11, p. 639.

R. H. RICHARDS.— School Laboratory Work, a Free Milling Gold Run. *Transactions of the American Institute of Mining Engineers*, 1903.

H. O. HOFMAN.— Recent Improvements in Lead Smelting. *The Mineral Industry*, Vol. 11, p. 425.

H. O. HOFMAN.— Notes on the Metallurgy of Copper of Montana. *Transactions of the American Institute of Mining Engineers*, 1903.

H. O. HOFMAN (with C. F. GREEN and R. B. YERXA).— A Laboratory Study of the Stages in the Refining of Copper. *Transactions of the American Institute of Mining Engineers*, 1903.

R. W. LODGE.— The Assay of Zinc-Box Residues from the Cyanide Process. *Transactions of the American Institute of Mining Engineers*, 1903.

PHYSICS.

C. L. NORTON.— Luxfer Prism Fire Test. *Insurance Engineering*, Vol. 6, p. 14.

C. L. NORTON.— Fire Test of Columbium Floor. Insurance Engineering Experiment Station, Report No. 10.

C. L. NORTON.— Protection of Steel from Corrosion. Insurance Engineering Experiment Station, Report No. 10.

C. L. NORTON (with EDWARD ATKINSON).— Fire Resistant Roofs. Insurance Engineering Experiment Station, Report No. 7.

C. L. NORTON (with EDWARD ATKINSON).— Bog-fuel. Insurance Engineering Experiment Station, Reports Nos. 9 and 12.

M. DEK. THOMPSON, Jr.— Studien zum Siemensschen Kupfergewinnungs-Prozess. (Inaugural Dissertation. University of Basle.)

MODERN LANGUAGES.

A. RAMBEAU.— Notes on Provençal Language and Literature. In *Modern Language Notes* edited by Professor A. M. Elliott, Johns Hopkins University, Baltimore, Md. I. Vol. 18, No. 8, p. 250. II. Vol. 19, No. 1, p. 28. (To be continued.)

A. RAMBEAU.— A French Reader for the Use of Schools and Colleges, based upon the "Chrestomathie Française." Holt, New York. In preparation.

G. T. DIPPOLD.— Scientific German Reader. Revised and Enlarged Edition. (In press.)

FRANK VOGEL.— Elementary German Scientific Reader. (In press.)

FRANK VOGEL.— Storm's "Geschichten aus der Tonne." Edition with Notes. (In press.)

H. R. KURRELMEYER.— Dissertation (Johns Hopkins). The Future Tense in Middle High German. Trübner, Strassburg. (In press.)

ASTRONOMY.

PERCIVAL LOWELL.— Cartouches of the Canals of Mars, *American Philosophical Transactions.*

PERCIVAL LOWELL.— Projections on Mars. Lowell Observatory Bulletin, No. 1.

PERCIVAL LOWELL.— Experiments on the Visibility of Fine Lines in its Bearing on the Breadth of the "Canals" of Mars.

Manner of Making of the Polar Caps of Mars.. Lowell Observatory Bulletin, No. 2.

PERCIVAL LOWELL.— Width of the Double Canals of Mars with Different Apertures. Lowell Observatory Bulletin. No. 5.

CIVIL ENGINEERING.

GEORGE F. SWAIN.— The Profession of Civil Engineering. A contribution to the series of articles in the New York *Tribune* on the various careers.

GEORGE F. SWAIN.— The Value of Non-resident Lectures on Engineering Subjects. Pittsburgh meeting. *Proceedings of the Society for the Promotion of Engineering Education.*

C. F. ALLEN.— Field and Office Tables, Curves and Earthwork. New Edition.

GEORGE L. HOSMER.— Notes on Practical Astronomy.

ELECTRICAL ENGINEERING.

LOUIS DUNCAN.— Stone Wireless Telegraph System, *Electrical World and Engineer*, October 24, 1903.

LOUIS DUNCAN.— Technical Education. *Engineering Magazine*, November, 1903.

H. E. CLIFFORD.— Some Fundamentals of Photometry. *Proceedings of the National Electric Light Association*, 1903.

R. R. LAWRENCE.— A New Form of Photometer. *Proceedings of the National Electric Light Association*, 1903.

MATHEMATICS.

F. S. WOODS.— Space of Constant Curvature. Lines of Curvature on Minimum Developables. *Annals of Mathematics.*

H. W. TYLER.— Report on Definitions for Entrance Requirements in Mathematics (as Chairman of Committee).

Bulletin of the Mathematical Society, October, 1903; *Educational Review*, October, 1903; *School Review*, November, 1903.

H. W. TYLER.— The Relation of the School of Technology to General Education. *Technology Review*, October, 1903.

ECONOMICS AND STATISTICS.

DAVIS R. DEWEY.— Financial History of the United States.

DAVIS R. DEWEY.—Census Report on Employees and Wages.

DAVIS R. DEWEY (as member of Committee).— Report of the Committee on Relations between Employer and Employee.

PART IV.

STATISTICS.

THE CORPS OF INSTRUCTORS.

The Catalogue of this year shows the number of instructors of all grades to be 186, 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 227. This year's Catalogue will show an increase of two in the number of lecturers and some changes in the grades of professors and instructors. Without counting lecturers, the number of instructors to that of students bears the proportion of one to eight and two-tenths. The following table shows the distribution among the several classes of instructors, in comparison with last year: —

	1902–03.	1903–04.
Professors	28	30
Associate Professors	12	14
Assistant Professors	25	25
Instructors	54	66
Assistants	46	51
Lecturers	39	41
Total	204	227

STUDENTS AND GRADUATES.

The registration of this year, as shown by the Catalogue amounts to 1,528. 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	1885–86	609
1866–67	137	1886–87	637
1867–68	167	1887–88	720
1868–69	172	1888–89	827
1869–70	206	1889–90	909
1870–71	224	1890–91	937
1871–72	261	1891–92	1,011
1872–73	348	1892–93	1,060
1873–74	276	1893–94	1,157
1874–75	248	1894–95	1,183
1875–76	255	1895–96	1,187
1876–77	215	1896–97	1,198
1877–78	194	1897–98	1,198
1878–79	188	1898–99	1,171
1879–80	203	1899–1900	1,178
1880–81	253	1900–1901	1,277
1881–82	302	1901–1902	1,415
1882–83	368	1902–1903	1,608
1883–84	443	1903–1904	1,528
1884–85	579		

STUDENTS BY CLASSES.

The aggregate number of students for 1903–04 is divided among the several classes, as follows: —

Fellows	5
Graduate students, candidates for advanced degrees	13
Regular students, Fourth Year	238
" " Third "	238
" " Second "	289
" " First "	255
Special students	490
Total	1,528

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 and Graduates of the M.I.T.	18	—	18
Fourth Year	238	84	322
Third Year	238	144	382
Second Year	289	169	458
First Year	255	93	348
Total	1,038	490	1,528

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	40	42	28	21	16	35	2	13	5	7	2	—	27	238
3d " "	49	42	26	11	24	41	1	3	1	11	6	—	23	238
2d " "	43	77	37	21	15	50	1	7	—	9	6	1	22	289
Total	132	161	91	53	55	126	4	23	6	27	14	1	72	765

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.
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	1	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*
1900	89	127	69	53	50	87	6	4	8	34	17	1	38	582
1901	102	129	76	40	35	96	6	13	9	30	14	1	39	590
1902	129	133	83	43	58	118	2	20	9	30	12	1	65	703
1903	132	161	91	53	55	126	4	23	6	27	14	1	72	765

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 . . .	6	–	–	–	–	–	–	–	–	–	–	–	–	–
2d . . .	18	3	7	–	–	2	1	–	–	–	2	–	1	2
3d . . .	21	2	5	3	1	–	2	1	2	1	1	–	–	3
4th . . .	7	–	1	1	–	–	1	–	1	–	–	1	–	2
5th . . .	9	2	1	1	2	–	1	–	–	–	–	1	–	1
	61	7	14	5	3	2	5	1	3	1	3	2	1	8

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

* Deducting those counted twice.

	First Year.	Second Year.	Third Year.	Fourth Year.	Total.
Mathematics	346	430	186	6	968
Chemistry	352	64	129	102	647
English	315	376	6	8	705
French	102	107	70	—	279
Physics	—	443	347	119	909
German	144	199	161	3	507
Mechanic Arts	—	212	70	110	392

The total registration in the Summer School was 258 students as compared with 214 in 1902; the registration in the various subjects is shown in the following table:—

	1903
Mathematics.	
Analytic Geometry	21
Integral Calculus	33
Applied Mechanics	45
Mechanical Drawing and Descriptive Geometry	52
Mechanic Arts (Shopwork).	
Forging	13
Chipping and Filing	7
Machine-Tool Work	14
Modern Languages.	
French	33
German	17
Chemistry.	
Inorganic and Analytical Chemistry	60
Air, Water, and Food Analysis	12
Physics.	
Mechanics, Light, and Electricity	59
Heat	11
Physical Laboratory	15
Civil Engineering.	
Surveying	20
Mechanical Engineering.	
Mechanism	23
Mechanical Engineering Drawing	6

RESIDENCE OF STUDENTS.

States.	Candidates for Advanced Degrees.	Fourth Year.	Third Year.	Second Year.	First Year.	All Regular Students.	Special Students.	Total.
Alabama	–	1	–	–	–	1	–	1
Arkansas	–	–	–	–	–	–	1	1
California	–	4	–	4	4	12	7	19
Colorado	–	–	1	5	2	8	3	11
Connecticut	–	10	6	5	5	26	18	44
Delaware	–	–	2	–	–	2	1	3
Dist. of Columbia,	–	6	2	4	1	13	2	15
Florida	–	–	–	–	–	–	2	2
Georgia	–	–	–	1	–	1	3	4
Hawaii	–	–	–	–	–	–	1	1
Illinois	–	10	7	7	3	27	17	44
Indiana	1	2	1	2	–	6	–	6
Iowa	–	1	1	–	1	3	3	6
Kansas	–	–	–	–	1	1	–	1
Kentucky	–	–	4	1	–	5	4	9
Louisiana	–	–	–	1	–	1	1	2
Maine	–	2	8	6	2	18	16	34
Maryland	–	6	4	5	2	17	8	25
Massachusetts	12	138	130	179	180	639	230	869
Michigan	–	1	1	2	1	5	4	9
Minnesota	–	1	–	2	1	4	5	9
Mississippi	–	–	–	–	3	3	1	4
Missouri	–	3	5	4	2	14	8	22
Montana	–	1	–	–	–	1	1	2
Nebraska	–	1	1	–	–	2	2	4
New Hampshire	–	4	5	6	4	19	4	23
New Jersey	–	1	1	4	2	8	5	13
New Mexico	–	–	–	–	–	–	1	1
New York	–	13	23	11	13	60	44	104
North Carolina	1	1	2	–	1	5	2	7
North Dakota	–	–	–	–	1	1	–	1
Ohio	–	8	6	4	5	23	14	37
Oregon	–	1	1	2	–	4	3	7
Pennsylvania	–	3	3	10	14	30	22	52
Porto Rico	–	–	1	1	–	2	–	2
Rhode Island	–	8	4	6	1	19	9	28
South Dakota	–	1	1	1	–	3	–	3
Tennessee	1	1	–	–	–	2	3	5
Texas	–	2	1	1	2	6	5	11
Utah	–	–	1	–	–	1	2	3
Vermont	–	3	1	3	–	7	4	11
Virginia	1	1	–	2	–	4	3	7
Washington	–	1	–	–	–	1	2	3
Wisconsin	1	1	4	4	1	11	2	13
Foreign Countries.								
Armenia	–	–	–	–	–	–	1	1
Australia	–	–	–	2	–	2	1	3
Bermuda	–	–	–	–	–	–	1	1
Brazil	–	–	–	1	–	1	2	3
Chili	–	–	–	–	–	–	1	1
China	–	–	1	–	–	1	1	2
Cuba	–	–	–	1	1	2	1	3
Denmark	–	–	–	–	–	–	1	1
England	–	–	2	1	–	3	1	4
Germany	1	–	–	–	–	1	1	2
India	–	–	–	–	–	–	1	1
Ireland	–	–	–	1	–	1	1	1
Japan	–	–	–	–	–	–	2	2
Malta, Island of	–	–	–	–	1	1	–	1
Manitoba	–	–	1	–	–	1	–	1
Mexico	–	–	1	–	–	1	7	8
New Brunswick	–	–	–	–	–	–	1	1
Nova Scotia	1	1	3	1	1	7	2	9
Ontario	–	–	2	–	–	2	–	2
Quebec	–	–	–	–	–	–	1	1
Scotland	–	–	–	–	–	–	1	1
Syria	–	–	1	–	–	1	–	1
Total	18	238	238	289	255	1,038	490	1,528

Forty states of the Union and two territories, besides the District of Columbia and Porto Rico, are represented on our list of students. Of the total number of 1,528, 869 are from Massachusetts, or 57 per cent. of the whole; 140 are from other New England states; 519 are from outside New England. Of these, 50 are from foreign countries.

A table showing the number of students in each year, from 1897, coming from each state or territory, and from each foreign country, may be not without interest and instruction: —

States.	1897.	1898.	1899.	1900.	1901.	1902.	1903.
Alabama	1	1	–	1	2	1	1
Arkansas	1	–	–	1	1	1	1
California	9	11	9	10	9	15	19
Colorado	8	8	7	8	6	10	11
Connecticut	30	26	29	35	42	43	44
Delaware	6	3	4	4	3	4	3
Dist. of Columbia	13	8	7	13	14	17	15
Florida	1	–	1	1	1	2	2
Georgia	4	4	3	3	4	6	4
Hawaiian Islands	–	1	–	1	–	–	1
Idaho	1	–	–	–	1	–	–
Illinois	40	51	36	39	44	49	44
Indiana	7	3	5	7	11	14	6
Iowa	12	7	6	10	8	8	6
Kansas	3	–	–	–	1	1	1
Kentucky	10	10	4	5	9	11	9
Louisiana	1	1	1	2	1	2	2
Maine	24	19	25	22	30	35	34
Maryland	8	8	8	13	16	27	25
Massachusetts	739	719	731	770	837	935	869
Michigan	5	9	10	8	12	10	9
Minnesota	8	11	10	7	10	10	9
Mississippi	–	–	–	–	–	–	4
Missouri	6	10	11	13	19	20	22
Montana	5	2	3	5	4	3	2
Nebraska	2	1	3	4	3	5	4
Nevada	–	–	1	1	–	–	–
New Hampshire	25	25	29	26	31	34	23
New Jersey	15	13	12	8	6	8	13
New Mexico	–	–	–	–	–	1	1
New York	62	68	61	68	79	96	104
North Carolina	1	2	2	2	6	6	7
North Dakota	–	–	–	–	–	1	1
Ohio	30	23	27	27	27	43	37
Oregon	3	3	2	1	2	4	7
Pennsylvania	41	34	33	37	36	44	52
Porto Rico	–	–	–	–	1	2	2
Rhode Island	19	23	32	35	38	40	28
South Carolina	4	1	1	1	2	4	–
South Dakota	–	–	1	1	2	1	3
Tennessee	3	3	4	6	4	3	5
Texas	2	1	2	4	7	9	11
Utah	3	5	6	7	7	2	3
Vermont	11	12	12	15	15	12	11
Virginia	4	3	2	3	5	7	7
Washington	4	7	4	2	4	3	3
West Virginia	1	–	1	1	1	–	–
Wisconsin	6	8	7	8	11	11	13
Wyoming	–	–	–	–	–	1	–
Foreign Countries.							
Armenia	–	–	–	–	–	2	1
Australia	–	–	–	–	–	2	3
Austria	–	–	–	–	1	–	–
Bermuda	–	–	–	1	2	1	1
Brazil	–	–	–	–	4	5	3
Cape Breton	–	1	–	–	–	–	–
Chili	–	–	–	–	1	1	1
China	–	–	–	–	1	1	2
Cuba	1	–	–	–	1	2	3
Denmark	2	1	1	1	1	1	1
Dutch Guiana	–	1	1	–	–	–	–
England	2	4	1	3	3	3	4
France	1	1	2	4	1	–	–
Germany	1	1	1	2	3	1	2
India	–	–	–	–	–	–	1
Ireland	–	–	–	–	–	1	1
Jamaica	–	–	1	1	1	–	–
Japan	–	1	2	2	2	1	2
Malta, Island of	–	–	–	–	–	–	1
Manitoba	–	–	–	–	–	1	1
Mexico	6	7	7	7	7	10	8
New Brunswick	2	3	3	2	2	2	1
Nova Scotia	1	2	–	2	6	8	9
Ontario	–	–	–	–	3	2	2
Quebec	2	1	3	4	2	–	1
Russia	–	–	1	1	1	–	–
Scotland	–	–	–	–	–	1	1
Syria	–	–	–	–	–	–	1
Turkey	3	3	3	3	1	4	–
Total	1,198	1,171	1,178	1,277	1,415	1,608	1,528

RESIDENCE OF MASSACHUSETTS STUDENTS.

It has been said that 57 per cent. of our students are from Massachusetts. All the counties of the State send students to the Institute. One hundred and forty-one 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 seventy-five and Suffolk two hundred and forty-two pupils; Essex comes third, with one hundred and twenty-two; Norfolk, fourth, with eighty-one.

County.	No. of Towns.	No. of Students.	County.	No. of Towns.	No. of Students.
Barnstable	3	6	Hampshire	2	6
Berkshire	5	14	Middlesex	37	275
Bristol	12	32	Nantucket	1	2
Dukes	1	1	Norfolk	18	81
Essex	23	122	Plymouth	13	28
Franklin	4	7	Suffolk	4	242
Hampden	4	17	Worcester	14	36
			Total	141	869

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

Boston	227	Fitchburg	10	Arlington	6
Newton	49	Haverhill	10	Beverly	6
Malden	22	Medford	10	Canton	6
Somerville	21	New Bedford	10	Everett	6
Cambridge	20	Quincy	9	Natick	6
Brookline	19	Springfield	9	Peabody	6
Lowell	19	Gloucester	8	Weymouth	6
Waltham	19	Taunton	8	Winthrop	6
Newburyport	17	Wakefield	8	Woburn	6
Salem	17	Andover	7	Concord	5
Lawrence	16	Belmont	7	Hanover	5
Framingham	15	Brockton	7	Holyoke	5
Lynn	14	Chelsea	7	Marlboro	5
Hyde Park	13	Stoneham	7	Milford	5
Melrose	11	Winchester	7	North Adams	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.
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
1900–1901	1,277	789	488	312	176
1901–1902	1,415	844	571	396	175
1902–1903	1,608	949	659	432	226
1903–1904	1,528	1,042	486	249	237

AGES OF STUDENTS.

The next table exhibits the ages of our students upon entrance, after taking out six who are repeating the first year, and five persons of unusual ages. These deductions leave two hundred and forty-five as the number of students whose ages have been made the subject of computation.

Period of Life.	1902–1903.		1903–1904	
	Half-year Groups.	Yearly Groups.	Half-year Groups.	Yearly Groups.
16 to 16½ years	3	—	1	—
16½ to 17 "	12	15	9	10
17 to 17½ "	30	—	13	—
17½ to 18 "	49	79	38	51
18 to 18½ "	85	—	50	—
18½ to 19 "	65	150	38	88
19 to 19½ "	65	—	31	—
19½ to 20 "	47	112	34	65
20 to 20½ "	28	—	14	—
20½ to 21 "	10	38	8	22
21 to 22 "	23	23	9	9
	417	417	245	245

The results appear in the table above in comparison with the corresponding results of 1902–1903.

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

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

Under 20½	1
Between 20½ and 21	4
" 21 " 21½	19
" 21½ " 22	19
" 22 " 23	48
" 23 " 24	39
" 24 and over	60
Total	190

The special students this year constitute thirty-two per cent. of the whole body, as against twenty-eight per cent. last year and twenty-nine per cent. the year before.

GRADUATE STUDENTS.

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

One hundred and fifty-five are graduates of the following institutions, and are pursuing undergraduate courses of study with us either as regular or as special students.

Universities.

Acadia	3	Norwich	1
Boston	2	Ohio State	1
Brown	1	Pennsylvania State	5
California	1	Porto Rico	1
Chicago	2	Princeton	9
Colgate	1	Rochester	3
Columbia	1	St. Louis	2
Cornell	1	Southwestern	1
Georgetown	3	Southwestern Presbyterian	1
Hamline	1	Tennessee	1
Harvard	20	Texas	1
Indiana	1	Tulane	1
Johns Hopkins	4	Virginia	2
Louisiana	1	Washington	1
Maine	1	Washington and Lee	1
Mercer	1	Wesleyan	1
Miami	1	Yale	7
Northwestern	1		85

Colleges.

Adelbert	1
Amherst	5
Bates	1
Beloit	2
Bowdoin	2
Butler	1
Canisius	1
Central	1
Colby	3
Colorado	1
Connecticut Agricultural	1
Davidson	1
Delaware	1
Detroit	1
Earlham	1
Hamilton	1
Haverford	1
Holy Cross	1
Iowa	2
Massachusetts Institute of Technology	15
Middlebury	1
Mount Allison	1
München Technische Hochschule	1
New Hampshire College of Agriculture	1
City of New York	2
North Texas Normal	1
Oberlin	3
Ouachita	1
Pomona	1
Randolph-Macon	1
Rock Hill	2
Saint Ignatius	2
Saint Joseph	2
Saint Xavier	1
Sheffield Scientific School	5
Syrian Protestant	1
Texas Agricultural and Mechanical	1
Trinity	2
Tufts	2
United States Naval Academy	12
Virginia Medical	1
Wellesley	1
Westminster	1
Williams	1
Wittenberg	1
Yankton	1
	92
Total	174
Deduct names counted twice	4
	173

WOMEN STUDENTS.

The number of women pursuing courses with us is twenty-six. Of these three are graduates of colleges. Of the total number six are regular students of the fourth year, five of the first year. Thirteen are special students. Of the eleven regular students of the upper classes, four take Course IV., Architecture; five Course V., Chemistry; one, Course VII., Biology; and one, Course XII., Geology. Of the special students, four devote themselves to architecture, four to biology, one to chemistry, one to physics, and one to general studies, while two are first-year specials.

STATISTICS OF ADMISSION.

Of the 1,528 students of the present year, 486 were not connected with the school in 1902–1903. Of these 237 were admitted as regular students of the first year upon the basis of their entrance examinations. The 249 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 examinations; (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 or from the College Examination Board. In addition to the 237 who were thus admitted to the first year on examination, and have taken their place in the school, 77 were admitted on examination, but have not entered the school.

In the case of the 237 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	179
" on one condition	41
" on two conditions	13
" on three conditions	4
	237

Ninety-four applicants were rejected.

GRADUATES BY COURSES.

The following table exhibits the number of persons who have received the Bachelor's Degree in 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*
1806	26	34	10	24	17	–	48	3	3	7	7	4	3	5	190*
1897	25	40	7	16	20	–	33	2	3	7	12	4	1	9	179
1898	32	41	7	29	25	–	33	3	4	6	9	3	–	7	199
1899	30	37	9	22	22	–	32	2	2	1	10	1	–	8	173*
1900	32	34	21	21	19	–	23	3	3	5	11	4	–	9	185
1901	37	39	18	21	17	–	25	1	1	6	14	4	1	16	200
1902	24	46	14	18	14	–	35	5	3	3	9	7	–	14	192
1903	26	37	27	15	13	–	39	1	4	1	10	4	1	12	190
Totals	525	643	248	251	307	1	506	46	43	89	124	44	10	85	2,916*
Deduct names counted twice															16
Net total															2,900*

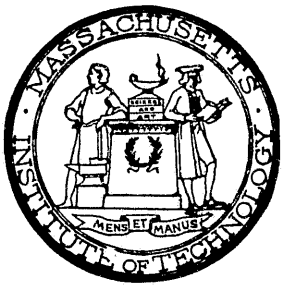
* Deducting names counted twice.

PART V.

GENERAL STATEMENT

OF THE

RECEIPTS AND DISBURSEMENTS BY THE TREASURER



FOR THE YEAR ENDING SEPT. 30, 1903

STATEMENT OF THE TREASURER.

The Treasurer submits the annual statement of the financial affairs of the Institute for the year ending September 30, 1903.

The net result of the year is a deficit of $36,432.14 in income compared with current expenses, and this, too, in spite of an increase in students' fees amounting to about $33,000. This is the largest deficit in the history of the Institute, and yet there was never a time when the number of students was so large, or the vigor and success of the different departments in the matter of education, so great.

Going back to the year 1891 we find the number of students was then 937; this last year it has been 1,608.

If the present deficit were considered by itself it might be accounted for in part by an increased expenditure for coal due to the exceptional conditions of last year, and amounting to about $15,000, and in part by expenditures indirectly growing out of the rapid growth of the Institute, which has necessitated the construction of new buildings and a large increase in equipment. The expenditure for the new buildings themselves, and for new machinery to equip them, is not included in the above figures. But if we go back to 1891 and follow the figures from that time to the present date, we find that the increase in expenses has been greater proportionally than the increase in students, and that this has gone on year by year, and that such increase is not limited to any one item but embraces all the principal ones. The underlying cause seems to be that with the progress in technical education in all high grade technical schools more and more is required of any educational institution which aims to hold a foremost rank. There was never a time in the history of the Institute when the facilities were so good or when so much was offered to its students as at the present time.

The total property of the Institute amounts to a little more than $3,600,000, not including the land on Boylston Street. Of this real estate and equipment represent just about one-half. Of the $1,800,000 in round numbers, which is invested in interest bearing securities, something over $800,000 is held for scholarships or similar purposes, leaving only about $1,000,000 of personal property from which income is derived for current expenses. To this should be added the rents, amounting to about $10,000, received from a small portion of the real estate, and making a total available income of about $50,000. It is manifest, therefore, that the income from endowment is insignificant as compared with annual expenses, which this year amount to about $468,000 apart from those paid from funds for scholarships and the like. The main support of the Institute is derived from students' fees. Anyone familiar with educational institutions of the first rank, knows that it is practically impossible to support them simply on the revenue derived from students' fees. This difficulty is especially great in the case of technical education where the proportion of instructors to students must be large, and where new and expensive apparatus is constantly required. It should be borne in mind that our tuition fee has been raised above that of any similar educational institution in the world and cannot be further advanced. The grant from the State of $25,000 per annum for ten years cannot be relied on as permanent. The recent action of the legislature in giving to the Institute the fee of the land on Boylston Street makes possible further growth either by using more of that land, or by selling what land we now own and removing to some less expensive site, but in either case large additional endowment is necessary. If we remain where we are we must have money for new buildings, and even then our present limits will be outgrown before many years are past. If we move, the proceeds of the land

sold will not suffice to purchase new land, erect new buildings, pay expenses of removal, and provide any satisfactory endowment for carrying on the work. The problem which confronts us is not one appealing only to friends of the Institute, or to local pride. It is freely acknowledged both in this country and in Europe that the work done by the Massachusetts Institute of Technology in technical education has been of the highest value to all, and its continued success should be a matter of interest to all who believe in the importance of higher technical training. It is, however, manifest that to provide adequately for the future a large additional endowment must be secured, and this is a subject demanding most careful consideration from all friends of the Institute.

During the year there has been expended for the Augustus Lowell Laboratory of Electrical Engineering, $52,036.83, and for equipment for the same, $66,695.60. There has also been spent for the new engineering building, $38,059.13.

The following legacies and gifts have been received: —

Additional payments from the estate of the late Henry L. Pierce, $45,000.

Additional subscriptions to the Walker Memorial Fund, $10,050.

For the Augustus Lowell Laboratory of Electrical Engineering additional subscriptions as follows: —

Mrs. William L. Putnam, $10,000; Mrs. T. J. Bowlker, $10,000; Miss Amy Lowell, $10,000; C. C. Jackson, Esq., $3,000; A Friend, $3,000; in all, $36,000.

From the Estate of Joseph B. Glover, $5,000.

From the estate of James H. Danforth to establish the Isaac Warren Danforth Scholarship Fund, $5,000.

For the Sewage Experimental Fund. an additional $5,000 has been paid by the same generous giver who contributed the like amount a year ago.

For the Chemical Research Fund, Prof. A. A. Noyes has contributed $3,000, and Prof. W. R. Whitney, $1,000. $1,000 for the same purpose have also been received from the trustees of the estate of William E. Hale.

$6,000 have been contributed to the Dormitory Fund as follows: Mrs. Edward M. Cary, $3,000; Estate of Mrs. Mary Hemenway, $1,000; Mrs. Henry Pickering, $1,000; A Friend, $1,000.

From the estate of the late Susan E. Dorr an additional gift of $1,940.38.

Besides the above, $895.75 have been contributed for various purposes, including $500 from a friend to be used in payment of salaries, $200 from Mrs. Wm. B. Rogers for the purchase of periodicals, and $150 from Col. Thomas L. Livermore.

The total net increase in the property of the Institute of all kinds held for either general or special purposes, apart from money borrowed, is $49,427.20.

The total amount paid in for the Walker Memorial Fund during the past year has been $10,050. Adding this to the sum previously in the fund, and deducting $1,025 and $307.10 for architects' fees and plans, make the fund $80,065.20, to which are to be added as interest $3,401.50, making a total of $83,466.70.

Securities Sold or Paid, General Account.

$1,000 Bur. & Missouri River R.R. 6s	1918	1,000.00
6,000 West End Street Rwy. 5s	1902	6,000.00
47,000 Walter Baker Co. Ltd. 4½s	1903	47,000.00
4,000 Ozark Equipment Co. 5s	1910	4,000.00
25 Shares National Bank of the Republic		4,320.00
40 " The Molson's Bank, Montreal		4,025.00
		$66,345.00

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

Dr.

Cash balance, Sept. 30, 1902		18,307.26
From A. Lawrence Lowell for Lowell Institute Courses		6,105.70
RECEIPTS FOR CURRENT EXPENSES.		
Income of funds for salaries	4,324.00	
" " " " Savage Fellowship	400.00	
" " " " scholarships (students' fees),	11,425.00	
" " " " Joy "	275.00	
" " " " W. B. Rogers Scholarships,	525.00	
" " " " Library	480.00	
" " " " general purposes	26,710.42	
" " Rogers Memorial Fund	10,970.50	
" " Charlotte B. Richardson Fund	1,495.15	
" " Rotch Prize Funds	400.00	
" " Rotch Architectural Fund	1,000.00	
" " Edward Austin Fund, Scholarships	7,350.00	
" " " " " Awards	2,474.72	
" " Teachers' Fund	500.00	
Letter Box Fund	75.00	
Students' fees	286,660.55	
State Scholarships	4,000.00	
United States Act of 1862	5,223.94	
United States Act of 1890	8,333.34	
Gift of State of Massachusetts	25,000.00	
Laboratory supplies and breakages	16,080.40	
Rents, per Table (page 12)	10,065.03	
Gifts	895.75	
Interest	5,153.38	
Boston University	2,898.00	
Sale Printed Lecture Notes	4,093.27	436,808.45
GIFTS AND BEQUESTS FOR SPECIAL PURPOSES.		
Increase Scholarship Funds	378.18	
" Teachers' Fund	3,500.00	
" Edward Austin Fund	4,575.28	
" Susan E. Dorr Fund, additional	1,940.38	
Aug. Lowell Lab. Electrical Eng. Fund, add'l,	36,000.00	
Isaac W. Danforth Fund	5,000.00	51,393.84
GIFTS AND BEQUESTS FOR GENERAL PURPOSES.		
Henry L. Pierce Legacy, additional	45,000.00	
Joseph B. Glover Legacy	5,000.00	50,000.00
SECURITIES SOLD OR PAID.		
General Fund, page 3		66,345.00
SUNDRIES.		
Income credited to Bond Premium Acc't	3,635.00	
" " " Rogers Bond Premium Acc't,	832.50	
Copley Society of Boston, on acc't	666.66	
Walker Memorial Fund, additional	13,451.50	
Sewage Experiment Fund, additional	5,000.00	
Dormitory Fund	6,000.00	
Chemical Research Fund	5,000.00	
Notes Payable	25,000.00	59,585.66
		$688,545.91

MASSACHUSETTS INSTITUTE OF TECHNOLOGY.
FOR THE YEAR ENDING SEPT. 30, 1903.

Cr.

Paid for Lowell Institute Courses		6,105.70

EXPENSES.

Salaries, per Table (page 12)	319,573.58	
" paid from Gifts	500.00	
Fellowship paid from Savage Fund	400.00	
" " " Dalton Grad. Chem. Fund,	250.00	
" " " Willard B. Perkins "	1,000.00	
Edward Austin Fund, Awards	2,474.72	
Teachers' Fund "	500.00	
Prizes, Rotch Funds	400.00	
Repairs, per Table (page 13)	15,986.58	
General Expenses, per Table (page 13)	30,398.98	
Fire Insurance	4,153.68	
Fuel	25,131.68	
Water	3,246.00	
Gas	2,704.08	
Electricity	1,689.74	
Printing and Advertising	7,548.44	
" Lecture Notes	2,729.48	
" Annual Catalogues and Reports	3,854.01	
Rents paid Natural History Society	200.00	
" " 71 Newbury Street	266.70	
Laboratory Supplies and Libraries, per Table (p. 12),	49,978.10	
Society of Arts	169.82	
Pan-American Exposition	85.00	473,240.59

(Expenses more than Income, $36,432.14)

SECURITIES BOUGHT OR RECEIVED AS LEGACIES.

Walker Memorial Fund		39,000.00

SUNDRIES.

Extension Lot, No. 3 Trinity Place	26.35	
Aug. Lowell Lab. Electrical Eng. Bldg., 1902	52,036.83	
Brookline Real Estate	60.00	
Walker Memorial Fund, expense	307.10	
Equipment Electrical Engineering Building	66,695.60	
Engineering Building C	38,059.13	
Sewage Fund, expended	5,492.60	
Chemical Research Fund, expended	109.00	
Dormitory Fund, expended	1,667.30	
Students' Deposits	200.00	164,653.91
Cash balance Sept. 30, 1903		5,545.71
		$688,545.91

The following account exhibits the property held by the Institute, as per Treasurer's books, Sept. 30, 1903:—

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
4,000.00	Kansas City, Fort Scott & Gulf R.R. 7s,	1908	4,000.00
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. & St. Fé 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
3,000.00	Chi., Mil. & St. Paul R.R. 7s	1905	3,000.00
	Advances to Bond Premium acc't		8,375.00
			249,757.50

INVESTMENTS, GENERAL ACCOUNT.

7,000.00	Bur. & Mo. River (Neb.) R.R. 6s, non-exempt	1918	7,000.00
2,000.00	Bur. & Mo. River (Neb.) R.R. 6s, exempt	1918	2,000.00
5,000.00	Chicago, Burlington & Quincy R.R 4s	1922	4,100.00
3,000.00	Hannibal & St. Joseph R.R. 6s	1911	3,000.00
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 S. 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
50,000.00	Chi. Terminal & Transfer Co. 1st 4s,	1947	47,507.50
120,000.00	Illinois Steel Co., non-conv. 5s	1913	119,586.25
43,000.00	Chesapeake & Ohio R.R. 5s	1939	43,000.00
100,000.00	Long Island R.R. 4s	1949	96,137.50
7,000.00	K. C., Clinton & Springfield R.R. 5s,	1925	6,289.21
8,500.00	K. C., Mem. & Birmingham R.R. 4s,	1934	8,287.50
13,000.00	K. C., St. Jo. & Council Bluffs R.R. 7s	1907	13,000.00
50,000.00	Kansas City Stock Yards 5s	1910	50,000.00
25,000.00	Atchison, Top. & St. Fé R.R. 4s	1995	25,000.00
50,000.00	Rio Grande & Western R.R. 4s	1939	49,180.00
50,000.00	Oregon R.R. & Navigation Co. 4s,	1946	50,000.00
50,000.00	Union Pacific R.R. 4s	1947	50,000.00
100,000.00	Chic. & W. Michigan R.R. 5s	1921	100,000.00
100,000.00	American Tel. & Tel. Co. 4s	1929	99,875.00
50,000.00	New England Tel. & Tel. Co. 4s	1930	50,000.00
50,000.00	Chi. Junc. & Union S. Yards 4s	1940	49,250.00
50,000.00	K. C., Fort Scott & Memphis R.R. 6s	1928	50,000.00
25,000.00	Southern Ry., St. Louis Div. 4s	1951	24,875.00
18,000.00	Ozark Equipment Co. 5s	1910	18,000.00
50,000.00	Northern Pac. Gt. Northern Joint 4s,	1921	48,500.00
	Advances to Bond Premium acc't		36,575.00
			1,373,162.96
	Amount carried up		$1.622,920.46

Amount brought up $1,622,920.46

STOCKS.

Shares.					
172	Boston & Albany R.R.	par	100	34,456.50	
50	Chi., Milwaukee & St. Paul R.R. Pf.	"	100	6,775.00	
12	Cocheco Manufacturing Co.	"	500	6,000.00	
56	Hamilton Woolen Co.	"	100	5,390.00	
31	Great Falls Manufacturing Co.	"	100	3,472.00	
2	Dwight Manufacturing Co.	"	500	1,600.00	
17	Pepperell Manufacturing Co.	"	100	2,789.50	
27	Essex Co.	"	50	3,780.00	
64	Boston Real Estate Trust	"	1000	68,909.64	
1	Boston Ground Rent Trust	"	1000	900.00	134,072.64

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	$1,776,116.80

Amount brought up			$1,776,116.80
REAL ESTATE.			
Rogers Building		200,000.00	
Walker "		150,000.00	
Land on Garrison Street	50,840.00		
Mechanic Arts Building	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	
Engineering Building, C		38,059.13	
Lot No. 2, Trinity Place		137,241.60	
Lot No. 3, " "		282,286.35	
Henry L. Pierce Building, Trinity Place		154,297.05	
Boiler and Power House, " "		26,916.74	
Clarendon St. Land and Building		142,762.94	
Real Estate, Massachusetts Ave., Cambridge		16,154.38	
Real Estate, Brookline, Mass.		112,964.32	
Aug. Lowell Lab. Elec. Eng. Bldg., 1902		121,741.95	1,695,405.10
Equipment, Engineering Building		16,555.24	
" Mechanical Laboratories		20,628.56	
" Elec. Eng. Building		66,695.60	103,879.40
SUNDRIES.			
Notes Receivable		37,000.00	
Loans to Copley Society of Boston		8,333.33	
Students' Notes		770.50	
Cash Balance, Sept. 30, 1903		5,545.71	51,649.54
			$3,627,050.84

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 "	4,764.40	
John W. and Belinda Randall Fund	83,452.36	
James Fund	163,654.21	
George Robert Armstrong Fund	5,000.00	
Arthur T. Lyman Fund	5,000.00	686,850.21
Amount carried up		$686,850.21

Amount brought up		$686,850.21
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	
Sarah H. Forbes, "	500.00	108,100.00
SCHOLARSHIP TRUSTS.		
Richard Perkins Fund	53,298 45	
James Savage "	14,303.38	
Susan H. Swett "	10,582.95	
William Barton Rogers Fund	10,721.61	
Joy Fund	9,048.70	
Elisha Thatcher Loring Fund	5,370.52	
Charles Lewis Flint "	5,285.63	
Thomas Sherwin "	5,000.00	
Farnsworth "	5,000.00	
James H. Mirrlees "	2,841.43	
William F. Huntington "	5,234.33	
T. Sterry Hunt "	3,233.50	
Elisha Atkins "	5,000.00	
Nichols "	5,000.00	
Ann White Vose "	60,809.28	
Ann White Dickinson "	40,668.64	
Dalton Grad. Chemical "	6,480.30	
Willard B. Perkins "	6,397.26	
Billings Student "	50,000.00	
Henry Saltonstall "	10,000.00	
Isaac W. Danforth "	5,000.00	319,275.98
OTHER TRUSTS.		
Charlotte Billings Richardson Ind. Chem. Fund,		37,378.78
Susan Upham Fund		1,301.52
Susan E. Dorr "		14,897.01
William Hall Kerr Library Fund		2,000.00
Charles Lewis Flint " "		5,000.00
Rotch Architectural " "		5,000.00
Rotch Architectural Fund		25,000.00
Rotch Prize "		5,200.00
Rotch "Special" Prize Fund		5,200.00
Edward Austin "		371,124.37
Teachers' "		107,500.00
Saltonstall "		41,006.00
Letter Box "		54.00
MISCELLANEOUS.		
Students' Deposits	250.00	
Henry L. Pierce Legacy, 1898	848,000.00	
Joseph B. Glover Legacy	5,000.00	
Aug. Lowell Lab. Electrical Eng. Fund	68,000.00	
Walker Memorial Fund	703.37	
Roentgen-Ray Experiment Fund	1,000.00	
Sewage Experiment Fund	4,507.40	
Dormitory Fund	4,332.70	
Chemical Research Fund	4,891.00	
Notes Payable	25,000.00	
M. I. T. Stock Account	930,478.50	1,892,162.97
		$3,627,050.84

Comparative Statement of Funds, etc.

	Sept. 30, 1902.	Sept. 30, 1903.
Trusts for general purposes	686,850.21	686,850.21
" " Salaries	108,100.00	108,100.00
" " Scholarships	314,349.28	319,275.98
" " Library	7,000.00	7,000.00
Charlotte B. Richardson Ind. Chem. Fund	37,378.78	37,378.78
Susan Upham Fund	1,299.54	1,301.52
Susan E. Dorr "	12,956.63	14,897.01
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
Henry L. Pierce Legacy	803,000.00	848,000.00
Robert C. Billings "	100,000.00	
Saltonstall Fund	40,600.00	41,006.00
Aug. Lowell Lab. Electrical Eng. Fund	32,000.00	68,000.00
Rebecca A. Goddard Legacy	1,000.00	
Matilda Goddard Legacy	500.00	
Barthold Schlesinger "	2,000.00	
Edward Austin Fund	366,549.09	371,124.37
Teachers' Fund	104,000.00	107,500.00
Letter Box Fund	10.50	54.00
Students' Deposits	450.00	250.00
Roentgen-Ray Experiment Fund	1,000.00	1,000.00
Sewage Experiment Fund	5,000.00	4,507.40
Walker Memorial Fund	26,558.97	703.37
Samuel Cabot Gift Brookline Land Account	20,000.00	
Joseph B. Glover Legacy		5,000.00
Dormitory Fund		4,332.70
Chemical Research Fund		4,891.00
Notes Payable		25,000.00
M. I. T. Stock Account	841,620.64	930,478.50
	$3,552,623.64	$3,627,050.84

Increase,		
Consisting of:		
Bequests for Special Purposes, etc. (See page 4),	51,393.84	
Gifts and Bequests for General Purposes. (See page 4)	50,000.00	
Net Gain on Stocks sold	1,790.00	
Dormitory Fund, net	4,332.70	
Chemical Research Fund, net	4,891.00	
Borrowed on Notes Payable	25,000.00	
Less Expenses more than Income	36,432.14	137,407.54
" Students' Deposits	200.00	
" Sewage Experiment Fund, expended, net	492.60	
" Walker Memorial Fund, invested, net	25,855.60	62,980.34
		$74,427.20

INCOME FROM GENERAL INVESTMENTS, AND APPLICATION THEREOF.

Applied to Salaries	4,324.00	From Dividends, Bank Stocks	181.25
" " Scholarships	11,850.00	" State Tax returned on Bank Stocks	260.50
" " " James Savage Fund	400.00	" Bonds	63,302.50
" " Charlotte B. Richardson Fund	1,495.15	" Dividends, Railroad Stocks	1,855.00
" " Teachers' Fund	4,000.00	" " Manufacturing Stocks	1,190.00
" " Edward Austin Fund	14,400.00	" Real Estate Stocks	2,915.00
" " Rotch Prize Funds	400.00		
" " Rotch Architectural Fund	1,000.00		
" " Library	480.00		
" " General Purposes	26,710.42		
" " Samuel Dorr Annuity	1,000.00		
" " Increase of Funds	9.68		
" " Advances to Bond Premiums	3,635.00		
	$69,704.25		$69,704.25

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

Paid Massachusetts Institute of Technology	10,970.50	Received Income from Railroad Bonds	11,803.00
Credited to Advances Bond Premiums	832.50		
	$11,803.00		$11,803.00

DETAILS OF SOME ITEMS IN TREASURER'S CASH ACCOUNT.

Rents.

Huntington Hall, for Lowell Lectures	5,250.00	
Land and Building, Clarendon St., on account	2,000.00	
Use of Rooms and Gymnasium	2,345.43	
Cambridge Real Estate	469.60	$10,065.03

Department Supplies.

Chemistry	15,285.61	
Physics	4,748.98	
Mining	4,024.53	
Mechanical Engineering	2,608.43	
Civil Engineering	2,542.96	
Mechanic Arts	2,369.56	
Architecture	2,044.70	
Periodicals	1,904.66	
Applied Mechanics	1,560.68	
Geology	873.55	
Biology	1,272.63	
English	764.25	
Naval Architecture	839.43	
Mathematics	202.38	
Military	162.07	
Drawing	170.28	
Modern Languages	110.71	
Physical Culture	157.40	
Equipment Phys. Chem.	56.47	
Electrical Engineering	8,278.82	$49,978.10

Salaries.

Instruction	243,920.91	
Administration	37,643.09	
Labor	38,009.58	$319,573.58

General Expense.

Window Shades		296.29	
Furniture		7,440.06	
Stationery and Office Supplies		3,420.87	
Postage		3,222.59	
Electrical Wiring, Lamps, etc.		4,603.77	
Sundries		2,769.92	
Express		1,088.03	
Janitor's Supplies		2,034.09	
Examinations		676.94	
Diplomas and Commissions		519.27	
Washing		769.81	
Telephone Service, Installing Stations, Rentals, Repairs, etc.		999.50	
Engine Room Supplies:			
Oil	275.95		
Waste	108.48		
Sundries	82.28	466.71	
Library		363.33	
Ice		315.09	
Examination Books		291.54	
Examination of Title		250.00	
Graduation Exercises		181.92	
Removing Ashes		205.40	
Glass		249.90	
Union Safe Deposit Vaults (two years)		150.00	
State Street Safety Deposit Vaults		75.00	
Gymnasium		8.95	$30,398.98

Repairs.

Department Improvements:			
Chemistry		1,699.95	
Mechanical Engineering		385.76	
Architecture		177.83	
Mechanic Arts		408.11	
Physics		1,066.48	
Mining		454.56	
Naval Architecture		92.68	
Geology		77.63	
Biology		732.29	
Civil Engineering		48.64	
English		7.73	
Applied Mechanics		11.69	
Electrical Engineering		1,207.53	
Modern Languages		58.09	
Drawing		10.25	6,439.22
Rogers Building			1,718.39
Walker "			2,118.60
Sundries			1,791.98
Engineering Buildings, A and B			796.02
Mechanical Laboratories			339.54
Engineering Building, C			125.25
Lowell Building			342.17
Tech. Union			1,256.59
Pierce Building			399.57
Boiler and Power House			531.45
Gymnasium			127.80
			$15,986.58

BOSTON, December 2, 1903.

Mr. E. L. Parker, an accountant employed by this committee, has examined the accounts of the Treasurer of the MASSACHUSETTS INSTITUTE OF TECHNOLOGY for the year ending September 30, 1903, and his report is hereto annexed.

We have verified the list of personal property held by the Institute.

CHARLES C. JACKSON,
JAMES P. TOLMAN, } *Members of the Auditing Committee.*

BOSTON, December 2, 1903.

To the Auditing Committee of the Massachusetts Institute of Technology:

GENTLEMEN,— I have audited the accounts of Mr. George Wigglesworth, Treasurer, for the year ending September 30, 1903.

They are correct, payments duly vouched, and the receipts from students' fees and all other income duly accounted for. The cash at office and in banks, according to the deposit books, is correct. The account of property held by the Institute and the funds and balances, as shown in the Treasurer's report of September 30, 1903, is in accordance with the books.

Respectfully submitted,

EDWARD L. PARKER,
Public Accountant.