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Massachusetts Institute of Technology

BOSTON

REPORTS

OF THE

PRESIDENT AND TREASURER

PRESENTED AT THE DECEMBER MEETING OF THE CORPORATION

JANUARY, 1909

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Report of the Acting President.

To the Members of the Corporation:

I have the honor to present to you to-day a report upon the progress of the Institute during the past year and upon its condition at the present time. In the report made last year I had the privilege of placing before you my views as to the educational policy which the Institute should follow and as to the most important problems of development. I shall try to show you what degree of progress has been made in the solution of these problems, and shall bring to your attention certain other matters which seem to deserve especial consideration.

CHANGES IN THE CORPORATION AND FACULTY.

The most important event connected with the membership of the Corporation and Faculty is, of course, the recent election of Professor Richard C. Maclaurin, now of Columbia University, to the Presidency of the Institute. By this appointment, this institution is to be placed under the leadership of a man of the highest personal qualities, of an eminent scholar distinguished in two of the most fundamental branches of science taught at the Institute, and of an experienced educator acquainted with the systems of higher education prevailing all over the world and highly sympathetic with our own. Under his guidance, aided as he will be by the most cordial co-operation of Corporation, Faculty, Students, and Alumni, we may rest assured that the Institute is about to enter upon a new epoch in its history, to be characterized by an unexampled development in all directions, carried out upon sound principles.

The Corporation has welcomed to its membership three new

term members, elected from among the nominees of the Alumni Association—Messrs. Arthur T. Bradlee, Everett Morss, and James W. Rollins, Jr., all of Boston. Through this election the number of term members attains the maximum of fifteen provided for by the by-laws of the Corporation.

It is with great regret that I have to recall that during the past year the Corporation has suffered the loss of one of its life members, Mr. Charles L. Lovering, who has been a member of this body since 1896. A memorial of his life, prepared by a colleague on this board who was well acquainted with his work, was published in a recent number of the *Technology Review*, which was sent to all members of the Corporation.

During the past year there have been, I am glad to say, no changes in the Faculty brought about through resignation or death. Its membership has, moreover, been increased by the promotion to the grade of Assistant Professor of eight members of the Institute staff, whose successful work as instructors has shown them to be well worthy of this honorable recognition. These newly appointed members are: Charles W. Berry, Assistant Professor of Mechanical Engineering; Arthur A. Blanchard, Assistant Professor of Inorganic Chemistry; Harry C. Bradley, Assistant Professor of Drawing and Descriptive Geometry; Harrison W. Hayward, Assistant Professor of Applied Mechanics; Ervin Kenison, Assistant Professor of Drawing and Descriptive Geometry; Joseph C. Riley, Assistant Professor of Mechanical Engineering; Hervey W. Shimer, Assistant Professor of Paleontology; and Alpheus G. Woodman, Assistant Professor of Food Analysis. Dr. Gilbert N. Lewis, who during the past year has acted as Director of the Research Laboratory of Physical Chemistry, has been advanced to the grade of Associate Professor of Physico-Chemical Research.

Upon Professor Robert H. Richards, the degree of Doctor of Laws has been conferred by the University of Missouri, in recognition of the distinguished services rendered by him in promoting the science and practice of mining engineering. A similar honor was conferred upon Professor George F. Swain

a little more than a year ago by the University of New York, in recognition of his expert knowledge and high accomplishment in the field of civil engineering.

FACULTY AND DEPARTMENT ORGANIZATION.

By the new appointments just referred to, the Faculty becomes a body of ninety-two members. In spite of its large size, its work is carried on effectively through the agency of a large number of Standing Committees. The character of this organization and its satisfactory working were described in my former report. Improvements in it are, nevertheless, frequently discussed by the Faculty. At the present time there is an especially important question of this kind under consideration by the Committee on Faculty Business—that of appointing a new standing committee of the Faculty on each of the thirteen Courses of Study, to take the initiative in recommending changes in the curriculum of the Course. This initiative has previously rested almost wholly within the single department most closely associated with the Course; but the composite character of our Courses seems to make desirable the closer participation of several departments in the matter; thus, to cite a rather extreme example, the Course in Mining Engineering and Metallurgy includes, in not very far from equal proportions, studies in these two subjects, in Chemistry, in Geology, and in Mechanical Engineering; and a well-balanced course-schedule can probably be best worked out through the joint co-operation of all the departments concerned. The same is true in greater or less degree of almost all our other courses. Another important result that might be secured by this plan is a larger influence and participation in Faculty and Departmental affairs of professors who are not in charge of departments.

This last consideration is one of great importance not only because of the direct value of the advice and opinions of these men, but also because it is essential to give to them positions of as much influence and responsibility as possible, if teachers

and scientists of the first rank are to be secured and retained in our departments. To this end and also for the purpose of increasing the efficiency of our administrative system, I believe it is desirable that the formal organization of our departments —at any rate of the larger and more composite ones—be carried one step further and that there be definitely appointed, upon recommendation of the professor in charge of the department, other professors to take charge of the larger branches of instruction; for example, within the Department of Civil Engineering individual professors might be placed in charge of the instruction in structural, hydraulic, railway, and topographical engineering, respectively. As their titles would indicate, such men should deal with the distinctly educational aspects of the work of instruction intrusted to them, and should be held personally responsible for its success. To make such responsibility effective, they should be given the privilege of submitting to the President and Executive Committee, through the professor in charge of the department, recommendations as to the promotion and salaries of their own subordinates.

It is also, I believe, desirable that there be established a more definite system of promotion and salary payments applicable to all the departments of the Institute. This seems important from many points of view—as an aid to the President and Heads of Departments in deciding many vexatious personal questions, as a means of securing uniformity of treatment throughout the Institute, and as an aid in improving the character of our staff.

THE REGISTRATION OF STUDENTS.

The number of students now registered at the Institute is 1,461, an increase of 51 over the number attending at the same time last year. This is mainly accounted for by the fact that the first-year class contains 57 more students than it did a year ago, while the three higher classes, taken together, include about the same number of students as last year.

This large increase again raises the much discussed question whether a limitation should be placed upon the number of our students. Upon this matter my own opinion is that it should be the permanent policy of the Institute to receive and provide for all those capable and well-prepared students who desire to avail themselves of the opportunities it offers; for only in this way can it attain its full measure of usefulness. It should not be deterred by the educational difficulties involved in the instruction of large numbers of students. The Institute is already a large school; and, if it continues to hold the first place among institutions of its kind, it will inevitably become still larger: for it is not justifiable to raise the standard to the point of demanding extraordinary scholarly attainment, since other qualities than scholarship play an important part in determining the success of a professional or scientific career. The Faculty and staff of instruction must therefore face resolutely the problem of teaching large classes effectively; administrative officers must see that the character and organization of the staff is such as is adapted to this end; and the Corporation and Alumni must aim to secure the resources which will provide sufficient facilities in the way of class-rooms, laboratories, and equipment, and will make possible the payment of adequate salaries, such as will retain efficient teachers.

This last factor—the financial resources of the institution—is, however, the crucial one in deciding at any given time the question of numbers. While I have expressed the opinion that, looking to the future, our general policy should be to provide for any natural growth of the institution, I wish to emphasize even more strongly the idea that, for the present, until additional accommodations have been provided and until increased funds for this purpose and for the current expenses have been secured, it would be a serious mistake to permit the number of students to increase much beyond the present registration; for it would mean that the effectiveness of our teaching would be much impaired. The quality of our work is the first consideration; and the quantity of it must be increased,

whether through growth in the size of our classes or through provision for new lines of instruction, only when the funds available are sufficient to enable it to be done without detriment to the work already in progress. Regrettable as it may be from some points of view, it is therefore, I believe, imperative that the Faculty take measures to prevent any further increase in the number of first and second-year students, through a more rigorous enforcement of scholarship requirements.

The number of new students who have previously attended other colleges has again shown a substantial increase—from 155 last year to 170 this year. Of these students 16 per cent. enter the first year, 28 per cent. the second year, 46 per cent. the third year, and 9 per cent. the fourth year of our undergraduate courses. Of the 230 candidates who received the degree of Bachelor of Science last June, 18 per cent. had previously graduated at some other college, and 14 per cent. more had attended some other college for one or more years.

There is also a notable increase (from 20 last year to 29 this year) in the number of students pursuing advanced work for the degrees of Master of Science, Doctor of Philosophy, and Doctor of Engineering.

The proportion of Massachusetts students (57.5 per cent.) has somewhat increased over that of last year (55.5 per cent.).

Other interesting statistical information will be found in the report of the Registrar.

DEVELOPMENTS IN THE WORK OF INSTRUCTION.

Advanced Courses of Study.

From the standpoint of our general system of instruction the two most important developments of the past year have been the much fuller provision made for advanced courses of study leading to the higher degrees of Master of Science, Doctor of Philosophy, and Doctor of Engineering, and the more definite organization of five-year undergraduate courses leading to the Bachelor's degree. The former courses have

been developed by the Faculty along the lines referred to in my last report; and a Bulletin entitled "Advanced Study and Research" has been issued by the Institute, in which these courses are fully described. As this Bulletin has been sent to members of the Corporation, I shall not discuss these advanced courses further.

Five-Year Courses leading to the Degree of Bachelor of Science.

I wish, however, to call your attention to the new five-year undergraduate courses which have been arranged for. The Faculty has taken this action, in order that students who can afford to spend an additional year may realize that it is highly important to do so, if they wish to secure in full measure the advantages of the combination of liberal education, scientific training, and professional knowledge which the Institute offers.

These courses are of three types. In one of these the student supplements all the required work of one of the regular four-year courses with the equivalent of an extra year of study in language, literature, fine arts, history, economics, and in the fundamental sciences of chemistry, physics, astronomy, geology, and biology. These additional general studies are entirely elective. This plan of study thus provides in large measure for the breadth of scholarship which a college course is designed to supply; but it does this by the methods and in the atmosphere of the scientific school and with special emphasis upon general scientific studies as a part of a liberal education. Upon students who complete such a course is conferred the degree of Bachelor of Science in two departments of study, namely, in General Science, and in that branch of engineering in which the professional work has been completed.

The range of such elective studies of a liberal character which the Institute offers to its students is an extended one; and only in one direction does this side of our work seem to need strengthening. We have, unfortunately, no courses of lectures on philosophy, psychology, and ethics; and I would

again bring to your attention the desirability of having a professorship of these important subjects established at the Institute, either through a special endowment or through direct provision for the necessary salary payments through a period of years.

A second type of five-year course makes provision for those students who desire to secure a training in two allied branches of science or engineering, as in electrical and mechanical engineering, mechanical and chemical engineering, mining engineering and geology, etc. Such a combination of knowledge and training is so often required in professional practice that the student who has received it has exceptional opportunities open to him. For the completion of such a course, the degree of Bachelor of Science in two professional departments of study is awarded.

In a third type of five-year course provision is made for distributing the work of the last three years of the regular four-year courses over four years without additional requirements, thus reducing the number of subjects required in any term. This arrangement affords the opportunity for more thorough work in each subject by enabling a student to devote more time to outside study and to practice in the laboratories, drawing-rooms, and in the field; and it enables regular standing to be maintained by the slow, thoughtful student, who, though able to understand and perform our work satisfactorily, finds it difficult to do it properly at the rate and under the pressure which our four-year schedules involve.

Requirement of Physical Training.

Of the more specific changes that have been made in the courses of instruction the most important is the introduction, upon the recommendation of the Dean, of the requirement that all first-year students attend a course in physical training. The course as given this year consists of four lectures on personal hygiene, of the usual anthropometric measurements made upon each student at the beginning and at the end of

the school year, and of regular exercises in the gymnasium classes or upon the athletic teams throughout a large part of the year. A circular prepared for the use of students in regard to this subject has recently been sent to members of the Corporation for their information. The chief purpose of this requirement, which thus far has worked very satisfactorily, is to impress upon students the necessity of close attention to their health and the importance of physical exercise as a means of maintaining it.

Closer Relations between Instructors and Students.

I am glad to be able to state that a gift received from an anonymous friend has made it possible to extend the plan of individual conferences between the instructors in charge of sections and their students, which was last year provided for in the subjects of first-year English and mathematics, to second-year physics, which is one of our most fundamental subjects and one with which students have much difficulty.

The establishment of close personal relations between instructors and students is a matter of prime importance to the success of the work of instruction. Through the fact that an unusual proportion of our subjects are taught upon the recitation plan to small sections or in the laboratory to individuals, rather than by formal lectures to large classes, such relations are already developed at the Institute in a greater degree than at most other large educational institutions. The plan of conferences, just referred to, supplements the recitation system in a most valuable way. I believe, however, that there exists in some of our important first and second-year subjects a further opportunity for accomplishing much in this direction through a different organization of the work. Instead of having, as is now done in some cases, a group of instructors teach in common in the laboratory or drawing-room a whole class of from three to four hundred students, while another group carries on the class-room work in the same subject, and perhaps a third group corrects the written work

submitted, much better results would, I am sure, be obtained by placing each instructor in full charge of a limited number of students, say sixty or eighty, and having him, with the aid of an assistant when necessary, carry on with those students all the different sides of the work in the subject in question (except the course of experimental lectures, which it is especially uneconomical to repeat). He would thus not only get much more closely acquainted with his students and come to understand their individual difficulties, but he would feel a personal responsibility and pride in the success of those intrusted to him. He has, moreover, a greater variety of work, and avoids the monotony of an undue number of repetitions of the same exercise with a large number of sections. Professor A. E. Burton has called attention in his report submitted herewith upon the Department of Drawing and Descriptive Geometry to the importance of making such a change in the method of instruction in these subjects; and it would, I believe, be equally advantageous in such subjects as chemistry and physics, in which the instruction consists of a combination of lecture, recitation, laboratory, and problem work. The present method of giving such instruction to large classes has grown up in the larger colleges as a result of an assumed need of economy in this direction; for there is some economy of effort in the division of labor between the different sides of a teacher's work, and there is a large economy in the average salary paid when one professor is employed to supervise and to give the lectures, and inexperienced or otherwise inefficient instructors and assistants are engaged to do the real teaching. From an educational point of view, however, the method is unsatisfactory; and, until it is abandoned, the problem of handling large classes will not be adequately solved, and large colleges will be at a disadvantage in comparison with small ones. Moreover, though the other plan of individual responsibility does involve additional expense, the amount required is not inordinate; for the main work of instruction might well be done by men of intermediate grades receiving

(according to their length of service) from $1,000 to $1,800 a year; and it would, I believe, be better to curtail expenditure in almost any other direction than in this one, which is so essential to the efficiency of the teaching of our fundamental subjects.

Requirement of Summer Work.

In my previous report I called attention to the important advantages which would result from the transfer to a summer period of some of the required work in the field, laboratory, and drawing-room, as well as to some of the difficulties involved. A committee of the Faculty has studied this matter, and has prepared for the consideration of the Faculty a plan providing for the requirement of three and one-half weeks of work in the month of June by all students between their first and second years. The work included in this summer period would consist of surveying in all those courses of study which have this subject, of mechanic arts and descriptive geometry in certain other courses, and of chemical laboratory in certain others. The time set free in the school year it is proposed to utilize for the introduction, not of any new subjects, but of additional recitations and preparation time into the general courses in chemistry, physics, and English composition, literature, and history. For the transfer of surveying to the summer there are strong reasons of a special character which have been fully set forth by Professor Swain in his reports upon the Department of Civil and Sanitary Engineering both this year and in previous years. Professor Swain submits in this year's report a detailed plan for a surveying summer camp, to which I would call your attention.

New Subjects of Instruction.

A few important subjects of instruction are offered to undergraduates as new optional studies for the first time this year. A series of informal talks upon German life and institutions is being given in the German language by Dr. Hermann Schu-

macher, who has come to the Institute this term from the Royal Gymnasium of Cologne under the auspices of the Carnegie Foundation for the Advancement of Teaching. A course of lectures on Cosmic Physics, presenting the broad aspects of this subject and the recent advances in it, is to be given to our students through the kindness of Professor Percival Lowell. During the present year the instruction in Economic Geology has been placed under the charge of Dr. Waldemar Lindgren, an eminent expert in that subject from the United States Geological Survey. A new Option upon the subject of Steam Turbine Engineering has been introduced into the Course of Mechanical Engineering upon the initiative and under the direction of Professor C. H. Peabody. In addition, new courses for advanced students are offered in many of the departments.

A New Research Laboratory.

Through the liberality of a member of the Corporation it has been possible to make definite provision for the important extension of our advanced instruction and research work to the industrial applications of chemistry. By the establishment at the beginning of this year of the new Research Laboratory of Applied Chemistry as a division of the Chemical Department special opportunities are afforded for the execution, by salaried research assistants and by advanced students of investigations of chemical problems of interest to the manufacturer. In a report submitted herewith, the Director of the Laboratory, Professor William H. Walker, describes the work which is already in progress.

DEVELOPMENT OF THE BUILDINGS AND EQUIPMENT.

Some important additions have been made during the past summer to our laboratories and equipment.

Greatly needed space has been provided for the Laboratory of Steam Engineering by extending it into the old lunch room in the Pierce Building; and there has been installed in

it a 500-kilowatt steam turbine, together with a condenser, pumps, and other accessories.

In the boiler and power plant there have been installed two new boilers, furnished at a greatly reduced price by the Babcock and Wilcox Boiler Company, for which assistance the Institute wishes to express its great indebtedness. The whole plant has, moreover, been rearranged and modernized under the direction of Professor E. F. Miller; and it is largely in consequence of his experience, good judgment, and devotion to the undertaking that the Institute now possesses a model plant, which will serve not merely to furnish heat, light, and power to its buildings, but will enable its students to study in a more practical way the problems of steam engineering.

Additional room has also been assigned to the Laboratory of Analytical Chemistry, to enable the Department of Chemistry to provide for the increased number of students pursuing its subjects in the higher years.

A very valuable addition has been made to the instrumental equipment of the Department of Geology. A modern seismograph of the most improved form, purchased with the aid of a gift from the estate of Caroline A. R. Whitney, has just been received by the Department. It is hoped that provision can soon be made for setting it up in a suitable location in the suburbs, remote from the shocks of the city.

The Department of Economics has received an important addition to its equipment through the generous gift to the Institute of the private library of General Francis A. Walker, by his widow, Mrs. Exene Walker. This library consists of about 1,500 volumes on economics, many of which are very rare and valuable. In appreciation of this gift and in further recognition of the distinguished services of our former president to this institution and to this branch of science, the Executive Committee has voted that the name Francis A. Walker Library of Economics be attached to the whole collection of works upon this subject possessed by the Institute.

In speaking of our buildings and equipment, I must not

fail to emphasize the seriously crowded condition of our present quarters, even though it be a time-worn topic of college presidents. I wish specifically to call your attention to the following facts: our limited space makes impossible any increase in the number of our students; it prevents development of our present work in any new direction, however desirable it may be; it prevents, through lack of class-rooms, an extension of the plan of instruction in small sections, which as I have stated is so essential to efficient teaching; it involves (most strikingly in the case of the Chemical Department) a separation of different divisions of the departments, thus hindering a close association of the different instructors and proper correlation of their work; it makes necessary a crowding of students and apparatus in our laboratories which makes thoughtful and reliable work difficult; and it gives no opportunity for providing our instructing staff with adequate offices and private laboratories in which writing, calculations, and investigations can be properly carried on.

Though the physical condition of the Institute is, as I have indicated, one that makes impossible further growth or a development of its work in new directions, and one that does in some measure impair the efficiency of our present instruction, yet I should be sorry to give you the impression that the latter effect is of a very serious character. On the contrary, there has, I believe, never been a time when our teaching was so thorough or our system of education so generally effective; and this results from the fact that limitation of space is, after all, only a secondary factor in the whole problem. Equipment for lecture and laboratory work is another physical factor of at least equal significance; and on this side the Institute, taken as a whole, is extraordinarily well provided for. Far more important than either of these are, moreover, the character of the teacher, the spirit of the student, the methods of instruction, and the standards of scholarship and ideals of the institution; and in all these respects the Institute is steadily advancing.

Nevertheless, while recognizing the more vital importance of these considerations, we must not permit our growth and development to be hampered by inadequate accommodations and unsuitable physical surroundings. The situation is, moreover, one that requires radical treatment; for the condition referred to prevails throughout the whole Institute, and not merely in a few departments. In this respect our position is different from that of those universities which have developed upon the plan of making ample and permanent provision for one department every few years, instead of making during the same period such provision as might be possible for all departments of the institution. Since time is a highly important factor in determining the growth and reputation of institutions and the value of the service which they render, I believe the plan of continuous all-sided development which we have followed was the wisest; but it should be realized that we are now facing the logical result of that plan, which has made it imperative that the whole Institute be now rebuilt upon a permanent basis and upon a new site better adapted to its needs. Though no definite action in this direction has been taken by your body or by the Committee on the Site which you have appointed, yet I believe that, during the past year, through informal discussion and individual consideration of the matter, there has grown up not only among your own members, but among all the other groups of men connected with the Institute,—Faculty, Alumni, and Undergraduates,—a sentiment so strong that it will be satisfied with nothing less than the creation of a new Institute on a new site. It has also, I believe, come to be recognized that the securing by private subscription of a moderate sum of money is an essential preliminary to the serious discussion of any plan of rebuilding and removal. This feeling was expressed by the action taken at the last stated meeting of the Corporation requesting the Committee on the Site to act also as a committee for obtaining funds for the development of the Institute. In my own opinion, this is not a matter that should be left to the initiative of the President or of other

individuals. It can be adequately accomplished only through a well-organized effort carried on jointly by representatives of the Corporation and the Alumni.

DEVELOPMENTS IN THE CONDITIONS OF STUDENT LIFE.

Through the opening of the new Technology Union in the building erected on Trinity Place during the past summer, a most important step has been taken in the development of the social life of our students.

The new Union was made possible mainly through the interest and efforts of the Committee on the Welfare of Students appointed by the Corporation last March, and through the generous donations of individual members of this body, which provided for a large part of the expense involved. That this assistance is highly appreciated by the students is shown by the following resolution, which I present to you with much pleasure at the request of the Institute Committee, which is a large committee thoroughly representative of the whole student-body:—

Whereas a new and magnificent Union has been provided for the use of the students of the Massachusetts Institute of Technology largely through the efforts of the Committee on Student Welfare of the Corporation and through the gifts of members of the Corporation and Alumni.

And whereas the management of this Union has been largely vested in the hands of the students, be it

Resolved by the student-body of this institution that their heartfelt gratitude be extended to the said Committee and all others through whose generosity this important development of student life has been made possible; and be it also

Resolved that the students by their use of the Union will at all times demonstrate this appreciation; and be it further

Resolved that a copy of these resolutions be sent to the members of the Committee on Student Welfare of the Corporation and to all other members of the Corporation and Alumni who have contributed funds for the erection and equipment of the Union.

The Union serves the purposes both of a club house and of a general eating place for students. On the first floor there

is a large dining-room, in which students who desire to do so may get all their meals, both week-days and Sundays, the kitchen being in the adjoining basement of the Pierce Building. On the second floor, there is a smaller dining-room available for the meeting of student societies; and a large social or living room, where students may gather in their spare time for reading and conversation and where evening entertainments may be held; also a small room known as the quiet room. In the mezzanine part, a coat room and students' post-office, a lavatory, and three small rooms for offices for student organizations are provided. In an adjoining room is the office of *The Tech*, the students' newspaper.

The control of the Union has been placed in charge of a committee of nine members, of whom a majority are undergraduate students elected by the Institute Committee. There have also been elected by the students three sub-committees to take charge of different sides of the Union's activities, namely a House Committee, a Dining Room Committee, and an Entertainment Committee. The latter of these committees has arranged for the holding of popular lectures or musical or other entertainments regularly on every Friday evening.

The admirable spirit of our students, manifested not only in connection with this Union, but in many other ways, is, I believe, one which can be matched at few, if any, other colleges. I cannot refrain from mentioning to you a striking illustration of this. The Institute Committee has recently recommended, and the student-body has put into practice, a plan known as the "point-system," which has been introduced in only one or two other colleges. The purpose of this plan is to restrict the number of different offices in the various student organizations which one individual may hold. To each office a certain number of "points" is attached, and no student can hold positions corresponding to more than a specified maximum of points. This rule hinders a few aggressive individuals from monopolizing the direction of student-activities, whereby their own scholarship is sacrificed and the desir-

able participation in more moderate measure of a larger number of students is prevented.

THE DEVELOPMENT OF CLOSER RELATIONS.

In order to enable the Institute to fulfil more effectively its educational mission, a determined effort must be made to establish closer relations with and among the different organizations and groups of individuals that are in any way associated with the work of the Institute. While its success will, of course, depend primarily upon the character of the education it affords and upon the contributions to scientific progress it makes, yet no institution of learning, and least of all a school of applied science, can afford to neglect the cultivation of such relations. I believe that insufficient attention to this matter during the past ten years has been a serious obstacle in the way of our progress, and that there is no more important task before us in the immediate future than that of remedying this defect.

Relations among the Groups within the Institute.

First of all, there should be close co-operation among the different groups within the Institute itself, this Corporation, its Executive and other Committees, the Alumni, the Faculty and instructors, and the undergraduates. There should be full discussion of new questions as they arise, not merely by the body which may have the final decision, but by all others who have any natural interest in them. The carrying on of an educational institution is in its very essence a co-operative undertaking; and full publicity and free discussion of its affairs is one of the prime conditions of its success.

As suggested in my previous report, members of this Corporation can, I believe, render great assistance to the Institute through a more direct participation in its work. This may be done in the case of such matters as specific improvements in the courses and methods of instruction, in the con-

ditions of student life, in the equipment of the departments—in the case of any special matter in which a member may take a personal interest—through individual co-operation with the President, Dean, and professors in charge of departments. For the consideration of larger questions the appointment of special committees seems the best method, members of the Faculty or Alumni who are especially interested in the matter under consideration being invited to attend. The Committee on the Promotion of Welfare of Students appointed by the Corporation at the March meeting has furnished a striking illustration of the effectiveness of this plan. To the interest and activity of that Committee, which had the benefit of the co-operation of the Dean, the Bursar, and representatives of the alumni and student-body, the establishment of the Technology Union is, as I have already stated, largely due.

It is also important that close relations be maintained between the students and the administrative officers and other members of the Faculty, so that the needs and interests of the former may be well understood, their points of view appreciated, and their co-operation in promoting the aims of the Institute secured. Few greater mistakes could be made than that of failing to enlist the direct interest and support of the students in the solution of the general and educational problems which confront us. Such co-operation has been made easier through the reorganization during the past year of the Institute Committee, by which it is made thoroughly representative of the student-body, as well as by the closer contact between students and administrative officers which the Technology Union has brought about. The President and the Dean have also been greatly aided on this side of their work by the appointment made last year by the Executive Committee of Mr. H. A. Rapelye of the class of 1908 to the new position of President's Assistant. His intimate knowledge of our student life has enabled him to advise and assist us effectively in many ways. He has among other things taken an important part in the arrangements connected with the new Technol-

turned from a trip of this kind to the Pacific Coast, where he took part in the organization of new Technology Clubs in Seattle, Washington, and in Portland, Oregon.

Relations with the Secondary Schools.

The relations of the Institute to the secondary schools deserve constant attention. With those schools the Institute has always kept closely in touch with reference to its entrance requirements, taking care not to make them so excessive as that the brighter pupils from the better high schools cannot meet them without additional preparation, nor so uneven as to distort the curricula of these schools. Any addition to our requirements should, I believe, be of an alternative character, so that they may be adapted to the different preparation afforded by the various types of high schools, which are constantly becoming more diversified. It is, for example, desirable that it be made easier for graduates of classical courses in the high schools to enter the Institute.

But there is another direction in which the relations of the Institute and of other scientific schools to the secondary schools need to be cultivated. Owing to the fact that by far the larger number of teachers in the high schools have received an academic rather than a scientific training, owing to the undue development in this part of the country of the sentiment that a more effective education is secured under the collegiate plan than under that followed by even the best scientific schools, and owing to the failure to appreciate that the social and physical sides of student life are developed at the Institute upon a sounder basis and in better proportioned measure than at most of the colleges,—for these reasons the advantages of our system of education and the opportunities afforded by the scientific professions in general are not sufficiently understood by boys in the preparatory schools nor by their teachers and parents. There is, therefore, a need in this community that the public be better informed in this matter,—not so much because the interests of the Institute are involved, as

because it is important that both types of educational effort be duly appreciated. The Faculty Committee on the Relations with Secondary Schools has under consideration the question of what can be done in this direction. It is to be hoped that individual members of our instructing staff will also avail themselves of any opportunities that occur for the presentation of these considerations to teachers and pupils of the secondary schools. There is, however, no part of the Institute organization which can accomplish so much on this side as our student-body, the individuals of which can readily maintain close relations with the special schools from which they have come.

Relations with the Public.

There are also important relations to be maintained with the general public. The public should be kept informed, through the press and otherwise, of the activities of the Institute; and all those industrial, commercial, and transportation interests which are in any measure dependent on scientific knowledge and investigation should be made to feel that the Institute stands ready to place at their service for the study of their problems the expert advice of its staff and its laboratory facilities. In the further development of those facilities, through the establishment of research laboratories of applied science and of engineering testing stations, and through the installation of the elaborate testing machines and other scientific instruments needed for investigation purposes, the co-operation of the manufacturers of this community should be secured. As an aid to the officers of the Institute in promoting closer affiliations in these and other directions, the Institute has been fortunate in securing the services of Mr. I. W. Litchfield, one of our former students, who has long shown a deep interest in the Institute and an energetic and intelligent devotion to its welfare. Since the beginning of his official connection with the Institute last September, he has taken an important part in the successful starting of the Technology Union, in the development of the Society of Arts, in the

co-ordination of the work of the student press reporters, and in other matters relating to the public sides of the Institute's work and to the activities of the Alumni.

The Society of Arts, the oldest part of our organization, has for its primary function the general dissemination of scientific knowledge, especially with reference to the recent advances and practical applications of the sciences; but it also furnishes incidentally a means of making the work of the Institute known to the public. I am glad to be able to tell you that as a result of the earnest efforts of its Executive Committee, new life has been infused into that Society, and an unusually valuable and attractive program has been arranged for the meetings of the present year.

Relations with the State.

With the State the Institute naturally stands in intimate relations. It bears its name, it is located in its capital city, and it received from it its charter and the plot of ground on which its older buildings are located. Three representatives of the State sit upon its governing board. Forty free scholarships are maintained, available for applicants from the various senatorial districts. Finally, for a number of years financial aid has been received from the Commonwealth. Without sacrificing its national scope or its own independence, the Institute should therefore constantly strive to serve the State in every possible way,—in the development of its natural resources, in the improvement of its industrial processes and its transportation facilities, and especially in the solution of its educational problems. In all these respects, it should stand to the Commonwealth much in the same relation as do the progressive State universities of the middle West. In order that the Institute may render, in a larger measure, this public service, the State should supply the necessary resources. The forms which it would seem such assistance would most naturally take are: first, provision for a reduced tuition to Massachusetts students or increased scholarship funds for their benefit, such as will

place the educational opportunities which the Institute affords within the means of a larger proportion of the well-prepared graduates of the High Schools of the State; second, provision for the execution in its laboratories of investigations in engineering and applied science which are of especial importance to the development of the State's resources and industries; and third, co-operation with the Institute in providing for workmen a sound education in the industrial sciences, by means of evening courses carried on in its class-rooms, drawing-rooms, and laboratories by members of its instructing staff.

CONCLUSION.

It will, of course, be appreciated that, though it is the function of the President to be in touch with all the various organizations and interests that have been mentioned, and though he must often take the lead in extending the relations between them and the Institute, yet he can perform, even with the assistance of the other administrative officers, only a trifling part of all that needs to be done in these directions. In closing this report, I would therefore emphasize, as the watchwords of our future progress, the ideas of *co-operation* and *closer relationships*. If there be also shown the fullest *confidence* in the soundness of our educational system and in its support by the community, its proper growth and development will be assured.

I desire finally to lay before you the reports which have been presented to the President by the other Administrative Officers and by the Professors in Charge of Departments. These will be printed as a part of the President's Report and sent to members of the Corporation.

ARTHUR A. NOYES.

Reports of Administrative Officers.

REPORT OF THE SECRETARY OF THE FACULTY.

The plan proposed by the Committee on Five-Year Undergraduate Courses of publishing definite schedules for such courses has been adopted by the Faculty. This plan provides that the studies of the first year shall be the same as those required of all regular students, and that, beginning with the second year, three methods of continuing the Institute work for four years longer shall be open to students. One method arranges for the distribution of the remaining three years' required work over four years, giving the student an average of 540 hours per term, instead of 720 hours. Definite schedules have been prepared on this basis for the Courses in Civil, Mechanical, and Electrical Engineering. A second method gives the student the opportunity of combining the work of two allied Courses during the remaining four years, and makes it possible for him to receive the degree in two departments of study, in each of which it is required that a thesis be presented. The following combination-courses have been prepared: Civil and Sanitary Engineering, Mechanical and Electrical Engineering, Mechanical and Chemical Engineering, Mechanical Engineering and Naval Architecture, Electrical Engineering and Naval Architecture, Electrical and Chemical Engineering, and Mining Engineering and Geology. The third method is to occupy with additional studies in English, history, and general science, the time gained by the distribution of the required work of the course over five years, thus giving students the opportunity of obtaining a broader general education. Such a com-

bination of professional and general science studies may lead to a degree in General Science in combination with the degree in the professional course pursued.

The standing committees on first and second year students have met six times during the year to scrutinize the intermediate and final records of those students, and have endeavored to ascertain the reasons for the low standing of students having poor records. A similar committee reviews the records of the third year students at the end of each term. Students having low records are referred to the Dean or to some other member of the Faculty for conference and advice before any severe action is taken. During the year, 596 students have been so referred. In January, 1908, 24 students were advised, and 19 required, to withdraw from the Institute, and in June, 48 were advised and 40 required to withdraw; such action having been taken only after repeated conferences and evidence in each case that continuance at the Institute would not be for the best interests of the student. Students who have not obtained satisfactory records during the first year are in general not allowed to continue the full work of the second year, this plan being of assistance in maintaining the high standard of work which the Institute demands, and also discouraging students who are apparently unfitted for the higher work of their chosen Courses from attempting such work until they are thoroughly prepared.

There are at present twenty-nine students at the Institute taking graduate courses, one of these a candidate for the degree of Doctor of Engineering, seven, candidates for that of Doctor of Philosophy, and twenty-one for the Master's degree. Four have been appointed Fellows.

Fellowships and graduate scholarships to the amount of $5,100.00 have been awarded for the current year. One hundred and fifty-four undergraduate students have received scholarship grants from Institute funds, the total amount awarded being $19,100.00.

The number of new students at the Institute who have been admitted on credentials from other colleges is larger than that

of last year, eighty-nine of these being graduates, and eighty-one non-graduates.

In June, 1908, two hundred and forty-four students were awarded the degrees of the Institute,—three receiving that of Doctor of Philosophy, twelve that of Master of Science, and two hundred and twenty-nine that of Bachelor of Science.

ALLYNE L. MERRILL,
Secretary of the Faculty.

REPORT OF THE DEAN.

The work of the Dean's office has been much the same as for last year. Although it has been found that the system of advisers is not of much practical utility after the first few days of the year, when advisers are consulted chiefly in regard to questions of registration, it was decided to continue the system for at least one more year.

The "Conferences" in the English Department and in the Mathematical Department have made it possible to obtain for every first-year student a personal association with some member of the instructing staff, and these instructors are proving to be the best advisers for first-year men. This conference system has been introduced into the course in Physics during the present year, and it is expected that this will be of great benefit to second-year students.

There was some discussion among the members of the Faculty as to the advisability of placing in the hands of the Walker Club the reception which it is desirable to give to students coming to us from other colleges. I think our experience last year showed to us that the reception by the Walker Club had peculiar advantages from its informal character. The men attending it were much more likely to become acquainted with each other than if the reception had taken on the character of a formal presentation to members of the Faculty. I have found, from conversation with many of the men from other colleges

who have attended this reception given by the Walker Club, that it is regarded by them as a very pleasant event, and that to it they were principally indebted for their acquaintance among their fellow students during their first year.

The number of boarding-houses which were included in the list kept in the Dean's office the past year was something like three hundred, and through the kindness of the Secretary of the Student Young Men's Christian Association a better personal inspection of the city houses was made. In the future the room and boarding-house register will be in charge of the President's Assistant.

Great difficulty was experienced last year in securing positions for students during the summer months. This was undoubtedly due to the general inactivity in engineering work and building construction. The usual number of men, however, obtained positions at hotels, and as draftsmen, clerks, chauffeurs, etc. It is intended in the coming year to establish a regular employment office for undergraduates which will also be in the charge of the President's Assistant. It is hoped by this arrangement to actually seek out work for students by means of personal interviews with employers. The number of students applying for summer work was considerably over one hundred.

Many important changes have taken place during the past year in the management of student affairs. The Institute Committee, which has long been intended to represent the student body in treating with the Faculty and Corporation, has been made a much more representative body of men by adding to the members elected directly to the Committee from each class, the presidents of the departmental societies, such as the Civil Engineering and Mechanical Engineering Societies; and the presidents of the musical clubs, the Athletic Association, and the Young Men's Christian Association. The good effect of this change in the personnel of the Institute Committee was manifested at once. An agitation for a better social hall, which was begun by the editors of *The Tech*, the students' newspaper, was carried on by the Institute Committee; and a very effective

report on the need of a social and dining hall was made by the latter body to the Executive Committee of the Corporation. The result of this movement has been the erection of a new building on Trinity Place. This building for a social and dining hall was erected during the summer months, and its management was placed in the hands of a committee of which the Dean is Chairman, and upon which are the Bursar, the editor of *The Technology Review*, the President's Assistant, and five members from the undergraduate students elected by the Institute Committee. As soon as the opening of the term allowed students to begin their work upon this Committee, arrangements were made to transfer the real responsibility to the undergraduates; and now the Union is a building open to all Institute students, and is practically under the management of undergraduate committees with a senior as chairman of each.

In accordance with a vote of the Faculty, students in the first year were required to take a physical examination. This examination resulted in the pointing out rather forcibly of the need of systematic physical training for the great majority of our men. As it was the men who most needed physical exercise who would not seek the gymnasium while such training was optional, it was decided by the Faculty that this year some sort of physical training should be made compulsory and the Dean was authorized to arrange for the giving of systematic gymnasium training to all first year students who were not twenty-one years of age. It was also voted by the Faculty that systematic athletic work, under the direction of the athletic trainer appointed by the Advisory Council on Athletics, should be regarded as equivalent to the gymnasium work, and a Committee of the Faculty on Physical Training with the Dean, Medical Adviser and Director of the Gymnasium as ex-officio members, was appointed. Mr. Winfield C. Towne, Instructor in Physical Training, was authorized to prepare the gymnasium for class work, and to divide the first-year class into eight sections, each section to take one hour of work on two days of each week, beginning November 9. The Dean was also authorized to

secure lecturers to speak to the first-year students on the subject of Physical Training, and Professor Sedgwick and Dr. Sargent delivered such lectures, in addition to those usually given by Dr. White.

STATISTICS OF ILLNESS FOR THE SCHOOL YEAR 1907-08.

Fourth-year Class.

There were three hundred and twenty-six students in the fourth-year class. Of these, thirty were reported ill during the school year 1907-1908. Classified by illnesses, there were the following cases: appendicitis, 2; cold, 1; fever, 1; injury from fall, 1; internal strain, 1; malaria, 1; measles, 1; mumps, 5; ptomaine poisoning, 1; scarlet fever, 2; tonsillitis, 2; typhoid fever, 1; not specified, 11.

Third-year Class.

In this class there were three hundred and sixty-six students, of whom forty-nine were reported ill during the year. The following cases were reported: appendicitis, 2; cold, 4; diarrhœa, 1; trouble with eyes, 2; grippe, 11; injury to ear, 1; jaundice, 1; measles, 3; mumps, 3; scarlet fever, 2; sore foot, 1; sprained ankle, 1; surgical operation, 1; unspecified, 16. There was one death in this class, that of Mr. H. F. Foster, who died on May 20, 1908, of appendicitis.

Second-year Class.

This class numbered three hundred and seventy-one students, of whom fifty-nine were reported ill during the year. There were the following cases: abscess, 1; bronchitis, 2; cold, 2; concussion of the brain, 1; trouble with eyes, 2; grippe, 10; injury to leg, 1; jaundice, 3; measles, 8; mumps, 2; pleurisy, 1; scarlet fever, 1; surgical operation, 1; tonsillitis, 2; typhoid fever, 1; not specified, 20. The case of typhoid fever was that of Mr. Edward I. Cahill, and resulted in his death on April 23, 1908.

First-year Class.

The first-year class numbered three hundred and twenty-seven students. Of this number fifty-four were reported ill during the year. Classified by illnesses, there were the following cases: bilious attack, 1; broken cheek bone, 1; carbuncle, 1; cold, 3; grippe, 10; injury to knee, 1; jaundice, 1; measles, 3; mumps, 3; pulmonary tuberculosis, 1; surgical operation, 1; tonsillitis, 2; unspecified, 26. There were two deaths in this class; that of Mr. Walter L. Doane, who died of jaundice on April 25, 1908; and

that of Mr. Jesse Mathewson, who died of pulmonary tuberculosis on September 5, 1908.

SUMMARY.

	No. in Class.	No. Ill.	No. of Deaths.
Fellows and Graduates	20	0	0
Fourth Year	326	30	0
Third Year	366	49	1
Second Year	371	59	1
First Year	327	54	2
Total	1,410	192	4

ALFRED E. BURTON,
Dean.

REPORT OF THE MEDICAL ADVISER.

The medical work at the Institute has been carried on along the same lines as in previous years. Consultation hours were held on two afternoons a week throughout the year, and as usual this time was fully occupied by the students. On the majority of these days the time of consultation had to be extended to accommodate all those who came for advice. The average extra time needed was thirty-one minutes more than the appointed hour.

The following table gives the number of office visits made and the number of students seen. A few figures of previous years are given for comparison:—

	1906.	1907.	1908.
Total number of office visits made	345	409	318
Total number of different students seen	195	196	184
Greatest number of students seen per day			11
Least number of students seen per day			2
Average number of students seen per day			5
Number of students making more than one visit			49

The work of the medical office remains fairly constant from year to year and under the present arrangement does not seem likely to increase. The large majority of men found it necessary to make only a single visit; only four men made more than five visits; and seven was the greatest number made by any one

man. These facts seem to indicate that the great majority of the men have no difficulty in keeping in good physical condition throughout the year, and, on the other hand, that the Institute is no place for invalids. Several of the weaker men have been advised to distribute their work at the Institute over five instead of four years. I still found it necessary to point out to the less vigorous men the necessity of taking at least a few weeks actual vacation, just after their year's work, and just before beginning the fall term.

A great variety of illnesses were treated, the most numerous being digestive disturbances, diseases of the nose and throat, and surgical diseases. The following table shows in a general way the kind of diseases treated and the number of each:

Ear	5	Skin	25
Eyes	6	Specific Infections	25
Heart	6	Stomach and Bowel	30
Kidney	6	Surgical	45
Lungs	11	Miscellaneous	30
Nose and Throat	35		

Eight or ten men suffered from severe illnesses, such as appendicitis, typhoid fever, heart or kidney disease, all of which were more or less completely cured. One man had to leave the Institute on account of pulmonary tuberculosis and a small number of students were referred to specialists for treatment of the eye, ear, or skin. A few men were sent to the Massachusetts General or Boston City Hospital for the treatment of acute diseases, such as grippe, typhoid fever, appendicitis, etc.

In addition to the work of the Institute Office I have seen about fifty men at my private office and have been called to attend a smaller number of men at their residences.

The practice of asking for a sick excuse from class work without sufficient reason, which is often seen in our colleges, is practically unheard of at the Institute. Even excuses from Military Drill are rarely asked for without good reason. The only difficulty met with is in getting the men to take sufficient respite from work after an acute illness.

The posting of the following notice by Major Wheeler at the

suggestion of the Medical Adviser has proved useful in many ways:

"A doctor's certificate is required to explain absence from Military Drill on account of illness. If this is to be obtained from the Medical Adviser, men must report to him on the first office hour following their illness. (Monday or Thursday, 4–5 P.M., 27 Pierce Building.)"

This requirement, while increasing the work of the medical office but little, has largely prevented absence from drill without cause, and has brought some men promptly to see me who needed medical advice.

The number of cases of contagious diseases at the Institute, such as measles, mumps, scarlet fever, diphtheria, etc., is always very small. This is no doubt largely due to the scattered residence of the men. This year a few more contagious cases than usual appeared. This was due to the infection of one or two men in two of the fraternity houses, who in turn spread the infection to several of their mates in spite of every effort at isolation and disinfection. It is fortunate that such occurrences are so rare and limited at the Institute.

In addition to sick students ten healthy men were examined for the United States Civil Service. The Medical Adviser has occasional opportunity to help men to decide whether or not they are physically fit for certain sports, and to correct some physical ills which result from too rapid or insufficient training for athletic work.

Three talks on personal hygiene were given by the Medical Adviser to the Freshman class covering the following subjects: bathing; exercise; care of the eyes; the use of tobacco and alcohol; minor ailments, the emergency treatment of injuries; and also the prevalence and dangers of venereal disease. Some excellent pamphlets on sexual hygiene have been put in the hands of the Medical Adviser, but, it has seemed wiser to present the subject to the students in a personal talk, rather than by the distribution of pamphlets.

FRANKLIN W. WHITE,
Medical Adviser.

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FRANKLIN W. WHITE,
Medical Adviser.

REPORT OF THE LIBRARIAN.

The record of accessions for the year ending September 30, 1908, shows a total addition to the Library of 4,563 items, a decrease of 327 over the previous year, and an increase of 572 over the year before. Of those added this year 1,338 were obtained by purchase, 1,654 by the binding of periodicals and books received in parts, and 1,571 are gifts, of which 740 are pamphlets.

The cost of the purchase of books and periodicals and the administration of the Libraries, exclusive of salaries, as shown by bills approved by the Librarian,* amounts to $8,015.87, an increase of $955.93 over last year.

The items of expenditure may be classified as follows:

BILLS APPROVED, 1907–1908.

Books and Binding	$5,846.65
Periodicals	1,933.94
Supplies	235.28
Total	$8,015.87

The net accessions to the Library, calculated by deducting from the gross accessions the number of books and pamphlets lost or destroyed or counted twice amounts to 4,421 items, including 3,641 volumes, 689 pamphlets, and 91 maps. The total is an increase over last year of 955 items.

The following table shows the way in which these accessions have been distributed among the several Libraries, together with their cost and the total contents of the Libraries.

* On page 45 of the Report for 1906–07, the total amount of bills approved should read $7,059.94 instead of $6,059.94.

TABLE OF THE NET INCREASE WITH THE COST OF THE SAME DURING THE YEAR 1907–08, AND THE TOTAL CONTENTS OF THE LIBRARIES OF THE INSTITUTE, SEPTEMBER 30, 1908.

LIBRARIES.	NET INCREASE.				TOTAL CONTENTS.	
	Volumes.	Pamphlets.	Maps.	Cost.	Volumes.	Pamphlets and Maps.
General Library:						
General	155	—	—	$73.24	7,394	5,069
English	22	—	—	42.25	3,498	44
Military Science	—	—	—	2.00	367	9
Walker Memorial	—	—	—	—	485	—
Other Departments	1	—	—	24.00	48	1
Totals General Library	178	—	—	$141.49	11,792	5,123
Architecture	115	10	—	609.17	4,155	261
Biology	134	49	—	201.75	3,537	769
Chemistry	609	160	—	1,137.40	11,295	2,195
Electrical Engineering	141	6	—	227.83	1,458	78
Engineering	766	147	—	1,237.75	14,376	5,023
Geology	488	44	88	338.54	3,708	2,943
History and Economics	367	163	—	452.01	12,658	3,751
Margaret Cheney Room	—	—	—	14.50	676	13
Mathematics	168	1[1]	—	280.85	1,911	261
Mining	264	11	3	361.22	4,764	737
Modern Languages	44	—	—	27.53	1,763	56
Naval Architecture	114	25	—	270.55[2]	1,352	144
Physics	253	75	—	546.06	8,357	1,240
Totals	3,641	691	91	$5,846.65	81,802	22,594

Owing to the large number and varied character of the periodicals and other serials received, it is difficult to keep records correctly and up to date. A careful revision, however, has been made again during this year, and omitting agricultural experiment station reports, financial reports of railroads, and college catalogues, it is found that we are receiving 1,117 periodicals and other serials. Of these 622 are paid for in cash, 203 received in exchange for the *Technology Quarterly*, and 292 are gifts.

[1] Excess of pamphlets bound over those received during the year. A pamphlet when bound is deducted from the number of pamphlets and added to the volumes.

[2] Including gifts from Dr. Charles G. Weld.

The distribution of these serials among the several Libraries, and the cost, with the account to which it is charged, are exhibited in the following table:

TABLE OF PERIODICALS AND OTHER SERIAL PUBLICATIONS RECEIVED DURING THE YEAR 1907–08, CLASSIFIED BY DEPARTMENTS AND METHOD OF PAYMENT.

LIBRARIES.	Number Received.					Estimated Cost.			
	Gifts.	Charged to Department.	Periodica Account.		Totals.	Department Account.	Periodical Account.		Totals.
			Subs.	Exch.			Subs.	Exch.	
General	52	15	33	27	127	$39.91	$122.82	$50.00	$212.73
Architecture	7	5	31	3	46	24.71	146.75	2.00	173.46
Biology	14	16	34	12	76	60.38	260.76	12.00	333.14
Chemistry	24	48	33	17	122	208.17	227.19	27.00	462.36
Electrical Engineering	10	12	14	4	40	35.85	65.36	10.00	111.21
Engineering	51	74	53	60	238	205.98	225.28	115.00	546.26
Geology	20	8	11	15	54	34.83	78.04	18.00	130.87
History and Economics.	72	55	38	4	169	120.14	109.74	8.00	237.88
Margaret Cheney Room,	—	6	—	—	6	17.35	—	—	17.35
Mathematics	2	3	16	2	23	6.05	73.53	3.00	82.58
Mining	12	13	25	34	84	46.47	106.36	67.00	219.83
Modern Languages	3	—	18	1	22*	—	79.60	2.00	81.60
Naval Architecture	5	12	6	4	27	56.75	20.23	8.00	84.98
Physics	20	20	23	20	83	92.98	104.76	28.00	225.74
Totals	292	287	335	203	1,117	$949.57	$1,620.42	$350.00	$2,919.99

While the foregoing tables exhibit the main facts in regard to the conditions of the Libraries, the work done in the office of the Librarian includes much more than is represented by these tables. The following statistics will give some idea of a part of this.

As the subject catalogue becomes more extended the routine work of cataloguing new books is made increasingly laborious and difficult, and the total number of cards written for each book varies from two to six and sometimes more, and then these are duplicated for one of the departmental libraries.

The total number of cards added to the general catalogue during the year is 5,932, an increase of 463 over the previous year, bringing the total number of cards in the catalogue up to 92,201.

* 10 kept in the General Library.

The number of orders issued for the purchase of books during the year was 1,208, a decrease of 60 over the previous year, and 1,530 orders were issued to the binders, 594 less than the previous record.

The number of books and periodicals borrowed for home use, so far as records have been kept, are as follows:

CIRCULATION.

General Library	1,456 volumes
Architectural Library	1,681 "
Biological Library	239 "
Chemical Library	2,071 "
Engineering Library	1,488 "
Mining Library	762 "
Naval Architectural Library	600 "
Physical Library	2,429 "

This table shows an interesting increase in the use of the Libraries. In the General Library the number has increased nearly 50 per cent. and there is a like increase in the Physical Library; while the increase in the Engineering Library is over 87 per cent.

It is noticeable that in four of the professional libraries, in this table, the circulation exceeds considerably that of the General Library. In the Architectural Library, there were borrowed also 2,053 pamphlets.

This table shows, not only something of the use of the Libraries by students and others, but it also shows a considerable increase of the work of the assistants in charge, who act as library attendants usually in addition to other duties.

The custom of keeping the General Library open until 10 o'clock in the evening seems to be now firmly established, although the attendance is still small. From October 3 to June 5, the Library was open in the evening 214 days. During this time the total attendance was, between five and seven o'clock, 1,501, between seven and ten o'clock, 824; making an average, between the hours of five and seven, of 7.0, and between seven and ten, of 3.8.

With a Library of upwards of 80,000 volumes, and a catalogue

containing over 90,000 entries, the Libraries of the Institute have reached a condition when the old simple method of making only a catalogue of authors no longer serves the purpose of finding books upon the shelves.

This condition has been realized for some time, and with the present efficiency of the personnel of the library staff, it has been possible, when new departmental libraries were established, to begin the catalogue in the right way by making it a complete catalogue with each book entered under at least three headings, namely, the author, the title, and the subject. This has been done for the newly established libraries in the Departments of Electrical Engineering and Naval Architecture.

As previously reported a complete subject catalogue for the Chemical Library was finished last year.

One of the most important of the departmental libraries is the Engineering Library, in which are combined the books for the Departments of Civil, Mechanical, and Sanitary Engineering. In this library of upwards of 14,000 volumes, with an annual increase of from 600 to 700, not including pamphlets, only a small beginning had been made in the formation of a subject catalogue, and it was found impossible to remedy this defect without additional help. The corporation has made, however, an appropriation to meet this, and at the end of the year under review, arrangements were made for the completion of the subject catalogue of the Engineering Library. Work is now going on and it is hoped at the next report to show substantial progress.

Soon after the office of Librarian was established, the custom was adopted by the Librarian of reading from time to time, as work permitted, the weekly lists of books published in the four principal publishing countries in the world, the United States, England, Germany, and France. Items which seemed of possible interest were checked, and an assistant copied these items upon order forms which were marked "Suggested for Purchase," and sent to the Heads of Departments. This custom has been continued to the present time.

As such matters of routine may be continued by a sort of official inertia, it is desirable to inquire into their usefulness from time to time. Therefore, just previously to writing this report, the Librarian addressed a letter to Heads of Departments inquiring into the desirability of continuing this practice, under four heads,—(1) As to whether books were brought to their attention which they would not have heard of otherwise; (2) As to whether titles suggested included subjects in which they were not interested; (3) Whether any subjects of interest were usually omitted; (4) Whether the Head of the Department would consider the discontinuance of these "Suggestions" any deprivation.

Of the fifteen persons addressed, replies were received from thirteen. Of these, eleven wished to have the "Suggestions" continued, nine without change from the usual custom; one desired only a limited class of books suggested, and one wished to have more subjects included in the "Suggestions" sent to him,—showing that, on the whole, the system of "Suggestions for Purchase" has been useful and should be continued.

The gifts to the Library during the year covered by this report have been many and varied.

Dr. Charles G. Weld has continued his generous gifts of books to the Department of Naval Architecture, the total number of volumes received from him during the year amounting to sixty-eight, including fifty-two volumes of the "Proceedings of the United States Naval Institute." From B. J. Tideman has been received a copy of his valuable "Memoriaal van de Marine, 1876–1880"; from Mr. Harry C. Bradley a set of eleven volumes of the "Journal of the Association of Engineering Societies"; and from Madame Veuve F. Roussin, a life of her husband, entitled "Le Chimiste Z. Roussin." Twenty-six volumes from the Library of the late Arthur H. Birks of the class of 1901 have been given to the Library by his family, and fifty-one volumes on engineering subjects have been received from Mrs. Charles K. Stearns from the library of her husband. Miss Myra W. Rafter has presented us with a complete set, eleven

volumes and twenty-six pamphlets, of the works of her father, the late George W. Rafter, distinguished as an hydraulic and sanitary engineer. From the Imperial Earthquake Investigation Committee of Japan, we have received a complete set of their publications in foreign languages; from the Royal Society of London the "Meteorological and Physical Results of the National Antarctic Expedition, 1901–1904"; from Mrs. Stone, a valuable set of "Engineering," containing fifty-eight volumes, and eighty volumes of other books on engineering subjects from the library of her husband, Mr. Joseph Stone of the class of 1868; and from Mr. Charles K. Needham of New Albany, Indiana, we have received, through his nephew, Albert F. Bemis, '93, a copy of a book by Manger on "Fire Proof Stairs," together with a translation in manuscript carefully prepared so that the two can be bound in one volume, which has been done at the expense of the donor.

Professor John O. Sumner has presented us with two volumes; Mr. Tove, with four Russian books on "Gold Mining"; George C. Whipple, '89, with a copy of his book on "Typhoid Fever"; Sylvester Baxter, Esq., Secretary of the Metropolitan Improvements Commission, a translation of Theodor Fischer's "City Building"; Charles Bradley, Esq., a handsome bound volume of the "Miscellaneous Writings" of Joseph P. Bradley, late Associate Justice of the United States Supreme Court.

Professors Charles B. Breed and George L. Hosmer have presented the Library with the second volume of their "Principles and Practices of Surveying." Senator W. Murray Crane and the Honorable Andrew J. Peters, M.C., have responded to our requests for public documents with unfailing courtesy. In addition to these, other gifts have been received from Professor Swain, Mrs. Richards, and other friends of the Institute. Mrs. William Barton Rogers has continued her generous contributions, providing, not only for a considerable part of the periodicals bought for the Library, but also giving valuable books, including four volumes on architectural subjects.

During the year a complete reorganization was made of the

Library staff, partly as the result of the resignation of Miss Helen C. McGowan, who had served at First Assistant with marked success for nearly ten years, and who left the Institute to accept the post of Assistant Librarian of Public Documents in the Office of the Superintendent of Documents at Washington.

The division of our Library among many departments, with varying demands, complicates the administration of the Librarian's office and makes experience on the part of the First Assistant a factor of more than usual importance. We were fortunate, however, in securing for this position Miss Bertha P. Trull, A.B. (Smith), who, in addition to a broad college education, had received special training in the Woburn Public Library.

ROBERT P. BIGELOW,
Librarian.

REPORT OF THE REGISTRAR.

This report is based on statistics gathered, as is customary, from the registration on November 1st.

The registration is much larger than the previous year, the number of students having risen from 1,410 to 1,426. The principal gain is in the first-year class, although there has been a marked increase in the number of students coming to the Institute from other colleges. The fourth-year class is also larger than last year, as is the number of resident fellows and advanced students. The percentage of regular students has risen from 64 to 65 in the past year.

The total number of members of the instructing staff as shown by the Catalogue this year, including those in the Department of Mechanic Arts, but excluding the Research Associates and Assistants and those who are announced annually as lecturers only, is 207. Counting all, there are 245. Not taking into account the Research Associates, Assistants and Lecturers, the ratio of members of the instructing staff to students in regular attendance is 1 to 7.1; while last year it was 1 to 6.7.

The first-year class is larger than for the last two years and the relative number of special students is smaller. In view of the fact that a large number of the special students admitted to the first-year class during the past few years were those who had failed to fulfil the additional entrance requirement in language, this decrease in the number of specials would seem to show that the preparatory schools are now better able to meet this requirement. In 1903 when this took effect the percentage of special students jumped to 37 per cent. from 11 per cent. the year previous. This has gradually dropped until now it has fallen to 19 per cent.

While the number of students in the engineering courses this past year has decreased 3 per cent., the number in all the other courses has risen 8 per cent. as compared with last year. The number of regular students in the engineering courses has gradually risen during the last ten years from 73 per cent. of the total number of regular students above the first-year, to 89 per cent. While the greatest gain in any one course is that in Sanitary Engineering, there has been almost as large a one in Chemical Engineering. An increase over the past year has also been noted in the number of students in Architecture, Chemistry, Electrical Engineering, Biology, General Science, and Naval Architecture.

The number of new students this year is 594, a larger number than ever before, except when the class of 1906 entered. The number of new students, other than regular first-year students, has also been larger only once before. The percentages of new students for this year and last year are 41 per cent. and 39 per cent. respectively.

The number of students at the Institute this year who are graduates of this or of other colleges has risen from 188 to 215, and they have come to the Institute from 91 colleges or universities, while last year only 85 were represented. Harvard has 16 representatives, the largest number from any one college. All the classes except the second-year class have more of these college students than last year, and the number entering the

fourth year has increased from 4 to 16. The number who have come after a college course of four years is likewise larger.

Besides the graduates there have come to the Institute from other colleges many new students who have not completed their college course. The total number of new students from other colleges is 170, forming 29 per cent. of all the new students. Although there were 15 less in this group last year, the ratio to the new students was one per cent. more.

The number of students who have registered in regular five-year courses has risen from 24 to 46. In view of the special attention that the Faculty has given during the last year to preparing regular five-year course schemes in several of the larger departments, there is likely to be an increase in the number of students who elect to spread the work of a professional course over five years. These five-year students are found more often in engineering than in the non-engineering courses.

The women students last year numbered but thirteen, while this year there are nineteen. Of these five are college graduates instead of one as noted last year. One woman is a candidate for an advanced degree.

The number admitted to the first-year class without conditions in 1900 was as high as 77 per cent., but now it has fallen to 48 per cent., which is the lowest for several years. The per cent. of first-year regular students admitted last year without conditions was 58. There has, however, been much less difference in the proportion of those admitted clear and with one condition.

While 20 per cent. of those admitted to the Institute on examination last year failed to enter, this was true of only 12.5 per cent. this year. An entrance examination fee took effect this last year except for those candidates who already held preliminary certificates. In view of the fact that a large number of those taking the entrance examinations did not have to pay the fee this last summer it is doubtful whether the number of those who entered the school was affected by this newly required fee.

There is this year a noticeable rise in the average age of the first-year students. During the past ten years this age has never exceeded 18 years, 11 months, but this year it has risen to 19 years, 1 month. A large number of first-year students this year are of what might be called unusual age for entrance. These, however, as has formerly been the custom, have been excluded from the computation. It is also interesting to note that an unusually large number of students from other colleges have entered the first-year class.

The graduating class this year contained a larger number (74 instead of 60) as well as a larger per cent. of men from other colleges than that of last year. Of the graduates from other colleges the largest group (classified on the basis of the number of years spent at the Institute) consisted of those who spent two years; but of the non-graduates, the largest group was of those who spent four years at the Institute. The average age of this graduating class was again 23 years. Of this class 63 per cent. as against 61 per cent. last year, received their degrees after studying at the Institute four years; and 32 per cent. of the class was made up of students who had studied at other colleges as compared with 28 of the previous year.

Forty-four states and two territories, the District of Columbia, the Philippine Islands, Porto Rico and the Canal Zone are represented in the list of students. Although Delaware and South Carolina have this year no representative on the list, North Carolina, Louisiana and Idaho are represented, while last year they sent no students to the Institute. There has been a decrease in the number of students from the North Central group of states but all the other groups show an increase. From California the number has risen from 14 to 20.

The number of Massachusetts students this year has risen from 731 to 839, making the percentage of students 57.2 which is a gain of 1.7 per cent. over the last two years. Although not the largest number of students that have attended the Institute from Massachusetts nor the largest per cent., it is the largest for four years. Again this year the number of Massachusetts

cities and towns sending students is 128. The ratio of Massachusetts students, generally, is larger in the non-engineering than in the engineering courses.

The foreign countries that this year have representation which last year were not represented are British Columbia, Cape Breton, Central America, Honduras, Jamaica, and Quebec. The number of foreign students has, however, fallen from 80 to 72. Thirty countries are represented by these 72 students, and the greatest number from any one foreign country are the ten students from China. Ten years ago, there were but 27 students representing only thirteen foreign countries.

The registration in the summer school was somewhat less than in 1907, dropping from 283 to 269. The loss was in the number of students taking courses to anticipate work, as the number of those who remained in the summer to make up failures or deficiencies was practically the same in these two years. Work was anticipated principally in applied mechanics, mechanic arts, descriptive geometry, the languages, the new course in mathematics, mechanical drawing, surveying, generally by those purposing to enter the Institute from other colleges.

The total number of undergraduate students assisted from Institute funds was 154, and the amount awarded was $19,100. In addition to this 73 students were aided by the State, of whom fifty were not aided by the Institute, making a total of 204 students receiving scholarship assistance.

The statistics from which these conclusions are drawn are printed on the following pages.

THE CORPS OF INSTRUCTORS.

	1906-07.	1907-08.	1908-09.
Professors	39	43	44
Associate Professors	18	18	18
Assistant Professors	21	25	33
	78	86	95
Instructors	69	72	62
Assistants	52	52	50
	121	124	112
Research Associates	8	8	6
Research Assistants	3	3	1
	11	11	7
Lecturers	31	32	31
Total	241	253	245

STUDENTS BY CLASSES.

Class.	Regular.		Special.		Total.	
	1907.	1908.	1907.	1908.	1907.	1908.
Resident Fellows (3) and Candidates for advanced degrees	20	26	—	—	20	26
Fourth Year	208	199	118	146	326	345
Third Year	187	210	179	155	366	365
Second Year	211	190	160	151	371	341
First Year	276	323	51	61	327	384
Total	902	948	508	513*	1,410	1,461

YEARLY REGISTRATION SINCE THE FOUNDATION OF THE INSTITUTE.

Year.	No. of Students.	Year.	No. of Students.	Year.	No. of Students.
1865-66	72	1880-81	253	1895-96	1,187
1866-67	137	1881-82	302	1896-97	1,198
1867-68	167	1882-83	368	1897-98	1,198
1868-69	172	1883-84	443	1898-99	1,171
1869-70	206	1884-85	579	1899-00	1,178
1870-71	224	1885-86	609	1900-01	1,277
1871-72	261	1886-87	637	1901-02	1,415
1872-73	348	1887-88	720	1902-03	1,608
1873-74	276	1888-89	827	1903-04	1,523
1874-75	248	1889-90	909	1904-05	1,561
1875-76	255	1890-91	937	1905-06	1,466
1876-77	215	1891-92	1,011	1906-07	1,397
1877-78	194	1892-93	1,060	1907-08	1,415
1878-79	188	1893-94	1,157	1908-09	1,462
1879-80	203	1894-95	1,183		

* Including 3 possible candidates for an advanced degree.

GRADUATES BY YEARS AND COURSES.

Year.	Civil Engineering.	Mechanical Engineering.	Mining Engineering.	Architecture.	Chemistry.	Metallurgy.	Electrical Engineering.	Natural History or Biology.	Physics.	General Course.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	Total.
1868	6	1	6	–	–	–	–	–	–	1	–	–	–	–	14
1869	2	2	–	–	1	–	–	–	–	–	–	–	–	–	5
1870	4	2	2	–	1	–	–	–	–	1	–	–	–	–	10
1871	8	2	5	–	2	–	–	–	–	–	–	–	–	–	17
1872	3	1	5	–	3	–	–	–	–	–	–	–	–	–	12
1873	12	2	3	1	7	–	–	–	–	1	–	–	–	–	26
1874	10	4	1	1	–	–	–	–	–	2	–	–	–	–	18
1875	10	7	6	1	1	–	–	–	1	2	–	–	–	–	28
1876	12	8	7	–	5	1	–	2	3	4	–	–	–	–	42
1877	12	6	8	4	2	–	–	–	–	–	–	–	–	–	32
1878	8	2	2	3	3	–	–	–	–	1	–	–	–	–	19
1879	6	8	3	1	3	–	–	1	1	–	–	–	–	–	23
1880	3	–	3	–	1	–	–	–	–	1	–	–	–	–	8
1881	3	5	6	3	8	–	–	1	–	2	–	–	–	–	28
1882	2	5	5	3	6	–	–	1	1	1	–	–	–	–	24
1883	3	7	5	1	3	–	–	–	–	–	–	–	–	–	19
1884	5	6	13	–	12	–	–	–	–	–	–	–	–	–	36
1885	4	7	8	2	4	–	2	–	–	1	–	–	–	–	28
1886	9	23	7	1	7	–	10	1	–	1	–	–	–	–	59
1887	10	17	8	1	9	–	8	1	1	3	–	–	–	–	58
1888	11	25	4	5	10	–	17	3	1	1	–	–	–	–	77
1889	14	24	5	3	8	–	17	1	1	2	–	–	–	–	75
1890	25	28	3	5	13	–	18	3	2	6	–	–	–	–	103
1891	18	26	4	6	11	–	23	3	3	1	7	–	1	–	103
1892	22	26	4	13	7	–	36	6	1	7	4	6	1	–	133
1893	25	30	5	2	8	–	41	2	–	6	8	–	2	–	129
1894	21	31	4	14	11	–	33	1	3	5	12	3	–	–	138
1895	25	30	3	15	14	–	33	–	2	4	11	4	–	5	144*
1896	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
1904	34	45	32	24	15	–	34	3	13	5	7	2	1	17	232
1905	46	54	26	12	23	–	31	3	3	3	13	5	1	24	244
1906	47	69	38	22	21	–	37	2	7	–	10	6	–	19	278
1907	37	52	22	21	10	–	32	–	5	–	14	3	2	10	208
1908	48	61	19	19	16	–	38	4	2	–	15	2	–	5	229
Totals	737	924	385	349	392	1	678	58	73	96*	183	62	14	160	4,107*
Names counted twice, students graduating in two different years . . .															20
Bachelors of Science															4,087*
Masters of Science, not included in the above															38
Doctors of Philosophy, not included in the above															3
Total . . .															4,128*

* Deducting names counted twice (students graduating in two courses).

STATISTICS OF ADMISSION.

	Regular.	*Special.*	*Total.*
Admitted clear	138	0	138
" with one condition	76	11	87
" with two conditions	50	6	56
" with three conditions	22	10	32
" with four conditions	2	1	3
" on examination	288	28	316
Total First-year Class	323	61	384

Admitted but did not enter 41

Candidates at June Entrance Examinations 657

Candidates rejected in June:

Complete candidates	24
Final "	21
Preliminary "	54
Partial "	28
	127

Candidates in September for Entrance and Advanced Standing Examinations 321

Candidates rejected in September:

Complete candidates	21
Final "	13
Preliminary "	15

Certificates of the College Entrance Examination Board submitted 92

TOTAL REGISTRATION AND NUMBER OF NEW STUDENTS.

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.
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
1904–1905	1,561	986	575	295	280
1905–1906	1,466	984	482	213	269
1906–1907	1,397	862	535	272	263
1907–1908	1,415	888	527	273	254
1908–1909	1,462	868	594	323	271

NEW STUDENTS FROM OTHER COLLEGES.

Class, by Year, Joined at Institute.	Years Spent at College.						Total.
	One.	Two.	Three.	Four.	Five.	Six.	
First	20	4	1	3	—	—	28
Second	12	17	—	19	—	—	48
Third	—	10	6	59	3	—	78
Fourth	—	—	2	11	2	1	16
Total	32	31	9	92	5	1	170

GRADUATE STUDENTS.

Colleges and Universities Represented.

Acadia	1	Maryland Agricultural	1
Adrian	1	Massachusetts College of Pharmacy	1
Albright	1	Massachusetts Institute of Technology	22
Allegheny	1	Michigan College of Mines	1
Amherst	6	Middlebury	2
Anatolia	1	Mississippi Agricultural	1
Austin	2	Montevideo	1
Bates	1	Mount Holyoke	1
Beloit	2	Nebraska	1
Boston College	1	North Carolina	1
Boston University	2	Northwestern	1
Bowdoin	3	Notre Dame	1
Brown	3	Ohio Northern	1
California	2	Ohio Wesleyan	1
Canisius	1	Oklahoma	1
Carleton	1	Oregon Agricultural	1
Central College	1	Pennsylvania College	2
Central University	1	Pennsylvania University	1
Chicago	3	Pomona	1
Coe	1	Princeton	9
Colorado College	2	Richmond	1
Colorado University	1	Rhode Island Agricultural	2
Cornell	3	Rochester	7
Dakota Wesleyan	1	Rutgers	1
Dalhousie	1	Saint Johns	1
Dartmouth	5	Santa Clara	1
DePauw	1	Southwestern Presbyterian	1
Earlham	1	Texas Agricultural	1
Emory	1	Texas University	4
Fairmount	1	Trinity, Cambridge University	1
Georgetown	1	United States Military Academy	1
Georgia School of Technology	1	United States Naval Academy	13
Harvard	16	Vanderbilt	1
Haverford	2	Virginia	2
Holy Cross	3	Virginia Military	2
Illinois	2	Washington and Jefferson	3
Indiana	2	Washington and Lee	2
Iowa	3	Wellesley	1
Iowa State	1	Wesleyan	4
Japanese Naval Engineering	1	Whitman	2
Johns Hopkins	3	Williams	6
Kingston School of Mines	1	Wooster	1
Leland Stanford Junior	1	Worcester Polytechnic	1
Louisiana	1	Yale	12
McGill	1		218
Manitoba	1	Counted twice	3
Marietta	3	Total	215
Marquette	1		

Graduates who are candidates for Advanced Degrees 26
Graduates who are pursuing undergraduate work 189
Colleges and Universities represented 92

COURSES OF INSTRUCTION.

REGULAR AND SPECIAL STUDENTS BY COURSES FOR THE CURRENT YEAR.

YEAR.		Civil Engineering.	Mechanical Engineering.	Mining Engineering and Metallurgy.	Architecture.	Chemistry.	Electrical Engineering.	Biology.	Physics.	General Science.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	Total.
4th	Reg.	43	37	18	14	7	40	2	4	1	13	8	—	12	199
	Sp.	26	22	17	17	14	21	6	4	1	9	5	2	2	146
3d	Reg.	43	43	17	7	8	47	2	5	1	18	9	—	10	210
	Sp.	22	23	20	24	10	30	5	—	—	6	8	—	7	155
2d	Reg.	34	43	15	5	5	44	2	2	1	20	12	—	7	190
	Sp.	27	28	15	18	14	24	3	4	—	5	10	—	3	151
Tot.	Reg.	120	123	50	26	20	131	6	11	3	51	29	—	29	599
	Sp.	75	73	52	59	38	75	14	8	1	20	23	2	12	452
Total		195	196	102	85	58	206	20	19	4	71	52	2	41	1,051

THE SAME CLASSIFICATION FOR THREE YEARS.

YEAR.	Civil Engineering.	Mechanical Engineering.	Mining Engineering.	Architecture.	Chemistry.	Electrical Engineering.	Biology.	Physics.	General Science.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	Naval Construction.
1906–07 .	210	214	100	94	49	192	10	18	0	55	32	2	43	17
1907–08 .	210	226	118	82	53	200	17	20	2	59	39	0	37	16
1908–09 .	195	196	102	85	58	206	20	19	4	71	52	2	41	13

NUMBER OF STUDENTS PURSUING CERTAIN LEADING BRANCHES OF STUDY.

	First Year.	Second Year.	Third Year.	Fourth Year.	Total.
Mathematics	409	318	156	6	889
Physics	—	311	332	79	722
Chemistry	378	104	123	97	702
English	353	297	33	—	683
Mechanic Arts	—	138	67	84	289
French	190	22	24	—	236
Geology	—	69	121	31	222
German	124	40	41	—	205

REGULAR FIVE-YEAR STUDENTS.

YEAR.	Total.	Civil Engineering.	Mechanical Engineering.	Mining Engineering.	Architecture.	Chemistry.	Electrical Engineering.	Biology.	Physics.	General Science.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.
1st . . .	4	—	—	—	—	—	—	—	—	—	—	—	—	—
2d	1	1	—	—	—	—	—	—	—	—	—	—	—	—
3d	8	—	2	—	—	—	1	—	1	—	1	2	—	1
4th . . .	10	2	5	—	—	—	2	—	—	—	1	—	—	—
5th . . .	23	5	4	4	1	1	6	—	1	—	—	1	—	—
	46	8	11	4	1	1	9	0	2	0	2	3	0	1

WOMEN STUDENTS.

COURSE.	Architecture.		Chemistry.		Biology.		Total.
Year of the Course.	Regular.	Special.	Regular.	Special.	Regular.	Special.	
Graduate	1	—	—	—	—	—	1
Fourth	3	2	1	1	—	—	7
Third	—	1	1	—	—	3	5
Second	—	1	—	1	—	1	3
Special, without course classifications . . .	—	—	—	—	—	—	3
Totals	4	4	2	2	—	4	19

STATISTICS OF GRADUATION, CLASS OF 1908.

Number receiving degree at end of one year	4
" " " " " " two years	32
" " " " " " three "	20
" " " " " " four "	144
" " " " " " five "	26
" " " " " " six "	4
Total number of degrees of S.B. awarded	230*
Number entering from other colleges	74
" graduates	42
" non-graduates	32

*Including one as of the Class of 1907 and one recommended since June.

FURTHER STATISTICS OF THE STUDENTS FROM OTHER COLLEGES OF THE GRADUATING CLASS, JUNE, 1908.

Yrs. at the Inst.	*Graduate.*	*Non-graduate.*	*Total.*
1	2	2	4
2	26	5	31
3	10	10	20
4	2	14	16
5	2	1	3
	42	32	74

AGES OF THE MEMBERS OF THE GRADUATING CLASS, JUNE, 1908.

Under 20½	4
Between 20½ and 21	6
" 21 " 21½	16
" 21½ " 22	40
" 22 " 23	53
" 23 " 24	51
" 24 " 25	20
" 25 " 26	16
26 and over	24
Total	230*

The average age was 23 years.

AGES OF THE REGULAR FIRST-YEAR STUDENTS.

PERIOD OF LIFE.	1907–1908.		1908–1909.	
	Half-year Groups.	Yearly Groups.	Half-year Groups.	Yearly Groups.
16 to 16½ years	1	—	—	—
16½ to 17 "	4	5	3	3
17 to 17½ "	14	—	11	—
17½ to 18 "	34	48	20	31
18 to 18½ "	45	—	50	—
18½ to 19 "	54	99	64	114
19 to 19½ "	41	—	69	—
19½ to 20 "	30	71	31	100
20 to 20½ "	14	—	30	—
20½ to 21 "	9	23	11	41
21 to 22 "	16	16	11	11
	262	262	300	300

Repeating the first year 4
Students of unusual age 19
Average age, omitting these 23 . . . . . 19 years, 1 month

*Including one as of the Class of 1907 and one recommended since June.

SUMMER SCHOOL.

	1907.	1908.
Number from other colleges and schools attending	58	52
Number not referring to any other college or school	1	3
Number from Massachusetts Institute of Technology	224	214
	283	269
Number who registered, but did not attend	10	7
Number who applied, but cancelled registration	3	6
Registrations for failures or deficiencies	186	184
Registrations to anticipate work	347	312

NUMBER OF STUDENTS REGISTERED IN EACH OF THE COURSES OF THE SUMMER SCHOOL FOR THIS YEAR AND THE YEAR BEFORE.

	1907.	1908.
Analytic Geometry	29	0
Applied Mechanics	19	48
Carpentry and Wood Turning	12	7
Chemistry, Inorganic and Analytical	47	46
Chipping and Filing	8	4
Descriptive Geometry	37	34
Design	18	14
Forging	16	9
French	14	4
German	16	5
Integral Calculus	6	22
Machine Tool Work	27	16
Mathematics	—	19
Mechanical Drawing	14	14
Mechanical Engineering Drawing	20	21
Mechanism	13	21
Metal Turning	1	5
Organic Chemical Laboratory	11	8
Pattern Work	14	8
Physical Laboratory	9	8
Physics	30	29
Precision of Measurements	4	9
Shades and Shadows	4	6
Surveying	35	17

RESIDENCE OF STUDENTS.

NUMBER OF STUDENTS IN EACH YEAR, FROM 1902, COMING FROM EACH STATE OR TERRITORY.

STATES AND TERRITORIES.	1902.	1903.	1904.	1905.	1906.	1907.	1908.
North Atlantic.							
Connecticut	43	44	48	50	36	29	31
Maine	35	34	26	22	18	23	22
Massachusetts	935	869	889	807	764	781	839
New Hampshire	34	23	36	32	26	27	24
New Jersey	8	13	16	11	15	17	14
New York	96	104	94	71	84	82	99
Pennsylvania	44	52	56	58	55	57	53
Rhode Island	40	28	19	24	23	28	28
Vermont	12	11	5	5	4	5	6
Total	1,247	1,178	1,189	1,080	1,025	1,049	1,116
South Atlantic.							
Delaware	4	3	2	1	2	1	–
Dist. of Columbia	17	15	17	13	12	10	10
Florida	2	2	4	3	3	3	6
Georgia	6	4	6	8	4	2	3
Maryland	27	25	18	19	17	18	17
North Carolina	6	7	1	–	1	–	1
South Carolina	4	–	–	1	3	2	–
Virginia	7	7	4	7	8	9	11
West Virginia	–	–	–	1	2	3	3
Total	73	63	52	53	52	48	51
South Central.							
Alabama	1	1	1	1	2	4	3
Arkansas	1	1	–	1	–	2	1
Kentucky	11	9	8	5	5	5	4
Louisiana	2	2	5	1	2	–	3
Mississippi	–	4	4	4	5	3	3
Tennessee	3	5	2	2	3	6	8
Texas	9	11	13	16	15	16	16
Total	27	33	33	30	32	36	38
North Central.							
Illinois	49	44	43	42	37	31	23
Indiana	14	6	10	10	15	12	9
Iowa	8	6	9	13	14	16	14
Kansas	1	1	4	7	6	5	4
Michigan	10	9	9	10	7	8	7
Minnesota	10	9	11	13	14	8	8
Missouri	20	22	25	29	17	14	6
Nebraska	5	4	5	4	2	3	2
North Dakota	1	1	1	–	3	4	3
Ohio	43	37	35	34	30	26	30
South Dakota	1	3	2	–	1	3	3
Wisconsin	11	13	14	12	7	12	12
Total	173	155	168	174	153	142	121
Western.							
California	15	19	18	23	21	14	20
Colorado	10	11	16	17	12	10	5
Idaho	–	–	–	–	–	–	1
Montana	3	2	5	3	3	3	2
Nevada	–	–	–	1	1	1	1
New Mexico	1	1	2	–	–	1	1
Oklahoma	–	–	–	–	–	1	1
Oregon	4	7	8	5	2	3	4
Utah	2	3	3	2	3	3	5
Washington	3	3	2	2	5	12	13
Wyoming	1	–	–	2	5	1	1
Total	39	46	54	55	52	49	54

District.	1902.	1903.	1904.	1905.	1906.	1907.	1908.
Canal Zone	–	–	–	–	–	–	1
Hawaii	–	1	1	1	2	2	1
Philippine Islands	–	–	4	2	3	1	1
Porto Rico	2	2	4	5	2	3	6
Total	2	3	9	8	7	6	9
Total for the United States	1,561	1,478	1,505	1,400	1,321	1,330	1,389

Number of Students in Each Year, from 1902, coming from Each Foreign Country.

Foreign Countries.	1902.	1903.	1904.	1905.	1906.	1907.	1908.
Argentine Republic	–	–	–	–	1	2	2
Armenia	–	1	1	3	2	2	2
Australia	2	3	1	3	3	3	–
Austria	–	–	–	–	–	–	–
Belgium	–	–	–	–	1	1	–
Bermuda	1	1	–	1	1	–	–
Brazil	5	3	3	1	–	2	3
British Columbia	–	–	–	–	1	–	1
Cape Breton	–	–	–	–	–	–	1
Cape Colony	–	–	–	–	1	1	1
Central America	–	–	1	–	–	–	1
Chile	1	1	1	2	1	1	1
China	1	2	8	8	7	9	10
Costa Rica	–	–	–	–	–	2	3
Cuba	2	3	4	4	4	4	2
Denmark	1	1	1	1	1	1	–
Ecuador	–	–	1	–	2	2	2
Egypt	–	–	–	1	2	2	2
England	3	4	4	5	6	4	3
France	–	–	1	1	–	–	–
Germany	1	2	–	–	–	–	–
Honduras	–	–	–	–	1	–	1
India	–	1	1	2	1	1	2
Ireland	1	1	–	2	2	3	1
Italy	–	–	–	2	–	2	1
Jamaica	–	–	1	–	1	–	1
Japan	1	2	1	3	5	3	4
Korea	–	–	2	–	–	–	–
Malta, Island of	–	1	1	–	–	–	–
Manitoba	1	1	–	–	–	–	–
Mexico	10	8	4	7	12	12	6
New Brunswick	2	1	2	4	3	2	1
Nova Scotia	8	9	4	1	4	3	4
Ontario	2	2	5	6	6	4	7
Panama	–	–	–	–	–	1	–
Paraguay	–	–	–	–	–	1	1
Peru	–	1	–	1	1	2	2
Poland	–	–	–	–	–	1	–
Quebec	–	1	2	1	1	–	1
Russia	–	–	–	–	–	2	2
Scotland	1	1	2	1	1	1	–
Sweden	–	–	1	–	–	–	–
Syria	–	1	1	–	–	–	–
Transvaal	–	–	1	3	3	3	2
Turkey	4	–	2	1	1	2	1
Uruguay	–	–	–	2	1	1	1
Total	47	50	56	66	76	80	72
Total in school	1,608	1,528	1,561	1,466	1,397	1,410	1,461

RESIDENCE OF STUDENTS FOR THIS SCHOOL YEAR.

States.	Candidates for Advanced Degrees.	Fourth Year.	Third Year.	Second Year.	First Year.	All Regular Students.	Special Students.	Total.
Alabama	–	1	1	–	–	2	1	3
Arkansas	–	–	–	–	1	1	–	1
California	–	1	3	2	7	13	7	20
Canal Zone	–	–	–	1	–	1	–	1
Colorado	–	2	–	–	1	3	2	5
Connecticut	–	3	6	3	10	22	9	31
Dist. of Columbia	–	1	2	2	1	6	4	10
Florida	–	1	–	1	2	4	2	6
Georgia	–	1	–	–	–	1	2	3
Hawaii	–	1	–	–	–	1	–	1
Idaho	–	–	–	–	–	–	1	1
Illinois	1	2	3	2	3	11	12	23
Indiana	–	3	–	1	3	7	2	9
Iowa	–	5	1	–	–	6	8	14
Kansas	–	–	–	1	1	2	2	4
Kentucky	–	1	–	1	1	3	1	4
Louisiana	–	–	1	–	–	1	2	3
Maine	–	5	3	6	2	16	6	22
Maryland	–	5	2	2	2	11	6	17
Massachusetts	15	103	126	124	215	583	256	839
Michigan	–	–	2	1	4	7	–	7
Minnesota	–	1	2	–	–	3	5	8
Mississippi	1	1	–	–	–	2	1	3
Missouri	–	3	–	1	–	4	2	6
Montana	–	–	–	1	–	1	1	2
Nebraska	–	–	–	–	1	1	1	2
Nevada	–	1	–	–	–	1	–	1
New Hampshire	–	3	6	2	6	17	7	24
New Jersey	1	1	–	3	7	12	2	14
New Mexico	–	–	–	–	–	–	1	1
New York	2	11	14	12	19	58	41	99
North Carolina	–	1	–	–	–	1	–	1
North Dakota	–	–	1	1	1	3	–	3
Ohio	–	4	4	3	3	14	16	30
Oklahoma	–	1	–	–	–	1	–	1
Oregon	–	–	1	1	–	2	2	4
Pennsylvania	–	11	13	1	2	32	21	53
Philippine Islands,	–	–	–	–	–	–	1	1
Porto Rico	–	–	–	–	3	3	3	6
Rhode Island	1	5	2	3	5	16	12	28
South Dakota	–	–	1	–	–	1	2	3
Tennessee	–	1	1	1	1	4	4	8
Texas	2	5	1	2	1	11	5	16
Utah	–	1	–	1	1	3	2	5
Vermont	–	–	2	2	2	6	–	6
Virginia	–	–	2	3	1	–	6	5	11
Washington	–	–	1	2	–	–	3	10	13
West Virginia	–	–	1	–	1	–	1	2	3
Wisconsin	–	–	1	3	3	1	8	4	12
Wyoming	–	–	–	–	–	–	–	1	1
Total	23	189	206	186	311		915	424	1,389
Foreign Countries.									
Argentina	–	–	–	–	–		–	2	2
Armenia	–	–	–	–	1		1	1	2
Brazil	–	1	–	–	1		2	1	3
British Columbia	–	1	–	–	–		1	–	1
Cape Breton	–	–	–	1	–		1	–	1
Cape Colony	–	–	–	–	–		–	1	1
Central America	–	–	–	–	1		1	–	1
Chile	–	–	–	–	–		–	1	1
China	2	2	–	–	2		6	4	10
Costa Rica	–	–	–	–	2		2	1	3
Cuba	–	–	–	1	–		1	1	2
Ecuador	–	–	–	–	1		1	1	2
Egypt	–	–	–	–	–		–	2	2
England	–	1	–	–	–		1	2	3
Honduras	–	–	–	–	1		1	–	1
India	–	–	–	–	1		1	1	2
Ireland	–	–	–	–	–		–	1	1
Italy	–	–	–	–	–		–	1	1
Jamaica	–	–	–	–	1		1	–	1
Japan	–	–	–	1	–		1	3	4
Mexico	–	2	–	–	–		2	4	6
New Brunswick	–	–	–	–	–		–	1	1
Nova Scotia	–	–	1	–	1		2	2	4
Ontario	–	2	–	–	1		3	4	7
Paraguay	–	–	–	–	–		–	1	1
Peru	–	–	–	–	–		–	2	2
Quebec	1	–	–	–	–		1	–	1
Russia	–	–	1	1	–		2	–	2
Transvaal	–	1	–	–	–		1	1	2
Turkey	–	–	1	–	–		1	–	1
Uruguay	–	–	–	–	–		–	1	1
Total	3	10	4	4	12		33	39	72

RESIDENCE OF MASSACHUSETTS STUDENTS.

County.	No. of Towns.	No. of Students.	County.	No. of Towns.	No. of Students.
Barnstable	1	5	Middlesex	28	252
Berkshire	5	17	Nantucket	1	2
Bristol	5	19	Norfolk	18	95
Dukes	2	2	Plymouth	16	34
Essex	22	105	Suffolk	4	257
Franklin	4	5	Worcester	15	23
Hampden	4	20	Total	128	839
Hampshire	3	3			

FROM CITIES WHICH SEND FIVE OR MORE STUDENTS.

Boston	238	Springfield	11	Concord	7
Newton	47	Gloucester	10	Holyoke	7
Brookline	39	Quincy	9	Salem	7
Cambridge	30	Wakefield	9	Wellesley	7
Somerville	27	Winchester	9	Watertown	6
Malden	19	Brockton	8	Arlington	5
Lowell	17	Everett	8	Barnstable	5
Newburyport	14	Framingham	8	Danvers	5
Lawrence	13	Haverhill	8	Marlboro	5
Waltham	13	Hyde Park	8	North Adams	5
Taunton	12	Medford	8	Pittsfield	5
Lynn	12	Beverly	7		

DISTRIBUTION OF MASSACHUSETTS STUDENTS, ABOVE THE FIRST YEAR, AMONG THE COURSES.

YEAR.		Civil Engineering.	Mechanical Engineering.	Mining Engineering and Metallurgy.	Architecture.	Chemistry.	Electrical Engineering.	Biology.	Physics.	General Science.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	Total.	
4th Year	Reg.	19	22	9	6	4	20	–	3	–	8	6	–	6		103
	Sp.	10	13	8	4	10	6	4	4	1	5	3	–	–		68
3d Year	Reg.	25	25	12	3	7	30	2	5	1	8	6	–	2		126
	Sp.	8	12	6	8	4	11	2	1	–	3	6	–	2		62
2d Year	Reg.	25	23	10	2	5	28	2	1	–	15	11	–	2		124
	Sp.	17	16	9	7	10	11	3	2	–	3	7	–	2		87
1st Year	Reg.	–	–	–	–	–	–	–	–	–	–	–	–	–		215
	Sp.	–	–	–	–	–	–	–	–	–	–	–	–	–		39
Total	Reg.	69	70	31	11	16	78	4	9	1	31	23	–	10	353	824 Adv.
	Sp.	35	41	23	19	24	28	9	6	1	11	16	–	4	217	15 Deg.
Totals		104	111	54	30	40	106	13	15	2	42	39	–	14	570	839

WALTER HUMPHREYS,
Registrar.

Reports of Departments.

DEPARTMENT OF CIVIL AND SANITARY ENGINEERING.

No changes in the staff of the Department have occurred during the past year, except that one assistant, Mr. Clarence D. Howe, resigned to accept the position of Professor of Civil Engineering at Dalhousie University, Halifax, Nova Scotia. This left one vacancy among the assistants, and one additional assistant having been authorized by the corporation, Messrs. Howard B. Luther and Mason T. Whiting were appointed. The staff of the Department is now larger than ever before, consisting of four professors, two associate professors, four assistant professors, two instructors, and eight assistants.

During the past year Professors Breed and Hosmer published the second volume of their treatise on Surveying, thereby completing the work as planned. This book has already been adopted in a large number of the technical schools of this country.

The curriculum of the Course in Civil and Sanitary Engineering has not been changed during the past year. The senior class will, during the present year, experience the effect of the change made two years ago, by which one year of modern language was removed from the Course, and instruction in mechanics begun in the second year. It is not intended, on account of this change, to cover any more ground than previously; but it will be possible to devote more time to some of the subjects, and it is hoped that the instruction will in consequence be more thorough.

Owing to the business depression, the demand for graduates has been less this year than for many years past. Notwithstanding this, a large number of men who graduated last June

have found positions. Of a total of 76 men belonging to the class of 1908, 9 have returned to the Institute for further study, 2 have returned as assistants, and 37 are known to be employed elsewhere, leaving 28 unaccounted for. Many of these last are undoubtedly employed, but have not notified us of the fact; and, with the revival of business, if the experience of the past is any guide for the future, the demand for our men will soon greatly exceed the supply.

It is gratifying to note the number of graduates of this Department who are engaged in teaching. Reference has been made to Mr. Clarence D. Howe, who has taken charge of the Department of Civil Engineering at Dalhousie University, and reference may also be made to one of the graduates of the Class of 1908, Mr. Allston Dana, who has gone to the University of Montana. During the summer, also, one of the graduates of 1907, Mr. Fred W. Morrill, was sent to Tientsin, China, to take charge of the Department of Civil Engineering at the Imperial University. Another of the graduates of 1907, Mr. Hudson B. Hastings, has been made Assistant Professor at Bowdoin College.

The particular needs of the Department at the present time are increased space and the relief of the curriculum by the transfer of the field work in surveying to the summer.

With reference to space, while the number of students in the Department is not increasing very rapidly, and, while it is not desired that it should, nevertheless, there is great need of additional space because our drawing rooms are already crowded to their full capacity. The library, also, is growing so fast that it affords entirely inadequate opportunity for students to use it as a place for study. Within a year or two, if its growth continues as it has in the past, it will be practically only a storehouse for books.

There will be differences of opinion with reference to the advisability of increasing our numbers. Personally, however, I believe that it would be wisest not to allow our numbers to increase much above what they are at present, but to gradually

raise the standard of scholarship throughout the Institute so that we may turn out more first-class men. There are in the Institute, as in other educational institutions, men who ought not to be there; some because of lack of ability, and some because their abilities lie in other directions. Many of these men, of course, drop out before the conclusion of the Course; but, nevertheless, a good many remain. This question, of course, is one of general policy, which should be applied to all departments alike; but in any case it is to be expected that there should be a gradual, if slow, increase in the number of students, while if adequate room were available for expansion, and no effort were made to keep down the numbers by raising the standard, the growth might be quite rapid. In Cornell University, for example, the number of students in the Department of Civil Engineering (in all four classes) has increased from 326 in 1903–04 to 499 in 1907–08. There are many advantages in a large school, provided the number of teachers keeps pace with the increase in the number of students, and provided the increase in teachers is not made by increasing the number of assistants, but by increasing the number of members of the Faculty as well.

In the Department of Civil Engineering there are fewer students now per teacher than there were ten years ago. A comparison in this respect may be instructive. In 1897–98 there were 4 professors, 1 assistant professor, 3 instructors, and 3 assistants, a total of 11 teachers; while the number of students was 155, giving an average of 14 students per teacher and 31 students per professor. In 1907–08 there were 4 professors, 2 associate professors, 4 assistant professors, 2 instructors, and 7 assistants, a total of 19; while the number of students was 227, giving an average of 12 per teacher and 23 per professor.

SUMMER SCHOOL OF SURVEYING.

With reference to the desirability of relieving the crowded curriculum by the transfer of the field work in surveying to the summer, I have already reported in previous years, and I wish once more to urge the importance of this matter. The Institute should either purchase or lease a large tract of land in one of the New England States, and should provide a summer camp, equipped to accommodate some one hundred and fifty students. In this camp, instruction should be given during the summer in the surveying field work now given in our second year, the railroad and surveying field work now given in the third year, and the hydraulic field work now given in the fourth year. The best plan would seem to be to require every student at the end of the second year to spend eight weeks at this camp, of which time, four weeks would be devoted to the surveying field work now given in the second year and the remaining four weeks to the field work now given in the third and fourth years. It might be well to allow students the option of taking the entire work in one summer, that following the second year, or in two summers, taking in the summer following the first year the four weeks course in elementary surveying and in the summer following the second year the four weeks course in railroad and advanced surveying and hydraulic field work.

A camp for carrying on this work, on the basis of one hundred and fifty students at one time, should be provided with one main building, containing two rooms to be used as lecture rooms, drawing rooms, or living rooms which would have an area of 2,500 or 3,000 square feet; also a building containing a kitchen and dining-room; another building containing an instrument room and supply room and several sleeping rooms for students who may be ill or who for some reason cannot occupy tents; an ice house, and a sanitary. It would be expected that the students would ordinarily sleep in tents provided with wooden floors. The estimated cost of these build-

ings and of the other things necessary to furnish a permanent camp is as follows:—

Main building (unfurnished)	$3,500.00
Building containing dining-room and kitchen (unfurnished)	2,700.00
Building containing instrument and supply rooms, with sleeping rooms overhead	1,500.00
Ice house	200.00
Sanitary	100.00
Tents and floors ($50 per tent)	2,000.00
Cot-beds and washstands	600.00
Boats	300.00
Water supply (uncertain, but possibly)	1,200.00
Furnishing of dining-room and kitchen	2,000.00
Furnishing of drawing room	200.00
	$14,300.00
10 per cent. for contingencies	1,400.00
	$15,700.00

Some of the above items are rather uncertain, and especially the cost of water supply. The cost of purchasing or leasing a proper site is also very uncertain. It would appear probable however, that for $25,000 a permanent camp could be provided, including the cost of the land, or its capitalized cost, if leased.

In case this plan can be carried out, the present summer school in elementary surveying, now given by Professor Robbins each summer, and also the summer school in advanced surveying now given every other summer, would both be discontinued. Owing to the relief of the curriculum, moreover, the regular work for the year could probably be done with three fewer assistants than would otherwise be required. The following, therefore, is an estimate of the actual net financial result which might follow the change recommended:—

ANNUAL EXPENSE OF TRANSFERRING WORK IN SURVEYING TO THE SUMMER.

Interest on first cost, say 5% of $25,000	$1,250.00
Repairs (uncertain) and insurance	500.00
General expenses	500.00
Care of camp	250.00
Salaries: Professors Robbins, Hosmer, Russell, and Breed, one instructor and 5 assistants, say $1,200 per month for two months	2,400.00
Total	$4,900.00

Deduct salaries of three assistants during school year, @ $500 . .	$1,500.00
Net additional cost of summer camp	$3,400.00
Net cost of present summer schools, variable, but say	400.00
	$3,000.00

The last deduction is intended to represent the net cost of the summer course given by Professor Robbins and one assistant each summer, and of the summer school given in alternate years. Both of these courses, however, are optional, and the students taking them pay for them, the fee for the summer course being $25 and for the summer school the same. The net cost of these schools, therefore, varies with the number of students. In 1907, the gross cost of the summer school in advanced surveying was $969.35, but there were 31 students, each of whom paid $25, so that the receipts were $775, making the net cost for the school about $200. In other years the number of students and also the number of instructors has been less, so that the cost is a variable.

This leads naturally to the question whether students should be required to pay an additional fee for the summer courses, if made obligatory. The objection to doing so would be that the cost of the Course in Civil Engineering would thereby be made greater than the cost of other Courses of the Institute and this might deter some students from taking this Course. Students would in any case, I assume, be required to pay for their board and lodging a sum sufficient to defray the expenses of the camp, other than estimated above. If it should appear to the Corporation desirable, as I believe it would be, to charge a small fee for the summer courses, it appears that with one hundred and fifty students a fee of $20 each would just about cover the cost of the summer work, while if a fee of $10 were charged the deficit would be $1,500, chargeable to summer work.

The uncertainties of this estimate are, of course, apparent, and there is no way of making a closer estimate at present. With reference to the salaries, however, I wish to state that, if this summer work is undertaken, the instruction should be given not mainly by young assistants, but largely by teachers of

a higher grade. I believe that some other schools make the mistake of putting the students in the summer schools largely under the care of inexperienced teachers, many of them perhaps students in higher classes. I do not advocate this policy for the Institute.

Summarizing the above, it appears probable that the recommended change could be made by the permanent investment of some $25,000, the interest on which, together with the cost of running the school, would result in an annual expense to the Institute not to exceed $3,000, and that this might be entirely or partially wiped out, as might seem best to the Corporation, by charging a fee not exceeding $20 per student. It may be added that with such a fee it is probable that the cost to each student for the eight weeks would not be over $75, and might, perhaps, after a little experience be made considerably less. Whether this would deter many men from taking the Course in Civil Engineering is a question which I cannot attempt to answer. I believe the above estimates to be outside figures.

The following table indicates the practice with reference to the work in surveying at other prominent schools in various parts of the country. The table shows the number of hours devoted to surveying during each year and during the succeeding summer periods, and it will be seen that all of the engineering schools included in the table, with the exception of the University of Illinois, require summer work in surveying. The table further shows that almost all of these schools, in addition to the summer work, give a considerable amount of instruction during the term. This instruction, however, is probably work in the class room and drawing room which can be arranged without disorganizing the curriculum.

APPROXIMATE TOTAL NUMBER OF HOURS ASSIGNED TO SURVEYING.

School.	During School Year.			During Summer Vacation following (on basis of 8 hours per day).		
	1st year.	2d year.	3d year.	1st year.	2d year.	3d year.
University of California .	144	108	—	—	192	192
Columbia University . .	60	—	—	288	336	192
Cornell University . . .	105	57	90	—	—	216
Case School	176	296	180	—	176	—
Harvard University . .	—	—	—	—	—	672
University of Illinois . .	—	135	—	—	—	—
University of Michigan .	—	150	60	—	—	288
Rensellaer Institute . .	time	not	stated	—	—	288
Rose Polytechnic Institute	—	270	72	96	—	—
Sheffield Scientific School	—	—	90	—	144	144
University of Wisconsin .	30	135	—	—	192	—
Worcester Polytechnic Institute.	—	240	—	—	144	288

The extent to which the curriculum is interfered with, if it is attempted to give surveying during the school year, is serious. Before the Back Bay was built over, it was comparatively easy for the Institute to teach surveying during the term without undue waste of time, because the students could gain their practice in the immediate vicinity of the Institute buildings. As the Back Bay was built up, however, it became necessary for the students to go further and further away in order to find a suitable site, and for a number of years it has been our custom to devote three entire days per week to field work in surveying. The second-year work is divided into two sections, one of which devotes Tuesdays and the other Thursdays to field work during the fall and spring, while the third-year is also divided into two sections, both devoting all day Wednesday to field work, either in surveying or in railroad location. All of the assistants in the Department, and a considerable number of the members of the Faculty, therefore, are entirely unavailable for other work during three entire days of the week during the field-work season. The interference that this causes with the Tabular View, especially in the case of students who wish to take subjects in two different years, will be apparent.

In view of the above facts, and as stated in my previous report on the subject, I strongly urge the Corporation to take steps immediately to secure a proper site and to authorize the establishment of a summer camp where all surveying field work shall be taught.

GEORGE F. SWAIN.

DEPARTMENTS OF MECHANICAL ENGINEERING AND APPLIED MECHANICS.

Notwithstanding the general depression in business, it appears, from the evidence that the Department has been able to obtain, that of the sixty-one young men who graduated in the Course in Mechanical Engineering in June, 1908, all were provided with positions by the middle of October, and nearly all of them much earlier. Moreover, many applications for graduates have been received which it has been impossible to fill.

The principal addition to the equipment has been the Westinghouse Parsons Steam Turbine of five hundred kilowatts capacity, which was installed during the summer in that portion of the former lunch room which was added to the Mechanical Engineering Laboratory. The space thus gained amounted to about 2,000 square feet. Approximately one-half of this space is occupied by the steam turbine and its auxiliary apparatus; namely, a condenser, circulating pump, wet pump, dry air pump, etc. The turbine is set on an I-beam foundation, thus leaving the space underneath open. The floor of the room is of cinder concrete, five inches thick. This floor has been stiffened by I-beams resting on piers built in the sub-basement. The floor plates of the turbine are about sixteen inches above the floor of the room, and thus all the small piping and connections underneath are exposed. An Alberger surface condenser was also installed during the summer, with the steam entering at the bottom, and hot air well be-

neath the steam opening. The circulating water is drawn from a canal thirty inches wide and three feet deep, which was dug and concreted in the sub-basement. This canal is connected with the water reservoir in the Henry L. Pierce building and with that in Engineering A. The circulating water is pumped from the canal by a Lawrence Centrifugal Pump, with a discharge seven inches in diameter, driven by a thirty-five horse-power vertical engine, set on a masonry foundation. The condensing water is piped to the cooling tower, from which it returns to the canal and reservoirs through piping installed some years ago. A dry air pump, formerly located elsewhere in the laboratory, has been transferred to the turbine room and is connected with the top of the condenser. When experiments on the turbine are in progress, the condensed steam is discharged into tanks set on scales, so that it can be weighed. The water supplied to the glands comes from the condensed steam, so that leakage from the glands will introduce no error in the steam weight.

In order to investigate the behavior of the steam while passing through the turbine, thirteen connections have been made in the rotor casing to gages, so that pressures can be noted at every point where the length of blade and the diameter of the rotor changes.

The power of the turbine is absorbed by a water brake designed and built by the Westinghouse Company. This brake consists of a wheel of broad face on the rotor shaft, provided with teeth like those of a milling cutter. The casing which surrounds this wheel has teeth on its inner circumference. Water is delivered into the space between these two wheels. The outer casing has an arm which connects with a weighing system of levers. A trolley crane of six tons capacity has been built over the turbine.

For a number of years, tests of turbine plants varying in capacity from five hundred to five thousand kilowatts have been made by students, under the direction of the Department, for thesis work; but the limitations necessarily imposed upon

outside plants have prevented us from carrying on such investigations as we shall now be able to pursue with a plant of our own of practical size; and this turbine will enable us to study experimentally many problems connected with the performance of this motor, including questions of steam losses, leakages, brake effect of moisture in the entering steam, etc. We shall thus gain a great deal of information that is now only in the possession of turbine builders and is treated by them as a trade secret.

In consequence of the very important position that the steam turbine has taken as a prime mover, an additional Option in Steam Turbine Engineering has been added to the Course in Mechanical Engineering, so that those students who select this Option may now extend their study of the steam turbine beyond that pursued by all students of the Course in Mechanical Engineering. This Option includes a discussion of the arrangement and construction of various types of steam turbines and of the methods of determining sizes and proportions required for the development and distribution of power and the securing of sufficient strength and favorable conditions for operation.

A considerable amount of original work has, as usual, been carried on in the laboratories of the Department. A few of the investigations pursued in connection with the thesis work of the last school-year are:—

1. Friction and Velocity of a Steam Nozzle, forming the thesis of Mr. Edwin F. Church, Jr., for the degree of Master of Science.

2. An investigation of the friction of high-pressure air flowing in pipes. For this purpose, piezometer rings were used on each side of each fitting, and the losses due to fittings and to straight runs of pipe were noted.

3. An investigation to determine the cause of the occasional freezing of the moisture in the air-distributing valve of the engine and tender equipment of the air brake system.

4. The study of the causes of failure of locomotive driving-

springs and their remedies has been continued,—a question that is of great importance to the railroads and the locomotive builders.

5. An investigation of the proper methods of securing a running balance in the case of machinery with a high rotative speed.

6. Additional work has been done in the investigation of reinforced concrete beams.

Some of the new investigations that will be undertaken this year are:—

1. A study of the oscillations and of the effects of inertia of shaft governors, in consequence of change of load on the engine, or from any other causes.

2. A study of the action of different types of safety valves.

3. Investigation of spray nozzles for cooling condensing water.

The following gifts were made to the Department during the past school year:—

1. A large locomotive steam injector, presented by the Shutte Koerting Company.

2. A sectional injector presented by the same company.

3. A Steam Engine Indicator with an outside spring, presented by the Star Brass Company.

4. A set of detailed blue prints of a modern Mallet Compound Locomotive presented by the Baldwin Locomotive Works.

5. Valves presented by the following firms: the Hancock Inspirator Company, the Crosby Steam Gage and Valve Company, the Star Brass Company, the Lunkenheimer Company, the Jenkins Company, and the Fairbanks Company.

Much valuable literature has been provided at our request for the use of students by a large number of manufacturing firms.

Valuable modern apparatus has been lent to the Department, some for use in connection with investigations and some for use in connection with the work in the Drawing Room, by the B. F. Sturtevant Company, by Hill, Clarke & Company,

by the Holtzer-Cabot Company, by the Charles J. Jager Company, and by the Fitchburg Steam Engine Company.

The most pressing needs of the Department are,—

A refrigerating plant, an impact testing machine, a gas producer plant, an hydraulic accumulator, and a stationary plant for testing locomotives.

More room is also needed to relieve further present crowding, to provide for new apparatus, to furnish room to carry on thesis work on apparatus brought in from outside, and to provide room for stripping machines for the purposes of Machine Drawing, and also room in which large concrete beams and columns can be made.

I desire to emphasize once more the great importance of increasing the staff of the Department by the appointment of a number of research assistants. A full statement in connection with this matter was contained in my report of last year.

GAETANO LANZA.

DEPARTMENT OF MINING ENGINEERING AND METALLURGY.

Need of more Space.—The apparatus installed this year in an already overcrowded space emphasizes still more the need for at least double the present floor area for the department laboratories.

Changes in the Work of Instruction.—A change has been made in connection with the arrangement of laboratory hours in assaying which it is hoped will allow students to accomplish more work in a given time. Students now come into the laboratory from 11 A.M. to 4. P.M once a week with an hour for luncheon instead of two afternoons from 2 to 4 as formerly.

The subject of elementary metallurgy given to students in the Electro-chemistry Course in the first term of the fourth

year has been transferred to the second term and combined with the subject of electro-metallurgy.

In the laboratory there have been carried on three reverberatory furnace smelting operations, one with lead and two with copper; one of the copper refining runs has been replaced by zinc desilverization of argentiferous lead and by blast roasting of galena concentrate, thus extending the scope of the regular laboratory operations of the first term of the fourth year.

Equipment.—The following additions have been made to the equipment:—feeder for trommel, Johnston vanner, callow tank, Pierce amalgamator, triplex rolls, hand jig 12 in. square, new classifiers (given by R. H. Richards), pulsator jig and classifier 4 in. square, Calkins advance laboratory crusher, Braun disc pulverizer, Denver Fire Clay Company soft coal muffle, Hendrix combination agitator, Hendrix copper agitator, turbidimeter for sulphur determinations, ammeters, machine lathe, transferred from the Mechanical Laboratories, a hand diamond drill, a standard rock drill, and a pneumatic hand drill, loaned by the Sullivan Machinery Company.

Researches of the Staff.—Professor Richards spent three months of the summer in the western states inspecting concentrating mills. He now has the third volume of his work on ore-dressing nearly completed. Professor Locke made a professional trip to New Mexico. Professor Bugbee maintains his connection with the United States Geological Survey, and last summer made examinations of mines and mining districts in Idaho and Washington. This work enables him to keep in touch with mining conditions in the West and to enlarge his knowledge of the mining districts of the country. For other more special lines of investigations see the list of publications.

Advanced work.—W. Mostowitch, a Russian Metallurgist, who came to us last November, carried on a valuable piece of research work which has recently been read before the October meeting of the American Institute of Mining Engineers.

Two graduates of the class of 1908 are working for advanced degrees: one is preparing a thesis on the Wilfley table and the

other on heats of formation of some ferro-calcic-silicates. Two other students from the Michigan College of Mines and from Queen's College, Kingston, Ontario, are also doing advanced work.

Students.—The second, third, and fourth years average about 32 students each, 98 in all, showing that the numbers are keeping up.

Professional Positions.—The graduates were not seriously affected by the depression in business, only a few being out of work. Nearly all of the class of 1908 secured work during the summer. Summer work in mining and metallurgy was also secured for a large percentage of the third-year class, and also for some of the second-year.

Summer School.—A very interesting summer school of mining engineering and metallurgy was held in Nova Scotia, in which studies were made of the following: iron mines of the Londonderry Iron & Mining Co. at Torbrook; geology at Parrsboro; coal mines at Spring Hill; coal mines at Joggins; electric power plant from coal at mine at Chignecto; rolling mills of the Nova Scotia Steel & Coal Co. at New Glasgow; coal mines of the Acadia Coal Co. at New Glasgow; government diamond drill at New Glasgow; Boston Richardson gold mines and mill and bromo-cyanide plant at Goldboro; coal mines of the Dominion Coal Co. at Glace Bay; extensive plant of the Dominion Steel Co. at Sidney; and the coal mines of the Nova Scotia Steel and Coal Co. at North Sydney.

ROBERT H. RICHARDS.

DEPARTMENT OF ARCHITECTURE.

This year the Department of Architecture opened with an increase of fourteen students over the register of last year, and with a class of unusual size and strength taking fifth-year work. Seven members of this class are last year's graduates who have returned for the Master's degree. The fifth-year work shows a most satisfactory growth, which is due to the demand for more

highly trained men than those graduated in the regular Course, and perhaps to a certain extent to a reaction from the opinion until recently prevalent that the American architectural schools are hardly more than feeders of the Paris École des Beaux-Arts. More and more do our students both from abroad and on their return home speak with increased respect for the training received at the Institute, a training not fully appreciated till the Paris atelier and the Beaux-Arts' exhibitions give the opportunity for comparison. A recent example of what our standard means is shown in the case of one of our '07 graduates, who passed the examination at the Paris Beaux-Arts and entered first in architecture over all Frenchmen and foreigners. It appears as if our Travelling Fellows would, in the future, give more and more attention to travel, and the careful study of classic monuments of architecture with only incidental work in the French atelier or the American Academy in Rome.

The loyalty of former students of the Department has been markedly shown this year. Mr. Robert P. Bellows, '04, made a most interesting exhibition in our rooms of his work accomplished at the Beaux-Arts, of which he is a "diplomé." He also prepared a very careful paper on the foreign school methods and atelier ways of study, which he delivered to our students. Mr. F. L. W. Richardson, '03, after an exhibition of some of his foreign work, presented us with three water-colors, which now hang on the library walls. Mr. A. W. Longfellow, '78, has given us a large copper plate engraving of the "Leaning Tower of Pisa." He gave it "in memory of happy, useful days at the school where I gained so much. I should like to be remembered there, and send it in grateful memory." This also decorates our library. We are glad of this opportunity to record another of the many kind things done for us by Mrs. William B. Rogers. A gift of books, photographs, and engravings from her has an additional value in their association with one who has done so much for the Institute. Miss Helen M. Longyear, a present student who was in Europe last summer, has filled many a gap in our library by a most generous gift of photographs collected while travelling.

The first three-year scholarship given by the American Academy in Rome was to be granted without competition, and among the candidates from those eligible for this honor, Mr. Ernest F. Lewis, '07, received the appointment. It was a great compliment to the Institute, and we are glad to say that Mr. Lewis is proving himself well worthy of the confidence placed in him. An interesting, illustrated article explaining what the Academy in Rome stands for, written by Mr. Lewis, was sent to the Technology Architectural Record, and appeared in the August number. This year a regular competition takes place for the Academy scholarship, and a number of our students will take part in it.

Mr. Andrew N. Rebori, '07, was the winner of the 1908 Travelling Fellowship. Again Mr. Guy Lowell came to our aid and generously added five hundred dollars to a like sum granted from the Austin Fund to make this Fellowship possible for a year. Mr. Rebori sailed in September. Miss Ida A. Ryan, the previous beneficiary of this Fellowship, has recently returned after a year's study in Europe. As a result of her accomplishment she has received a very flattering invitation to take an important position in the office of one of our best architectural firms.

Mr. George E. Burnap, a graduate in the Option in Landscape Gardening and a beneficiary of a Travelling Fellowship from the Austin Fund, has also recently returned. His successful work had brought him to the knowledge of Cornell University, and he was invited to the position of instructor in the Rural Art Department, which he accepted.

The Rotch Prize of two hundred dollars for regular students was awarded to Mr. Edgar I. Williams, who has returned for a graduate year, and is a candidate for the advanced degree. There was no candidate for the special student prize.

There is little to be said in regard to our regular course of study. No radical changes have been made since last year. The steadily increasing demand, however, from the profession, for the highest standard of work from the schools is a very

effective stimulus to improve methods and avoid ruts, and we believe that each year finds us fully prepared to meet every requirement. The rapid progress in the methods of scientific construction demands continuous exertion in the Option in Architectural Engineering; and the preparation of material for use in the class room, the correction of students' work, etc., entail too great an amount of clerical labor which falls on Professor Lawrence at the expense of time that would be far better employed in the further development of the Course.

Fully appreciating the impossibility of obtaining more floor area for the use of the Department, we still desire to call attention to our growing needs for more class rooms and a larger exhibition hall.

We renew our plea that the Department be so endowed that a one-thousand dollar Travelling Fellowship may be awarded each year. The Executive Committee has already signified its willingness to allow five hundred dollars from the Austin Fund for this purpose, and it is earnestly hoped that a like amount may be secured from some other source. Not to have this fellowship is a great handicap in the accomplishment of the results we are striving for. We cannot make rules as to eligibility and invite candidates for competition if we are not sure beforehand that there is a fellowship to offer. Our plea, besides, is for nothing more than what every architectural school of standing in the country has enjoyed for many years.

F W CHANDLER.

DEPARTMENT OF CHEMISTRY AND CHEMICAL ENGINEERING.

It is a matter of much gratification to the Department that the hopes expressed in the departmental report of 1907 have been realized in the formal organization, in June, 1908, of the Research Laboratory of Applied Chemistry as a division of the Department, under the immediate charge of Professor William

H. Walker as Director. The steps which have led to this very desirable outcome have been outlined in previous reports; and a more detailed statement of the present status and future plans of the Laboratory will be found on page 90. There are good reasons for the expectation that this extension of the activities of the Department will prove most beneficial both in promoting close and helpful relations with the industries of the country and in the increased incentive and opportunity which it presents for research work on the part of members of the instructing staff and advanced and graduate students.

The increase in the number of students to be provided for in analytical and organic chemistry has made it necessary to extend the laboratory accommodations for both. This has been accomplished by transforming an additional recitation room on the second floor of the Walker Building into a laboratory for analytical chemistry, and utilizing a larger proportion of the laboratory on the fourth floor, formerly devoted entirely to analytical chemistry, for students in organic chemistry. This arrangement, while meeting numerical requirements for the present in a way to avoid a more disadvantageous and uneconomical division of the classes in organic chemistry, is far from satisfactory, and emphasizes a need for the more efficient housing of the Department, referred to later.

Of the candidates for the degree of Doctor of Philosophy, three, Messrs. George A. Abbott, Charles A. Kraus, and Edward W. Washburn, received that degree in June. Dr. Kraus remains at the Institute as Research Associate in Physical Chemistry, Dr. Washburn has been called to the position of Associate at the University of Illinois, and Dr. Abbott has charge of the instruction in Chemistry at the Indianapolis Manual Training High School.

In accordance with our custom in recent alternate years, the Summer Course of Industrial Chemistry was held under the direction of Professor Thorp, lasting from June 10 to June 27. The party of students numbered nineteen, seven from

the Course in Chemistry, one from the Course in Biology, and eleven from the Course in Chemical Engineering, most of them being members of the class of 1908. They were accompanied by Mr. John F. Norton, Assistant in Industrial Chemistry, and for a part of the time by Professor Talbot, beside Professor Thorp, who conducted the usual conferences. Visits were made to the following plants:—

Standard Sugar Refinery, South Boston, Mass.
Manhattan Rubber Co., Passaic, N.J.
Colgate & Co., Jersey City, N.J.
Tide Water Oil Co., Bayonne, N.J.
Murphy Varnish Co., Newark, N.J.
Berganport Chemical Works, Bayonne, N.J.
Nichols Copper Co., Laurel Hill, L.I.
J. T. Baker Chemical Co., Phillipsburg, N.J
Bethlehem Steel Co., South Bethlehem, Pa.
Lehigh Portland Cement Co., Ormrod, Pa.
American Plate Glass Co., James City, Pa.
James Mfg. Co., James City, Pa.
Pennsylvania Window Glass Co.
American Acid and Alkali Co., Bradford, Pa.
Atlantic Refining Co. (Eclipse Works), Franklin, Pa.
Galena Signal Oil Co., Testing Laboratory.
Colburn Machine Co.
Macbeth-Evans Glass Co., Charleroi, Pa.
National Tube Works, McKeesport, Pa.
Harbison-Walker Refractories Co., Hays Station, Pa.
H. J. Heinz Co., Pittsburg, Pa.
National Lead and Oil Co., Pittsburg, Pa.
Crucible Steel Co., Pittsburg, Pa.
Carnegie Steel Co., Duquesne, Pa.
American Sheet and Tin Plate Co., Vandergrift, Pa.

The Institute and the Department are again under great obligations to the representatives of these firms and corporations for the courtesies extended to our students. The unquestioned success of the trip and the great benefit which the students derived from the Course is largely due to them. A more detailed account of this trip has been prepared for the *Technology Review* by Professor Thorp.

In response to the third annual request of Harrison Brothers and Company, a second-year student was nominated to par-

ticipate in their summer course in Industrial Chemistry; namely, Mr. George P. Lunt, of Danvers, Mass., of the Course in Chemical Engineering. He and Mr. John A. Christie, the nominee of last year, derived much benefit from their experience in the works laboratories, an experience which affords an unusual opportunity for an insight into conditions under which the chemical industries are carried on, and which enables those who participate in it to better appreciate the opportunities afforded them in the later years of their undergraduate course. It is much to be desired that other firms should cooperate with educational institutions in a similarly helpful way.

At the request of the New England Association of Chemistry Teachers a course of lectures on Industrial Chemistry is being given by Professor Frank H. Thorp in connection with the Lowell Teachers School of Science. The lectures are given in the Institute lecture rooms, and are designed especially for the needs of teachers of chemistry in the secondary schools. These lectures, together with the course on Physical Chemistry given last year by Professor Lewis under similar auspices, and a course on "The Electrolytic Dissociation Theory" given by Professor Talbot before the Brooklyn Institute of Arts and Sciences, may serve as examples of the extension of the departmental service to those outside of the Institute classes. Beside these more formal lecture courses, a large number of individual talks and papers are delivered each year by members of the Department before a wide variety of organizations and involve in the aggregate a very considerable public service.

The changes in methods of instruction during the past year have related to improvement in details. The few changes in the instructing staff occurring at the close of the year chiefly concerned the junior members. Messrs. Blanchard and Woodman received deserved promotion to assistant professorships. Owing to ill health Professor Miles S. Sherrill has been obliged to ask for leave of absence for a part of the present

year; but it is anticipated that he will soon be able to resume his efficient service. During his absence his work is carried on by Professor Lewis and Mr. Richard C. Tolman. The Department is fortunate in being able to command their assistance in this emergency.

Each year the plea for a new building for the work of the Department becomes more urgent. During the past year the conditions in the laboratories of water and food analysis have become such that efficient instruction is possible only at a sacrifice on the part of instructors which is greater than should be demanded of them, and which prohibits desirable development of work along these lines. Similar conditions have prevailed in the laboratory for sugar analysis for some time, and instruction in both organic and analytical chemistry is hampered by disadvantageous distribution of the students in the several laboratories. The often expressed need for a chemical museum remains unsatisfied, and that for a suitably equipped lecture room for the sole use of the Department, and properly connected with such a museum, becomes more and more urgent. An increase of space for the work in industrial chemistry will soon be demanded, and funds are needed for the purchase or erection of some larger types of apparatus than are now employed, in order that this laboratory may become in some measure a laboratory of chemical engineering, as well as of applied chemistry.

Imperative as all these needs are, and much as the Department would benefit by their fulfilment, it is probable that an even greater benefit would accrue from the association of the different branches of the Department under one roof. In place of the present comparative isolation of certain laboratories and instructors, with the attending frequency of contact with their colleagues, would come an increased appreciation of community of purpose and interest and a better correlation of the work of the Department, and the present stimulating effect of the Research Laboratories would be much enhanced. How much the concentration of the work of the Department

in one, or at most two, buildings (instead of the present distribution through portions of four buildings) would mean can only be fully appreciated after visits to other institutions which are more fortunately situated in this respect.

H. P. TALBOT.

THE RESEARCH LABORATORY OF PHYSICAL CHEMISTRY.

During the past year several protracted investigations have been brought to a satisfactory conclusion. The complete revision of the methods of qualitative analysis, undertaken by Professor Noyes and Dr. William C. Bray, is now finished in so far as it relates to all the common metals and the more important of the rare metals. Mr. Roger D. Gale has made much progress also towards extending the new system to include the acid radicals.

Dr. Edward W. Washburn has published the results of a research of three years' duration on the degree of combination between water and dissolved salts. The data, which were obtained only after surmounting the most formidable experimental difficulties, unquestionably afford the most important contribution that has yet been made to our quantitative knowledge of hydration in solution. Dr. Washburn has also published, at the request of the editor of the *Jahrbuch der Radioaktivität und Elektronik*, an exhaustive summary of the present status of the hydrate theory.

Another investigation which has just been finished was begun by Dr. Charles A. Kraus over four years ago. During this time he has studied from nearly every possible point of view, the properties of the unique substances formed by the solution of metals in liquid ammonia, and in determining their quasi-metallic character has thrown a new light on the nature of the metallic state.

The extensive investigation of electrical conductivity and

allied properties of aqueous solutions has been generously supported by an annual grant to Professor Noyes from the Carnegie Institution of Washington. This year the grant was increased to $3,000. The work has developed in several new directions. Dr. Johnston studied the conductivity and freezing point of the higher types of electrolytes; Mr. Arthur C. Melcher determined the solubility of a number of salts at high temperatures; and Mr. Roy D. Mailey is engaged in determining data concerning the physical properties of water and water vapor near the critical point, which promise to be of the highest scientific and technical value.

The series of determinations of electrode potentials previously made in this laboratory has been continued by Dr. Carl L. von Ende, who succeeded in finding the true value for the thallium electrode and in explaining the strange anomalies observed by previous investigators. The potentials of the alkali and alkaline earth metals, notwithstanding their very great importance, have never been measured because of the extreme reactivity of these metals. This problem is now being attacked by Dr. Kraus and Professor Lewis. The potential of sodium has already been found, and with a higher degree of accuracy than has hitherto been reached in the case of any solid metal. This investigation has been aided by a grant of $300 from the Bache fund of the National Academy of Sciences.

Two weekly seminars are conducted in the present term, one by Dr. Bray on the applications of the phase rule, and one by Professor Lewis on thermodynamics. A weekly conference of all men engaged in research affords an opportunity for the full discussion of experimental problems while they are in process of solution, and thus in a certain sense every investigation is carried on with the collaboration of the whole research staff. Last spring the laboratory instituted the Physico-Chemical Colloquium, which takes the form of an evening smoker. At each meeting some topic in theoretical chemistry is presented by one of the members, and a general discussion follows. This Colloquium has proved a marked success, and is being attended

not only by all members of the Research Laboratory, but also by a number of men from other departments of the Institute and from neighboring colleges.

The Research Laboratory has always extended a hearty welcome to men of mature attainments who desire to take advantage of the facilities for investigation which the laboratory offers. This hospitality was extended last year to Professor Carl L. von Ende, from the University of Iowa, and more recently to Professor Kenneth L. Mark, of Simmons College, who is studying the phenomenon of gaseous absorption.

Several members of the research staff have recently been called to other laboratories by greater inducements in salary and opportunity than can be offered here. It is becoming increasingly difficult to retain the services of men who combine a thorough knowledge of chemistry with proficiency in research. Besides the call from other institutions of learning, there has been a remarkably rapid growth in the demand for experienced investigators from the scientific bureaus of the government, from the new laboratories for technical research, and from special laboratories such as those founded by the Carnegie Institution. While the loss of our trained men to these institutions frequently means an unfortunate interruption of an important investigation, it is inevitable; and indeed the training of men for such responsible positions must be regarded as one of the chief functions of our Research Laboratory.

GILBERT N. LEWIS.

THE RESEARCH LABORATORY OF APPLIED CHEMISTRY.

In the reports of the Department of Chemistry for the last two years, the great desirability of establishing at the Institute a Research Laboratory in which some of the many problems which now confront the industrial and manufacturing public could be investigated, has been clearly emphasized.

As a result of a generous donation from Mr. Charles W. Hubbard and the appropriation by the Executive Committee for this purpose of a part of the income of the Charlotte B. Richardson Fund for Industrial Chemistry, the foundation of a Research Laboratory of Applied Chemistry was made possible, and its organization was effected at the beginning of the present school year. Room 53, Pierce Building, has been partly refitted, and is now devoted to the work of the Laboratory, while Room 50, Engineering B, has been equipped as a shop with the lathes and tools necessary for building experimental apparatus.

Those Professors of the Department of Chemistry more closely associated with industrial work form the staff in whose care the management of the Laboratory is placed. It is at present constituted as follows: Professors William H. Walker, Henry P. Talbot, Willis R. Whitney, Augustus H. Gill, and Frank H. Thorp. Dr. Warren K. Lewis, who as Austin fellow spent the last two years in study at the University of Breslau, and Dr. William Guertler from the University of Göttingen, Germany, have been engaged as Research Associates and are now devoting their entire time to the problems under investigation. Dr. Peter Burns of the Department of Chemistry is giving a portion of his time to research work and is a member of the Laboratory force.

At the request, and with the co-operation of the H. P. Hood Milk Co., an investigation has been undertaken with a view to determining the cause of the alleged rapid deterioration of modern tin plate. This is a matter which concerns vitally all users of tin plate, and the problem is considered of sufficient importance to devote to it the entire time of a Research Associate. The manufacturers of tin plate are also co-operating in the work, and it is hoped that the investigation may lead to a more satisfactory knowledge of the causes of the trouble, and to some suggestions as to how the present difficulties may be met. A problem which is of growing importance and which confronts all the manufacturers of galvanized sheet iron, lies

in the production of what is known as "gray sheets." The American Sheet and Tin Plate Co. of Pittsburg, Pa., has placed at the disposal of the Laboratory sufficient funds to make a thorough investigation of this difficulty, and work towards its solution is now being energetically carried on. Two objects for research which have been undertaken by graduate students are the casehardening of iron, with reference to special alloy steels, and the physical and chemical properties of linseed oil in relation to its capability of protecting iron and steel from corrosion.

Dr. Burns is devoting his time to the development of a series of laboratory experiments with descriptive text designed for the use of students in the engineering courses, and treating of the chemical properties of the materials employed in engineering practice and the chemical principles of those processes with which the engineer most frequently deals. It is felt that there is an increasing demand for such a text-book in all schools of engineering, and that this Laboratory will render a real service in providing for engineering students a work of this kind.

During the present term Professor Walker conducts a weekly seminar upon the principles of chemical engineering, to which is attracted a number of the members of the instructing staff and advanced students. In the second term Dr. Lewis will offer a seminar upon the technical applications of the phase rule.

W. H. WALKER.

DEPARTMENT OF ELECTRICAL ENGINEERING.

The progress of the Department has been in the directions referred to in my report of last year. The changed curriculum then referred to has now gone into effect as far as the third-year class. Graduate instruction is being provided for several students who are accepted candidates for the Master's degree,

and for one student who is an accepted candidate for the degree of Doctor of Engineering. I believe that this is a forerunner of much work of an advanced character which will be done by the Department, and that this may be expected to attract students who are capable of carrying on engineering research, through which the utility of the Department will be materially increased.

The fourth-year class is now twenty per cent. larger than the fourth-year class at this time last year. This fact and the needs of the advanced classes which must be provided with suitable rooms in which to carry on lectures, conferences, and seminars, emphasizes the need of one or more class-rooms which may be placed solely at the disposal of the Department. We cannot fully develop the work of research and the instruction of advanced students without having these additional facilities.

The effort to maintain intimate relations between the lectures, recitations, problem work, and laboratory work in the Department is continued with good results. The relations of the work of this Department to that of surrounding departments are reasonably satisfactory in most respects; but efforts are being constantly made to improve them for the sake of arriving at that co-operation which is essential to the most successful training of electrical engineers.

During last term Professors Laws and Shaad made an inspection visit of several days to Cornell University. The expense of these visits was generously provided for by Mr. Frederick P. Fish of the Corporation. Each of them made brief written reports to me of their observations, and I have transmitted abstracts thereof to the donor of the fund. I believe that such visits of inspection to other engineering schools maintaining high-grade electrical engineering instruction ought to be extended. The teaching staff of the Department is composed mostly of men who have made the teaching of electrical engineering and allied subjects their work since the time of their graduation from the Institute or some other engineering school, and it is of advantage to us to afford these men an

opportunity to compare by observation the methods of other important engineering schools with our methods.

It is equally important that the members of our staff should attend meetings of the professional and commercial electrical engineering societies, such as the American Institute of Electrical Engineers, the National Electric Light Association, the American Street and Interurban Railway Association. It seems to me that it ought to be fixed as a matter of policy that one or more members of our staff should be present at the annual convention of each of these important societies. Such a policy would unquestionably add fertility to the teaching of our undergraduate classes, and it may be considered one of our proper contributions to the formal efforts that are being made for the improvement of electrical engineering practice. Some members of our staff also ought to attend the meetings of the Society for the Promotion of Engineering Education for the purpose of comparing experience with engineering teachers from all parts of the country in regard to the processes of teaching and related subjects. It is impossible, however, to expect junior members of our staff to personally defray out of their small salaries the expense of attending one or more such meetings each year; and it is therefore desirable, either that a fund be made available to the Department from which the expenses of delegates to suitable conventions may be paid, or else that the salaries of the staff be raised with the expectation that voluntary attendance on engineering conventions will then follow to the needed degree.

Professor Clifford was elected a member of the Board of Directors of the American Institute of Electrical Engineers at the last election of that Society.

Mr. Waldo V. Lyon of the staff has published a book during the year entitled "Problems in Electrical Engineering," which is the outcome of his work in the Department and represents the character of problems used with our third-year classes. The book has received general commendation from the engineering schools and from other sources, and I hope that it may be the forerunner of several important books published by the staff.

The relations of the staff with the students seem excellent; but it would be desirable if more distinctly social relations could be established. I do not know how this can be effectively done while the Institute is in its present location, with the students and faculty so separated as to their living accommodations.

The United States War Department has detailed a commissioned officer of the Coast Artillery, Captain Clifton C. Carter, to pursue a course in electrical engineering at the Institute, to prepare himself for further teaching in the professional schools connected with his branch of the service. Captain Carter is an officer of experience who has served on various important boards besides having been a teacher in the School for Submarine Defence. He has already gained the high regard of the Faculty.

The needs of the Department are of the same nature as those set forth in my report and estimates last year; but they are somewhat more critical now on account of the increased size of the fourth-year class and the probability of a rapidly increasing number of students pursuing advanced study and research. Among other things, it is very desirable for us to have a large room in which problem work related to the courses of professional lectures on electrical installations may be executed on the drawing board by fourth-year students.

One of the greatest needs of the laboratories is the formulation of additional alternative experiments, so that the students in the different sections may work upon different experiments illustrating the same principles. This improvement would make the laboratory work more interesting, and would bring greater results as the men could compare notes and gain a wider horizon in regard to manipulation and experimental processes than is possible to attain where all of the students go through a series of substantially the same experiments. The arrangement would also tend to afford an improved sequence of work in the laboratories by allowing more elasticity in the assignment of laboratory problems. These alternative experiments cannot be fully planned or carried out until we have

certain additional apparatus which I mentioned in my report last year, and the question of additional space (especially in the standardizing laboratory) is still pressing.

It would be highly advantageous to the electrical engineering students if the electrical books which are now housed by themselves in the Lowell Building were joined with the other books on engineering subjects, and the combined library were then located in a library and reading room conveniently situated for the use of the engineering students in all of the branches. This arrangement would also probably be of service to the students in the other engineering departments who are now deprived of the use of electrical books because of their location away from books on other engineering subjects.

The Department has received a number of gifts during the year. These include the money needed to defray the expenses of inspection trips to Cornell University already referred to, and the money to defray the expenses of three dinners of the Electrical Engineering Society at which Mr. H. G. Scott (President of the American Institute of Electrical Engineers), Dr. Charles P. Steinmetz, and Professor Elihu Thomson were respectively the guests of honor and addressed the Society. Mr. Charles L. Edgar of Boston presented the Department with a handsome framed photograph of Mr. Edison, in large size, which is now hanging in the reading room, and the Sangamo Electric Company presented meters of its manufacture.

DUGALD C. JACKSON.

DEPARTMENT OF BIOLOGY.

There has been for the last two or three years a marked increase in attendance upon the classes in bacteriology, industrial biology, sanitary science, public health, and municipal sanitation, more students from other Departments having resorted to these courses during the last year than ever before, while a gratifying increase in the number of graduate students in Biology has also occurred.

The degree of Bachelor of Science in Biology was awarded in June to four candidates. Of these one has since become a candidate for the degree of Doctor of Philosophy and has been awarded the Savage Fellowship; another was immediately appointed assistant biologist to the Typhoid Fever Commission of the city of Pittsburg; a third became resident bacteriologist and chemist on the municipal water filtration plant of Norfolk, Va.; and the fourth began preparations for entering the official service of the United States Army.

The demand for our graduates, and even for well-trained special students of biology, has continued, in spite of the industrial depression, far beyond the supply; and as this is a condition which has lasted now continuously for several years, it is greatly to be desired that some way be found of making the opportunities which Biology offers for successful public service more widely known.

A number of interesting and important investigations have been carried forward by the members of the teaching staff, particularly in co-operation with advanced and graduate students. Some of these have concerned the solving of problems directly affecting the public welfare, and especially the public health. By numerous public addresses, conferences, and recommendations, and by extensive and laborious correspondence upon questions affecting biological education and public health measures, the members of the staff have also further contributed to the service of the Commonwealth. They believe that their duty to the Institute, to the State, and to the larger community which they serve requires of them sound and wise teaching, careful investigation, and expert and helpful public service, and these to the best of their ability they have freely given.

The increase of students referred to above has brought about in our various laboratories a serious congestion, which already interferes with our work and in the near future will handicap it heavily. In my last annual report I drew attention to this subject and to the pressing need of a special build-

ing for the Department of Biology, so that adequate laboratories, lecture rooms, museums, and the like might be provided. It is true that we have got on thus far fairly well without most of these things, but we have now come to a point when we shall be unable successfully to maintain the prestige of the Department, and especially to attract desirable graduate students capable of carrying on the most important investigations and performing the most useful kinds of public service, unless a special building can be provided. Under one roof we ought to be able to house comfortably and efficiently the entire Department and also the principal laboratories of the Sanitary Research Laboratory and Sewage Experiment Station now on Albany Street. We need a new and much larger bacteriological laboratory, with special provision for hygienic lighting and ventilation. We need—what we have never yet had—a large lecture room for the Department, and especially for the classes in sanitary science and public health, in industrial biology, in municipal sanitation, and in general biology. Owing to the seriously overcrowded condition of the Institute today large lecture rooms in convenient locations are scarce, and must be shared in succession by different departments,—an inconvenient and objectionable arrangement involving wasteful loss of time and energy. The library of the Department, representing the working accumulations of a quarter of a century, is so overcrowded as to be used only at a great disadvantage. Worst of all, there is nowhere in the Department any place for quiet, uninterrupted study; no place for rest, or even repose; no sense of either space or seclusion; and until we have such places the proper study of biology, of life and the right conduct of life, under hygienic and sanitary conditions must remain an ideal rather than a reality.

We need also acutely a working and teaching museum, not of mere bones or stuffed animals or dried plants, but of plans and models and devices for applied biology; for the purification of sewage and water; for the ventilation of houses

and ships and schools and cars; for the materials of biological teaching in every grade; for plans and photographs of model towns, model dairies, model factories, model houses; for demonstrating the data of evolution; for microscopes and microtomes, and other indispensable biological apparatus. We need a chart-and-model room for storage. We need offices and consultation rooms in which to meet the ever-growing stream of students, visitors, and legitimate petitioners for scientific aid in important public service; and we need these completely separated from quiet and secluded private laboratories in which, and in which alone, in a busy modern metropolis, professors whose services are much in demand by the public can do any worthy investigation or fruitful study.

The professors of the Biological Department believe that as American civilization becomes more widespread and more wealthy, it also becomes more complex and more difficult; that the successful conduct of personal and community life is becoming increasingly important, and ought to become increasingly scientific; and that questions of life and death, of health and disease, of hygiene and sanitation, are coming to the front in the future as never before. They also believe that Biology, the science of life, is therefore deservedly receiving on every hand more and more attention, and that it is bound to receive yet more in the not distant future,—perhaps even becoming the most valued of the sciences. They believe that the central feature of the ideal scientific and technological school of that future will be a biological building of the sort described above, in which life and health and disease and death and the various problems of human efficiency and human happiness and human welfare shall be studied in the light of all the experience and all the learning and with all the aid of the applied sciences of the time. For such a building and its maintenance the sum of $100,000 would suffice.

WILLIAM T. SEDGWICK.

SANITARY RESEARCH LABORATORY AND SEWAGE EXPERIMENT STATION.

In February of the present year still another gift of five thousand dollars, the sixth of like amount in annual succession, was received from the anonymous donor who has so generously contributed to the Institute thus far the entire cost of the equipment and maintenance of the Albany Street Laboratories for experiment and research in sanitation,—especially the purification of sewage, "by cheap and simple methods, before it is cast into rivers, harbors, or lakes." For the current year the amount hitherto contributed was increased by an additional sum of five hundred dollars. For these continued and liberal donations, and especially for the confidence implied in the additional gift just referred to, the Staff of the Laboratory and Experiment Station desire to express their renewed and profound gratitude.

The work of the first four years of the Experiment Station culminated, as stated in the last Annual Report, in the presentation of the outlines of a practical plan for the purification of Boston sewage, and the prevention of the pollution of the harbor by the Boston main drainage system. This plan was publicly presented before the Boston Society of Civil Engineers and afterwards extensively discussed either orally or in print by some of the leading sanitary engineers of the United States and by a prominent representative of English sanitary science. It was accepted for the most part as both practical and important, one engineer in Boston having written, "This illuminating piece of work alone has more than justified the expenditure of the small appropriation necessary to maintain the Experiment Station."

At about the same time there was published by the Staff the results of an elaborate series of tests of sewage distributors suitable for trickling filters, which proved of sufficient

importance to form the subject of a lengthy editorial abstract in the *Engineering News* for January 9, 1908.

The actual work of the Station has again been under the immediate care of Professor C.-E. A. Winslow, Biologist in Charge, with the able co-operation of Professor E. B. Phelps, Research Chemist and Bacteriologist. Professor Winslow in a recent report to the Director writes:—

"The work of the Laboratory and Station upon trickling filters and the disinfection of sewage and sewage effluents has attracted wide attention all over the country. In particular the plan developed at the Station, largely through the investigations of Professor Phelps, of disinfecting the effluent of trickling filters with chloride of lime, has recently been adopted by the Sewage Commission of the City of Baltimore, in preference to other plans previously entertained, at a very large saving to that city over the cost of all other plans.

"The special type of sewage distributor for trickling filters invented at our Experiment Station has been received with favor in many places and is now being installed, or is already in operation, at sewage disposal plants as far apart as Minnesota, Canada, and Mt. Vernon, N.Y.

"Work has also been continued at our Albany Street Station for the purpose of fixing more accurately the optimum depth and kinds of material for beds of trickling sewage filters. The details of the process of disinfection by bleaching powder have been worked out more fully and a new series of investigations has been started on the treatment of sludge from trickling filters in various forms of septic and hydrolytic tanks. An important review of the whole question of disinfection by means of chlorine has also been prepared by Professor Phelps and is already in press as a Bulletin of the United States Geological Survey."

Professor Winslow continues:—

"The time has now come to put the work of the Sanitary Research Laboratory on a broader and more permanent basis. Work with our present Albany Street Plant can be continued

much longer only under serious limitations and disadvantages. At the same time any abandonment of the field occupied by the Sanitary Research Laboratory would be a distinct misfortune. By the work of the last six years the Laboratory and Experiment Station have attained a position of unique and almost national significance. It has even been said that many of the sanitary experts of the country are looking to the Institute for the most advanced and important investigations in the science of sewage treatment, and the reputation of the Institute in this direction in Great Britain and on the Continent is certainly flattering. Furthermore, the staff of the Laboratory and Experiment Station by its six years of experience has become trained to a high degree of usefulness in its special task. If our work on sewage treatment should stop, this reputation and this special training would soon be lost. If it is continued, the contributions of the Institute to the science and art of sewage purification should increase in value year by year."

The Officers of the Station greatly desire, and believe that it may be possible during the coming year, to secure a more favorable situation for the conduct of their investigations, as well as one in which the principal laboratory work could be brought within the walls of the Institute itself,—an arrangement eminently desirable from every point of view. With this possibility in mind Professor Winslow adds: "If a new plant can be obtained, as is expected, it is hoped that in the near future certain important phases of the question of purification on trickling beds, preparatory and final hydrolytic treatment, chlorine disinfection, sedimentation, and screening may be studied and settled. Moreover such a change as is now required would open up a new and important field of work in the possibility of a systematic study of sewage disposal systems for institutions, large and small, and for isolated houses. This problem deserves greater consideration than it has hitherto received; for in many respects the method of disposal adopted in these cases must be different from that available

for larger installations having sewages of different character. At present the principles underlying the construction and operation of such plants are not so well understood as they ought to be and some of the plants built to-day are foredoomed to failure."

Professor Phelps, in the course of a recent report to the Director, says:—

"In addition to the adoption of our sewage disinfection processes under my general supervision in Baltimore, I have also been engaged by the State Board of Health of New Jersey to report upon and design works for sewage disinfection plants in that State, and by a firm in Philadelphia to design similar works for another New Jersey community. A final report upon all these disinfection experiments both in Baltimore and in Boston has been prepared by me for the United States Geological Survey, in co-operation with which they have been made at our Sanitary Research Laboratory and at the Walbrook Testing Station of the Baltimore Sewage Commission.

"My report upon the disposal of sulfite waste liquors, also made to the Geological Survey and based upon work done at the Station, will likewise shortly be issued."

Professor Winslow has completed during the year under the auspices of the National Association of Master Plumbers an especially important and exhaustive series of investigations on the danger of the spread of bacteria through sewer air. The earlier ideas of the promiscuous conveyance of disease by "sewer gas" were long since given up, but certain leading English bacteriologists have recently published reports of investigations indicating that, contrary to the current opinion, bacteria may nevertheless be transmitted somewhat readily by means of sewer air. Professor Winslow by careful quantitative experiments has succeeded in showing that this danger is so slight as to be practically negligible. His investigations are the more noteworthy not only because of their fundamental and thorough character, but also because they harmonize hitherto discordant results, and particularly because the Insti-

tute was directly called upon by the National Association of Master Plumbers to do a piece of investigation which was only made possible and comparatively easy by the fact that it fortunately possesses a Sanitary Research Laboratory and Sewage Experiment Station.

It seems hardly necessary to point out once more the extreme educational importance of work of this kind as a demonstration, an example, and an incentive to our students of applied biology and chemistry and of civil and sanitary engineering. No other educational institution in America, and probably none in Europe, enjoys these particular advantages for practical studies in sanitary science. The only disquieting feature of our work is its annual uncertainty,—dependent as it has been thus far upon the beneficence of a single individual. We therefore earnestly appeal to all who realize, as we do, that "the first wealth is health," for a sufficient endowment to insure its permanency. The Institute can be trusted to administer it, to cherish it, and to maintain its efficiency.

WILLIAM T. SEDGWICK,
Director.

DEPARTMENT OF PHYSICS.

The changes which have been made in the instruction in the mathematics given to the first and second-year classes have made possible a better treatment of many of the subjects discussed in the lectures on general physics, because of which fact the whole Course is at present undergoing revision with this end in view. A revised edition of the "Notes on Mechanics," in use for many years, has been prepared by the writer; and a new collection of problems has been issued by Professor Drisko which covers the subjects of mechanics, electricity, and light. It is felt by the instructors that there is a distinct, though gradual, improvement in the knowledge of physics possessed by students on entering the Institute, and this makes possible a corresponding improvement in the results secured in our own courses.

One of the most serious hindrances to increased success is the unduly large size of many of the sections for recitation. The average number per section is too large for fully effective work, and the necessities of the tabular view cause so much inequality in division that certain sections are very unwieldy. With additional instructing force this difficulty could be remedied, provided, of course, that recitation rooms are available to accommodate the increased number of classes. The new system of individual conferences, commenced since the opening of the present school year, gives promise of great benefit from the more intimate relations which it necessarily established between teacher and student.

The experiment begun several years since, of giving special brief courses of illustrated lectures with attendance voluntary, in order to discuss certain newer branches of physics more particularly than is possible in the required course, has proved entirely successful. A course upon Hertz waves and wireless telegraphy was given for the first time in the second term of last year. This was attended by a large number of students whose interest was maintained to the end of the term. A course of like character in polarized light is planned for the autumn of 1909. It is intended that each of these courses shall be given once in two years.

The lectures in heat, fifteen in number, given to all students in the third year have been made somewhat more experimental in their character than was formerly the case. As there are numerous thermal processes and applications, however, which are highly important in certain branches of applied science, Professor Norton, who is in charge of this subject, has laid out a brief special course of technical lectures devoted particularly to such industrial applications of heat.

In the revised course schedules now in effect in the second and third years the long desired arrangement of bringing the laboratory work into closer connection with the class room work in Physics has been effected for all courses except those in Mining and Chemical Engineering. The laboratory work

now begins at the middle of the second year and ends at the conclusion of the course in heat in the third year. An immediate result of this arrangement has been a much greater interest on the part of the students and far more effective work, to which the correlated class room instruction in precision of measurements now given at the beginning of the laboratory work has contributed in no small degree. The Department is very desirous that the time devoted to the laboratory may be increased for all courses by the addition of fifteen hours in the first term of the second year, in order to bring this work into still closer connection with the lectures and to make possible the introduction of a number of electrical experiments in connection with the lecture and class room work in electricity.

In connection with the general laboratory instruction Professor Goodwin has prepared and printed a brief treatment of the subject of precision of measurements and allied topics, and also a new part of his "Laboratory Notes on Optics." A new edition of the "Laboratory Notes on Heat" has also been issued.

An advantageous modification has been made in the Course leading to a degree in pure Physics in the arrangement of the study of theoretical physics, in charge of Dr. Daniel F. Comstock. There is now given a continuous course extending through the whole third and fourth years, beginning with dynamics, occupying a year, which is succeeded by a somewhat advanced course in electrostatics and electrokinetics. Courses in optics by Dr. Comstock and on energetics and the kinetic theory by Professor Goodwin are also given in the fourth year as heretofore.

Aside from the completed investigations, the results of which are embodied in papers already published (see p. 137), a research by Dr. Herbert T. Kalmus, still in progress, should be mentioned in this place. A study of the effect of the ultra-violet radiations of the cadmium spark, when this is of very great power, upon chemico-physiological action and bacterial growth has given results which promise to be of much importance

when fully verified by longer experimentation. For these studies of Dr. Kalmus, the Zeiss ultra violet apparatus has been employed in connection with the powerful induction coil made for the Institute by Heinze of Lowell.

Attention ought also to be called to the investigations regarding the physical properties of concrete throughout wide ranges of temperature, which have been in progress in the laboratory of heat measurements for a year past. This investigation concerns a very important subject since it relates to the properties of a new and important building material whose action under great thermal changes is as yet little understood. The research referred to has been carried on by Mr. Armen H. Tashjian, at present Assistant in heat measurements.

Much new apparatus both for lecture room and laboratory work has been procured during the past year. A very considerable addition has been made to the collection of vacuum tubes, and much miscellaneous mechanical, acoustic, and electrical apparatus has been procured, in part by purchase and in part by construction in the workshop of the Department. In particular, the apparatus for illustration of the lectures on heat has been largely increased. Especially worthy of mention are also several devices for the study of electric waves, those of Lecher and of Coolidge (one of our own graduates) for producing waves in wires. For generating electric waves in space an electric arc lamp of particular construction with needed accessories has been designed by Mr. Eugene D. Forbes of our instructing staff and constructed by the Department mechanician, Mr. Thomas Cloonan. This apparatus is particularly intended for the investigation of wireless telegraphy and telephony.

An important instrument which will be of particular value to the students in Mining and Geology is the Zeiss crystal reflectometer for the investigation of the optical properties of small crystals. This was purchased from the Katharine Bigelow Lowell Bequest. A Brace spectrophotometer has been ordered from Schmidt & Haensch, of Berlin, which will form

an important addition to the apparatus of the optical laboratory.

For the instruction in physico-chemical measurements the latest types of Beckmann boiling and freezing point apparatus have been added, together with apparatus for the determination of critical constants and dielectric constants. The extensive equipment for studies of this character is such that students electing this course have a wide latitude in the choice of work which they may pursue.

In the laboratory of electro-chemistry the most important additions made during the past year have been a new carbide furnace, a Sturtevant crusher, a thermit outfit, and a Féry radiation pyrometer, for the measurement of furnace temperatures. It is hoped that the power available for the work in applied electro-chemistry may be increased during the coming year. The limit of the 30 kilowatt alternator furnishing power to the laboratory has already been reached. With the rapid development of electro-chemistry more time each year is needed for laboratory instruction, especially in high temperature processes.

Our exceptionally extensive collection illustrating the various processes of color photography has received a large increase of lantern slides made by Professor Derr and presented by him to the Institute. These illustrate the new Lumiére and other processes not only as applied to ordinary subjects, but also in their application to micro-photography and to the reproduction of the chromatic phenomena of polarized light. Certain other slides are designed to illustrate the theoretical and practical limitations of color photography in its present stage of advancement.

Since the date of the last Report the Department has received several valuable gifts which are very fully appreciated. Among these should be particularly mentioned a fine compound microscope by Tolles with objectives and accessories from Dr. William Rollins, and also a Geryk air pump from the same donor. Professor Norton has presented to the laboratory of

heat measurements, of which he is in charge, a Callendar electric temperature recorder, which gives a continuous record of high temperatures, as, for example, those of a pottery kiln or an annealing furnace. This instrument, made by the Cambridge (England) Scientific Instrument Co., is the most delicate and beautiful of modern temperature registering devices.

There has also been received from Mr. George Wigglesworth, late Treasurer of the Institute, a generous gift which has enabled the Department to be assured of skilled assistance in the preparation of the lectures, to the great advantage of teachers and students alike.

CHARLES R. CROSS.

DEPARTMENT OF GEOLOGY.

The two most important changes in the work of the Department of Geology in 1908 have been the rearrangement of geological schedules for students of Civil and Sanitary Engineering and the enrolment of an unusual number of graduate students in geology, working for higher degrees. Of the latter, one has been appointed instructor and another assistant in the Department, with the understanding that one-half of their working time be given to study and investigation. Three of the graduate students are candidates for the degree of Doctor of Philosophy. Advanced work in the petrographical laboratory has been carried on by Mr. George W. Edmond, who spent seven months of the winter and spring in exploration of the wild desert region of Lower California north of the 29th parallel of latitude.

Mr. Waldemar Lindgren, M.E., Geologist in charge of the sections of Mining Geology and Metal Statistics of the United States Geological Survey, has been appointed lecturer in Economic Geology for 1908-09, to succeed Professor Kemp. He has secured leave of absence from Washington for five weeks in the late autumn; and during this time, while resident in

Boston, he will give a course of lectures and conferences on ore deposits and economic geology. His course will cover in a broad way the general outlines of the science of mineral deposits, except the hydro-carbons, and lay special emphasis on the mining development of the Cordilleran district. Parts of the work are to be exhibits of lantern slides and a weekly conference with the mining students who take the course.

Professor Jaggar completed during the year a report on the Technology Expedition to the Aleutian Islands in 1907, and published some preliminary papers on that work.

Professor Daly has spent a large part of the year in completing the preparation of the report on the geology of the trans-Cordilleran belt along the 49th parallel boundary between the United States and Canada. A large number of the new rock-analyses have recently been made, making the total number for this report sixty-one. The great value of these complete and accurate analyses has clearly indicated the desirability of there being provided in the Institute similar facilities for making rapid and complete analyses of rocks in connection with the other investigations now in progress in the Geological Department. The Department is still suffering from a lack of lantern slides for use in the various courses of instruction. A special fund, say $200 per year for five years, could be advantageously expended in procuring the slides which are most essential to the Department.

Professor Warren reports additions to the mineralogical and petrographic collections of several suites of rocks from well-known localities in Canada. He gave the summer to travel in various parts of Canada and New England, carrying on mineralogical and petrographic study partly in connection with the work of students and partly by way of making special collections for the Institute. It is to be regretted that, on account of lack of proper cases of drawers, much of this material is inaccessible for study. Professor Warren calls attention to the need of more time for laboratory work in mineralogy, in order that our students of Mining

may acquire a more thorough knowledge of minerals, and to this end urges the holding of a required summer school in surveying between the first and second years in order to relieve the winter schedule of studies. He further calls attention to the great and increasing importance of the science of petrography for students of Mining, all of whom should acquire at least a rudimentary technical knowledge of the common rocks. In this connection it may be said that many advantages would result from a merging of Options I. and III. in the Mining Course; and it is to be hoped that the proposed requirement of summer work will make the distinction between the two Options thereafter unnecessary.

Professor Crosby has continued his work as geological expert in several important branches of the public service.

Professor Shimer reports important additions to the collection of fossils. During the summer Professor Shimer continued work on the book which he is writing jointly with Professor Grabau on North American Index Fossils. During the autumn he took voluntary excursions to places near Boston, in order to study recent and fossil animal life. These expeditions were well attended by students, the average number being eighteen. Professor Shimer strongly recommends the establishment of a field summer school in geology. Other large mining schools demand such field work. Most of the mining students of the Institute get some summer experience in practical mining; but they have small opportunity to study the geology of the mining districts in question and no practical study of fossils in the field. If some region could be found, such as Southern Ontario, where combined work in mining, geological field mapping, and identification of strata by fossils could be done from a single central camp, a school organized for the purpose would be invaluable to the students of the Mining Course.

Mr. Charles H. Clapp, Instructor in geology, is investigating the relations of the igneous rocks of Essex County, Mass. During the summer of 1908 he made, for the Geologi-

cal Survey of Canada, a geological and topographic reconnaissance of the south-eastern portion of Vancouver Island, the area explored including the Mt. Sicker copper district. A preliminary report of the work done will be published in the Summary Report of the Director of the Geological Survey of Canada for 1908. Dr. Gerald F. Loughlin has during the past year assisted in the instruction given in geology at Tufts College and Boston University. He has assumed, with Mr. Clapp, the work of compiling a bibliography of "Economic Geology"; and he has accepted the position of reviewer of American petrographic papers for the Geologisches Zentralblatt. Mr. John A. Allan, a newly appointed assistant in the Department, and Mr. Charles Camsell, a graduate student, were together engaged in exploration for the Canadian Geological Survey in the Similkameen Valley of Southern British Columbia.

The Department is indebted to Mr. Arthur Winslow, '81, for the gift of many sets of scientific periodicals and government reports, which constitute a valuable addition to the departmental library. The seismograph provided by the Trustees of the C. A. R. Whitney Estate and constructed by the firm of J. and A. Bosch in Strassburg, Germany, was delivered in Boston in November, 1908.

THOMAS A. JAGGAR, JR.

DEPARTMENT OF NAVAL ARCHITECTURE.

The Department of Naval Architecture, though the most recently established, has now been in operation for fifteen years. During that time, the Course has been so far developed and the equipment so far completed that changes and additions for such a period as one year may be only of minor importance. Such is the case for the year just passed. During the last year, however, a notable change was made in the curriculum of study for this Course, which is now in progress. Mention

may again be made of the addition of a torsion-meter to our equipment. This has enabled us to undertake a very important test on the steamship "Harvard" of which a recent report has been made to the Society of Naval Architects and Main Engineers. This test and that reported last year on the steamship "Governor Cobb" give us an established position along this new line of engineering development, comparable to that which we have attained for the older type of steamer. Meanwhile, the development of steam-turbine work in connection with our course in marine engines gives us a corresponding leading position on the theoretical side. As showing the interrelation of departments at the Institute, this development in our Department has made it possible to offer an Option in steam-turbine engineering in the Course in Mechanical Engineering.

Through the interest of a friend of the Institute lectures have been given every year by eminent men in the profession. This year, in addition to other lectures, a course will be given during the month of April, by M. Bertin, Directeur de Construction Navale (en retraite) au Ministère de la Marine Française. M. Bertin is not only a leading authority in his profession, but a distinguished lecturer, and his wide experience in connection with governmental and private work is sure to make this course one of unusual interest.

The Department has recently received the professional library of Admiral Philip Hitchborn, U.S.N., former Chief Constructor. The distinction of the donor and the importance of the books make this gift a valuable addition to our library.

C. H. PEABODY.

DEPARTMENT OF MATHEMATICS.

The period covered by the present Report has been characterized by continued progress in the remodelling of our general mathematical course, and by a considerable number of changes in the personnel of the Department.

With the present second-year class we are using in pamphlet form the earlier chapters of Woods & Bailey's Course in Mathematics, Part II. These chapters are devoted mainly to methods and applications of definite integrals, including the mean value of functions, areas bounded by curves, length of curves, volumes of certain solids, and various applications to mechanics, including work, attraction, pressure, and centre of gravity. It is expected that the remainder of the second volume will be ready in March. The advantages of the new program have, so far as can be judged from experience up to this time, fully justified the very considerable labor involved in working it out. Incidentally it has naturally been necessary to make special provision for graduates and students from other colleges securing admission to the second year without preparation in that part of the calculus now taught in our first year. Special supplementary lectures on the differential calculus have been given to these students outside of the regular tabular-view hours.

The changes of personnel referred to include the resumption of teaching by Professor Bartlett after two years' service as Acting Secretary of the Institute; the return of Dr. Moore from a year's leave of absence spent with much profit in geometrical studies at Turin; the resignations of Instructors Miller, Roever, and Lennes, and the appointment of Mr. Joseph Lipke to the same grade. Mr. Miller is now engaged in private business; Dr. Roever has been appointed an assistant professor at Washington University, of which he is a graduate; and Dr. Lennes is instructor in Brown University. All three men had rendered excellent service in the Department. Mr. Lipke comes to us as a graduate of Columbia University, after a year of valuable teaching experience at the University of California. In connection with this appointment it may be noted that the twelve persons now teaching in the mathematical department hold degrees from eleven different institutions, only two being graduates of the Institute. While an appointment policy so antithetical to "in-breeding" may be attended with certain

difficulties in securing the necessary co-ordination of methods and points of view, the variety in itself has proved stimulating, and the difficulties have been met by free discussion of matters of common interest in the bi-weekly department meetings which have been held since 1902.

H. W. TYLER.

DEPARTMENT OF DRAWING AND DESCRIPTIVE GEOMETRY.

During the last year a slight change was made in the instruction of the first-year students, Mr. Burrison giving the lectures in descriptive geometry in Huntington Hall. Although the number of students passing in the subjects of mechanical drawing and descriptive geometry was not markedly different from the preceding years, it is safe to say that the quality of the work of those who did pass was considerably improved.

At the close of the year Mr. Bradley and Mr. Kenison were promoted by the Corporation to the rank of Assistant Professors; and Mr. Sawyer tendered his resignation as Instructor in Freehand Drawing. It was found possible, by means of some rearrangement of the work and by the fact that Professor Adams and Mr. Bradley were now free to give a larger portion of their time to teaching, to continue the instruction for the coming year without replacing Mr. Sawyer.

The second part of the text-book in descriptive geometry is now ready for use by the students. The Department has been greatly in need of a suitable text-book on this subject, in order that the students might have a chance to study it in addition to the lectures. We now feel that we have, in the text-book in mechanical drawing, and in the two parts of the descriptive geometry, books which practically cover all the lectures given in the first year.

There were frequent Department conferences throughout the year, and among other things discussed was a plan for a radical

change in the teaching of the mechanical drawing and descriptive geometry. This change consists chiefly in the division of the class into four sections, each of which is to be assigned to an instructor who shall have entire charge and responsibility for the students assigned to him. The whole work, however, is to be under the general direction and supervision of one man. In order to make this plan a success it will be necessary to have four drawing rooms, each of which can be reserved for the exclusive use of one section. By this division of the work a greater incentive is given to the younger instructors to keep their men up to the standard. The comparison of the different sections will be made at the end of each term by an examination given by the man having general oversight of the work. It will also be possible under this arrangement to make the classes for one man smaller than they have been in recent years. It has been found by experience that personal instruction given at the drawing table is more valuable than the instruction given from the lecture platform. A plan for the arrangement of rooms on the fourth floor of the Rogers Building has been submitted to the President for his approval, and it is hoped to begin this work next year. It would have been undertaken at once had it not been for the expense and time necessary to fit these rooms up as suitable drawing rooms. In this way it will be possible to create a greater interest in the instruction among the younger men of the staff, and to produce a higher percentage of good work among the students; for, while descriptive geometry is not an exceedingly difficult subject as compared with some of the mathematical courses, it is a subject of an entirely different character from those which have been followed by the students before entering the Institute, and there is a greater difficulty in starting new men in this work than is encountered in any other first-year subject.

ALFRED E. BURTON.

DEPARTMENT OF MECHANIC ARTS.

The total number of students receiving instruction in the Mechanical Laboratories is two hundred and seventy-one. Some of these attend in more than one class, the numbers in the several subjects being as follows:—

Subject.	*Course.*	*Students.*
Carpentry and Wood Turning	II.	62
Joinery and Pattern Work	VI.	33
Forging	II. and XIII.	81
Metal Turning	VI., VIII., and X.	56
Chipping and Filing	II. and XIII.	60
Machine Tool Work	II. and XIII.	54
Total in all classes		346

The total number of students attending last year was two hundred and eighty-six. Many students from mechanic arts high schools have been excused from attending the carpentry, wood turning, and forging classes, and some from pattern work. The number of excuses granted in these earlier subjects is still increasing, but is not yet sufficiently large to warrant omitting the elementary and giving only the advanced wood work. It is believed that it will be advisable to provide advanced work in the wood-working department in the not far distant future.

Summer School.—The attendance in the Summer School was 46, a decrease of 20 as compared with last year. The numbers attending in the several classes were: wood work, 13; forging, 8; chipping and filing, 4; metal turning, 5; machine tool work, 16.

The proportionately large attendance in the machine-tool work continues, due to the desire of many students to anticipate the mechanic arts of the Senior year and thus obtain additional time for thesis and other departmental or allied work.

Equipment.—The following new machines and apparatus have been added to the equipment in the Machine Tool Laboratory:—

A Lucas power forcing press, a Gisholt universal tool grinder, a show case of emery wheels from the American Emery Wheel Works of Providence, R.I., and a case of Alundum wheels from the Norton Company of Worcester, Mass.

In addition the following new machines have replaced old ones: one Reed engine lathe with compound rest and taper attachment in the lecture room; five Reed engine lathes in the laboratory.

The prices on the above-mentioned machines were made very liberal, a considerable portion of the usual trade prices being donated by the manufacturers.

To maintain the required high standard of work in the Machine Tool Laboratory seven engine lathes, five speed lathes, and a planer purchased in 1876 should be replaced with modern tools. A small radial drill and an additional universal milling machine are also needed.

The installation of an automatic screw machine would permit adding instruction in the operation of automatic machines to our course.

Some of the equipment in the Wood Working Laboratory, in use since 1877, should be renewed. The addition of a few larger lathes and a surface planer is also desirable.

The equipment of the Forging Laboratory is now nearly worn out and can be kept in proper condition but a few years longer. Six new anvils were added last year, and the sheet metal work about the forges was repaired. Thirty-two new tool benches are much needed. So much of this equipment is of a fixed character that it is inadvisable to renew the same in case the laboratories are to be moved in the near future.

The Foundry equipment must be repaired and a new and larger cupola furnace should be installed before the opening of next year.

The quarters vacated by the old Technology Union have been given to the Department. This space will be utilized for an extension of the filing laboratory; for instruction in pipe fitting, which relieves much needed space in the machine-tool

laboratory; for a lecture room; and for machinery illustrating the use of pneumatic tools, which it is hoped soon to install.

Building.—The building is in fair condition, but new floors are advisable in the machine-tool and wood-turning laboratories, the present floors being too unsteady for good machine work. The lighting is not sufficiently good to enable exact work to be done, and the present inadequate gas-lighting system, installed in haste in 1884, should be replaced by a modern electric system.

PETER SCHWAMB.

DEPARTMENT OF ENGLISH.

In the Department of English the changes of the year have been mainly in the line of endeavors to improve methods already in operation and to render them more effective. The division of classes into small sections is made more difficult by the increasing number of students in successive classes; but this has been in part balanced by the exchange of an assistant giving but half time for an instructor whose whole time is available. The conference work has been constantly increased and improved, and is proving of the greatest practical value. In both first and second-year English new plans and methods are tried each year, at once for the sake of finding the best and of keeping the instructing staff alert and interested.

The most serious need of the Department is that of more time. Within recent years an advance has been made in this direction, but it is strongly felt by all the English instructors that in each term of the first and of the second year should be a 30–30 course in composition or literature. A most important step in this direction was made when a 30–0 course in rhetoric was put into the second term of Freshman year; and another advance was made when in the first term of Sophomore year the Courses in Civil, Mechanical, and Sanitary En-

gineering and in Naval Architecture were advanced from 15–5 in English literature to 30–30. The time in the first instance should be doubled, and in the second the arrangement should be extended to all courses. The readjustment which must soon be made of released time should provide for these needs in English.

ARLO BATES.

DEPARTMENT OF ECONOMICS.

The efforts of the Department during the past year have been in the direction of closer supervision of individual work. Conference work in general political economy has been emphasized more and more each year. For example, during the first half-year Professor Doten met 234 men for conferences of from fifteen to twenty minutes each, by special appointment. This work has proved very helpful in clearing up individual difficulties which could not be so well handled in lectures or recitations. It seems desirable to continue this plan, although it involves a great amount of labor.

In the special subjects of the second half-year the personal contact between student and teacher is maintained by means of laboratory methods in investigating special problems. Under this plan the classes in banking and finance, railroad economics, labor problems, etc., are divided into small sections for the third hour of the week, and each section works in the library or class room under the direct supervision of the instructor.

DAVIS R. DEWEY.

DEPARTMENT OF MODERN LANGUAGES.

During the past year the work of the Department has been carried on in accordance with the plan set forth in the Catalogue, except that elementary German, not included therein, has been offered with the approval of the Faculty. The subjects taught and the number of students taking each are shown by the following table:—

Subject.	*Sections.*	*Students.*	*Average Size of Section.*
Italian	1	1	1
French II.	9	198	22
French IIIA	1	7	7
French IIIB	1	22	22
French Colloquium	1	19	19
German I.	2	63	31.5
German II.	11	174	15.8
German III.	1	22	22
German IIIB	1	19	19
German Colloquium	1	28	28
Spanish I.	2	32	16
Spanish II.	2	7	3.5
Spanish III.	1	10	10
	34	602	16.7

Number of students taking French	246
Number of students taking German	306
Number of students taking Spanish	49
Number of students taking Italian	1

A comparison of this table with the corresponding one of last year suggests the following comments:—

1. The total number of students taking modern languages is only five less than it was last year.

2. The size of the average section has increased from 16.2 to 16.7. The most effective instruction is given in sections of from 10 to 12 students. Fifteen is considered a proper maximum. At present, there are 5 sections that number more than 25 students and 2 that number more than 30.

3. Three courses are given that were not given last year,

Spanish III, French IIIB, and German IIIB. This is the first year in which the last two courses, especially provided for students of Course VI., have been offered. Esperanto is offered for the first time, to begin with the second term.

4. The number of students taking elementary German has increased from 39 to 63. It seems probable that the number will further increase as it becomes more widely known that this subject, though not in the Catalogue, is given at the Institute. This raises the question whether the course had not better be announced hereafter in the Catalogue or the offering of it absolutely discontinued.

A large number of students desired to take Spanish, if they could be credited with it as a third-year option, but could not afford to do so if they had to take the option as an extra subject. The practical prohibition of the study of Spanish to regular students, not having advanced standing, appears to be felt especially in the Course in Mining. Students of this Course commonly look forward to working in Spanish-speaking countries, and seem to appreciate the hopelessness of finding a Spanish-American who can and will do business in English.

The Department experimented during the past year with the system of conferences, and would have used it extensively this year had not the force of the instructing staff been reduced.

The condition of the Department, so far as I am able to judge, will compare favorably with that of similar departments in other colleges of the country; but it is not what it might and should be. The Department would be much improved by the following innovations:—

1. Change of time distribution for the students, from 3 hours of class-room exercise and 6 hours of preparation, to 4 hours of class-room exercise and 5 hours of preparation per week. The present distribution is antiquated and wasteful.

2. Oral tests at entrance examination. The proper teaching of a language, whether for reading or for speaking, depends

upon a certain familiarity with the sound of the language. This ought to be the first thing imparted to the student. Our instructors should not have to teach our students, as they now do, the sound of the French alphabet.

3. A sufficient number of instructors to keep the size of the average section down to 15 students, to provide for conferences, and to admit of the change of time distribution already suggested.

4. Administrative measures that would secure for the modern language instruction more than it now has of the time nominally assigned to it. The optional courses in modern languages are not fairly started until about two weeks after the commencement of the term. Towards the end of the term students absent themselves more or less from modern language exercises to prepare for examinations in other subjects. Throughout the term they are commonly late or absent because they have been kept at shop work or assaying up to the end of the preceding hour or later, and then have had to wash or change their clothes. Moreover, interference sometimes results from subjects that are neither announced in the Catalogue nor provided for in the Tabular View. Thus, at the beginning of a term, at the end, and in between, the Department loses much time that would seem to belong to it. It is desirable also that hours assigned to modern languages in the Course for Naval Constructors be embodied in the Tabular View, and that three hours be reserved weekly for exercises in third-year general studies. There was but one hour reserved this term, leaving two to be determined from Tabular View cards, Having a number of courses to arrange in this way after the beginning of each term, I should appreciate anything that might be done to diminish the labor which it involves, and the consequent delay in the commencement of the term's work.

For the cutting of recitations towards the end of a term, two remedies suggest themselves: a strict adherence to the requirements in modern languages, especially for graduation, and a general abolition of final examinations.

The summer reading of last year in foreign languages, with the number of books to every ten students since this work was instituted, is shown in the following table:—

Year.	*No. of Reports Received.*	*No. of Foreign Books Read.*	*No. to every Ten Students.*		
			1906.	1907.	1908.
First	182	31	1.17	1.22	1.70
Second	179	29	1.29	1.34	1.62
First and second . . .	361	60	1.23	1.27	1.66

Mr. Dike has rendered a report on his observations of modern language teaching in France. Copies of this report have been furnished to all instructors in the Department for their perusal and consideration, and a meeting has been called for a general discussion of it. The idea suggested of avoiding the use of English in the class room is no new one to us. We have fully discussed it, and, while not in perfect, are in substantial accord as to its advantage and feasibility.

Mr. Dike informs us that the reform of modern language teaching in France came "from above," and remarks that at the Institute not half of its result can be obtained "for to a large extent the method of teaching is dictated by that of the preparatory schools, and in these the method of teaching by translation is hereditary." He probably does not mean to imply that the preparatory schools are primarily responsible for the backward state of modern language teaching in America, which in my judgment would be doing the schools a serious injustice. The method of teaching by translation is not as hereditary with them as it is with the colleges. The work of the schools consists largely in preparing pupils for college. If the colleges do not recognize oral language as of any value, giving their students no credit for it, how can it be expected that the schools will give any appreciable attention to it? The Modern Language Association of New England, composed for the greater part of school teachers, has expressed itself clearly and emphatically in favor of an oral test for college entrance. The Modern Language Association of America and the College Entrance Examination Board are now taking

the matter up. All this is due to the influence of the preparatory schools. For years the colleges, especially the larger and older universities, with their traditional disdain for the utilities, have sat like an incubus upon the comparatively young, progressive, and practical preparatory schools. The needed reform is coming, I believe, with us, not from above, but from below.

The work of Dr. Hermann A. Schumacher, exchange teacher from Germany, deserves special mention. In accordance with the original announcement by bulletin Dr. Schumacher has given a number of weekly talks for students registering therefor, which all members of the instructing staff of the Institute were invited to attend. I have attended a number of these talks. It is perhaps too soon to judge of their value to the Institute. Students attending them appear to be interested, and I judge therefrom that they understand and follow the lecturer. There is little or no conversation. The topics covered thus far are German Schools and Universities, the German Army, and the German Government. The attendance has averaged about twenty-eight students.

JOHN BIGELOW, JR.

The Society of Arts.

The report of the Executive Committee of the Society of Arts of a year ago entered somewhat at length into the purposes of the Society and its relation to the Institute and the public.

During the past year twenty-one members have been dropped for non-payment of dues, nine have resigned, chiefly as the result of persistent efforts to collect dues in arrears, one has died, and two have been elected to membership. There are at present two hundred and ninety-four associate members, forty-six of whom have paid twenty or more annual assessments, and are entitled to the benefits of life membership without further payment of dues.

The attendance at the meetings has been fairly good: eighteen was the smallest and two hundred and twenty the largest audience, with fifty or sixty a fair average.

There were thirteen meetings during the winter, with talks on the following topics:—

"Chilled Car Wheels." By Mr. F. A. Beebee, Assistant Manager of the Griffin Wheel Company, Chicago.

"The Grand Canyon District." By Professor Douglas W. Johnson, of Harvard University.

"Refrigeration." By Mr. Norman H. Cheney, Chief Engineer of the Merchants Cold Storage & Freezing Company, Providence.

"Forestry." By Mr. Phillip W. Ayers, State Forester of New Hampshire.

"Denatured Alcohol." By Rufus S. Herrick, Chemist, of Boston.

"Ascents of Orizaba and Colima, two Mexican Volcanoes." By Professor John E. Wolff, of Harvard University.

"The Evolution of Bogoslof, a new Volcano in Behring Sea." By Professor Thomas A. Jaggar, Jr., Institute of Technology.

"The Curtis Steam Turbine." By Mr. Charles B. Burleigh, of the General Electric Co., Boston.

"Recent Developments in Fire Protection Devices." By Mr. Gorham Dana, of Boston.

"The Lumière Autochrom Plates." By Mr. J. E. Brulatour, of the Lumière Co., New York.

"The Deflocculation of Non-Metallic Amorphous Bodies, with Special Reference to Graphite as a Lubricant." By Mr. E. G. Acheson, President of the Acheson International Graphite Co., of Niagara Falls.

"Factors Governing the Rates of Public Service Corporations and the Government Control of Rates." By Professor Dugald C. Jackson, Institute of Technology.

"The Quebec Bridge Disaster." By Professor George F. Swain, Institute of Technology.

For the Executive Committee,

EDMUND H. HEWINS, *Chairman.*
WALTER S. LELAND, *Secretary.*

Publications.

THE INSTITUTE.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY.—President's Report. *Bulletin of the Massachusetts Institute of Technology*, Vol. XLIII., No. 2. 161 pp. Boston, January, 1908.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY.—Advanced Study and Research. *Bulletin of the Massachusetts Institute of Technology*, Vol. XLIII., No. 1, Part 2. 41 pp. Boston, February, 1908.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY,—Summer Courses. *Bulletin of the Massachusetts Institute of Technology*, Vol. XLIII., No. 2, extra number. 15 pp. Boston, March, 1908.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY.—Register of Graduates. *Bulletin of the Massachusetts Institute of Technology*. Vol. XLIII., No. 3. 401 pp. Boston, March, 1908.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY.—Programme. *Bulletin of the Massachusetts Institute of Technology*, Vol. XLIII., No. 4. 381 pp. Boston, June, 1908.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY.—Officers of Instruction, 1908–09. Boston, November, 1908.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY.—Catalogue. *Bulletin of the Massachusetts Institute of Technology*, Vol. XLIV., No. 1. 463 pp. Boston, December, 1908.

ADMINISTRATIVE OFFICERS.

ARTHUR A. NOYES.—The Choice of a Course of Study. An address to the first-year class of the Massachusetts Institute of Technology. Printed separately. 1907.

ARTHUR A. NOYES.—Education in Engineering and Applied Science at the Massachusetts Institute of Technology. Address at the annual meeting of the Alumni Association of the Institute. *Technology Review*, January, 1908. Printed separately.

ARTHUR A. NOYES.—Address to the Graduating Class of the Massachusetts Institute of Technology. Printed separately. 1908.

ARTHUR A. NOYES.—A Talk on Teaching, given at a conference of members of the Instructing Staff of the Massachusetts Institute of Technology. *Science*, Vol. XXVIII., No. 724, p. 657. Printed separately.

ARTHUR A. NOYES.—Address to New Students at the Massachusetts Institute of Technology. Printed separately. November, 1908.

FRANCIS R. HART.—The Attacks upon the Spanish Main by Admiral Vernon. *Journal of American History*, Vol. II., No. 2, 1908.

JAMES P. MUNROE.—The Commonwealth and the Institute. *Technology Review*, April, 1908.

JAMES P. MUNROE.—The Heart of the United States. *Atlantic Monthly*. September, 1908.

JAMES P. MUNROE.—The Specialist Blight on American Education. *Popular Science Monthly*, October, 1908.

CIVIL ENGINEERING.

GEORGE F. SWAIN.—Report on Railroad and Street Railway Bridges in Massachusetts. *Report of Massachusetts Railroad Commission*, January, 1908.

GEORGE F. SWAIN.—Discussion on the Teaching of Mathematics to Engineers. *Science*, Vol. XXVIII., September, 1908.

C. FRANK ALLEN.—Technical Education for the Profession of Railroading. *Railroad Men*, December, 1908.

WILLIAM E. MOTT.—Review of Gibson's "Hydraulics" and Meade's "Waterpower Engineering." *Technology Quarterly*, Vol. XXI., December, 1908.

GEORGE L. HOSMER and CHARLES B. BREED.—The Principles and Practice of Surveying. Vol. II., 1908.

GEORGE E. RUSSELL.—Notes on Hydraulics. Revised and enlarged edition. Boston. 1907.

LEWIS E. MOORE and GEORGE A. GOODENOUGH.—Strength of Chain Links. University of Illinois, Engineering Experiment Station, *Bulletin*, No. 18.

MECHANICAL ENGINEERING.

GAETANO LANZA.—Report of the Committee on Standard Methods of Tests. *Proceedings American Society for Testing Materials*, 1908.

CECIL H. PEABODY and EDWARD F. MILLER.—Steam Boilers. Revised edition. New York. John Wiley & Sons. 1908.

CHARLES W. BERRY.—Temperature Entropy Diagram. Revised edition. New York. John Wiley & Sons. 1908.

MINING ENGINEERING AND METALLURGY.

ROBERT H. RICHARDS.—Velocity of Galena and Quartz falling in Water. *Transactions American Institute of Mining Engineers*, Vol. XXXVIII., p. 210, 1907.

ROBERT H. RICHARDS.—The Wilfley Table I. *Transactions American Institute of Mining Engineers*, Vol. XXXVIII., p. 556, 1907.

ROBERT H. RICHARDS.—The Wilfley Table II. *Transactions American Institute of Mining Engineers*, Vol. XXXIX., 1908.

ROBERT H. RICHARDS and CHARLES E. LOCKE.—Progress in Gold Milling in 1907. *The Mineral Industry*, Vol. XVI., p. 553, 1907.

ROBERT H. RICHARDS and CHARLES E. LOCKE.—Progress in Ore Dressing and Coal Washing in 1907. *The Mineral Industry*, Vol. XVI., p. 960, 1907.

HEINRICH O. HOFMAN and W. MOSTOWITSCH.—The Behavior of Calcium Sulphate at Elevated Temperatures with some Fluxes. *Transactions American Institute of Mining Engineers*, Vol. XXXIX., 1908.

HEINRICH O. HOFMAN and CARLE R. HAYWARD.—Pan Amalgamation. An instruction laboratory experiment. *Transactions American Institute of Mining Engineers*, Vol. XXXIX., 1908.

HEINRICH O. HOFMAN.—Recent Improvements in Lead Smelting. *The Mineral Industry*, Vol. XVI., p. 657, 1907.

HEINRICH O. HOFMAN.—Review of Vol. II. of Henry Louis' translation of Schnabel's "Handbook of Metallurgy." *American Chemical Journal*, Vol. XXXVIII., p. 379, 1907.

HEINRICH O. HOFMAN.—Review of Bett's "Lead Refining by Electrolysis." *American Chemical Journal*, Vol. XXXIX., p. 493, 1908.

CHARLES E. LOCKE.—See Robert H. Richards.

EDWARD E. BUGBEE.—Report upon Mines and Mining Districts in Oregon and Washington made to the United States Geological Survey.

CARLE R. HAYWARD.—See Heinrich O. Hofman.

CHEMISTRY AND CHEMICAL ENGINEERING.

HENRY P. TALBOT.—An Introductory Course of Quantitative Chemical Analysis. Fifth edition. Rewritten and Revised. New York. Macmillan Co. 1908.

HENRY P. TALBOT.—Some Recent Investigations in the Chemical Department. *Technology Review*, Vol. X., p. 405.

WILLIAM H. WALKER.—The Relation of Chemistry to Street Railway Work. *Street Railway Bulletin*, Vol. VII., pp. 134–136.

WILLIAM H. WALKER.—Standard Methods of Analysis for Chrome Tanning Materials. *Journal of the American Leather Chemists Association*, Vol. III., pp. 267–269.

HENRY FAY.—A Microscopic Investigation of Broken Steel Rails: Manganese Sulphide as a Source of Danger. *Proceedings of the American Society for Testing Materials*, Vol. VIII., 1908.

AUGUSTUS H. GILL.—On the Oxidation of Olive Oil. *Journal of the American Chemical Society*, Vol. XXX., p. 874.

AUGUSTUS H. GILL.—Gas and Fuel Analysis for Engineers. Fifth Edition. New York. John Wiley & Sons. 1908.

AUGUSTUS H. GILL.—Chapter on Wool Oil in Allen's "Commercial Organic Analysis."

AUGUSTUS H. GILL.—Engine Room Chemistry. Second Edition. New York. Hill Publishing Co.

FRANK H. THORP.—Summer School of Industrial Chemistry. *Technology Review*, Vol. X., p. 425.

F. JEWETT MOORE and ROGER D. GALE.—The Colored Salts of Schiff's Bases. A contribution to our knowledge of color as related to chemical constitution. I. The Hydrochlorides of Bases formed by condensing *p*-Amino Dimethylaniline with Aromatic Aldehydes. *Journal of the American Chemical Society*, Vol. XXX., p. 394; *Technology Quarterly*, Vol. XXI., No. 2, pp. 200–211, 1908.

F. JEWETT MOORE and R. G. WOODBRIDGE, Jr.—The Colored Salts of Schiff's Bases. II. The Hydrochlorides of Bases formed by condensing *p*-Amino Diphenylamine with Aromatic Aldehydes. *Journal of the American Chemical Society*, Vol. XXX., pp. 1001–1004.

ALPHEUS G. WOODMAN and A. L. BURWELL.—The Detection of Formic Acid in Food Products. *Technology Quarterly*, Vol. XXI., No. 1, p. 1, 1908.

ALPHEUS G. WOODMAN and E. H. NEWHALL.—The Detection of Caramel in Vanilla Extract. *Technology Quarterly*, Vol. XXI., No. 3, p. 280, 1908.

ALPHEUS G. WOODMAN and E. F. LYFORD.—The Colorimetric Estimation of Benzaldehyde in Almond Extracts. *Journal of the American Chemical Society*, Vol. XXX., p. 1607.

ARTHUR A. BLANCHARD.—Synthetic Inorganic Chemistry. New York. John Wiley & Sons. 1908.

ELLEN H. RICHARDS.—Laboratory Notes on Industrial Water Analysis. New York. John Wiley & Sons.

ELLEN H. RICHARDS.—The Cost of Cleanness. Cost Series, Vol. IV. New York. John Wiley & Sons.

ELLEN H. RICHARDS, E. MARION WADE, ROYCE W. GILBERT, CARL E. HANSON, and JAMES M. TALBOT.—Methods of Testing Efficiency in Ventilation. *Technology Quarterly*, Vol. XXI., No. 3, pp. 321–331.

ELLEN H. RICHARDS.—Farm Home a Centre of Social Progress. Encyclopædia of American Agriculture, Vol. III.

ELLEN H. RICHARDS.—Household Science in Elementary and Secondary Schools. *Proceedings of the National Educational Association.* Cleveland, Ohio, June 29–July 3, 1908.

JOSEPH W. PHELAN.—The Determination of Acids used in the Tannery. *Journal of the American Leather Chemists Association*, Vol. III., No. 10.

JOSEPH W. PHELAN and P. S. FISKE.—The Acidity of Tan Liquors. *Journal of the American Leather Chemists Association*, Vol. III., No. 4.

WILLIAM T. HALL and GEORGE DEFREN.—Text-book of Physiological Chemistry in thirty lectures, by Emil Abderhalden. (Translation.) New York. John Wiley & Sons.

ELWOOD B. SPEAR.—Catalytic Decomposition of Hydrogen Peroxide under High Pressures of Oxygen. *Journal of the American Chemical Society*, Vol. XXX., p. 195.

ELWOOD B. SPEAR, ARTHUR A. NOYES, and WILLIAM C. BRAY.—A System of Qualitative Analysis for the Common Elements. *Journal of the American Chemical Society*, Vol. XXX., p. 481.

WARREN K. LEWIS.—Eine neue Methode zur Berechnung von Ionen Koncentrationen. *Zeitschrift für physikalische Chemie*, Vol. LXIII., p. 177.

PAUL S. FISKE.—See Joseph W. Phelan.

R. G. WOODBRIDGE, Jr.—See F. Jewett Moore.

ROGER D. GALE.—See F. Jewett Moore.

RESEARCH LABORATORY OF PHYSICAL CHEMISTRY.

Serial Publications of the Research Laboratory.

No. 20.—The Theory and Practice of the Iodimetric Determination of Arsenious Acid. By Edward W. Washburn. *Journal of the American Chemical Society*, Vol. XXX., p. 31.

No. 21.—The Equivalent Conductance of Hydrogen-ion derived from Transference Experiments with Nitric Acid. By Arthur A. Noyes and Yogoro Kato. *Journal of the American Chemical Society*, Vol. XXX., p. 318.

No. 22.—The Conductivity and Ionization of Salts, Acids, and Bases in Aqueous Solutions at High Temperatures. By Arthur A. Noyes. *Jour-*

nal of the American Chemical Society, Vol. XXX., p. 335; *Journal de Chimie Physique*, Tome VI., p. 505.

No. 23.—A System of Qualitative Analysis for the Common Elements. III. Analysis of the Aluminum and Iron Groups, including Beryllium, Uranium, Vanadium, Titanium, Zirconium, and Thallium. By Arthur A. Noyes, William C. Bray, and Ellwood B. Spear. *Journal of the American Chemical Society*, Vol. XXX., p. 481.

No. 24.—Solutions of Metals in Non-Metallic Solvents. II. On the Formation of Compounds between Metals and Ammonia. By Charles A. Kraus. *Journal of the American Chemical Society*, Vol. XXX., p. 653.

No. 25.—The Osmotic Pressure of Concentrated Solutions, and the Laws of the Perfect Solution. By Gilbert N. Lewis. *Journal of the American Chemical Society*, Vol. XXX., p. 668.

No. 26.—The Effect of Concentration and Ionization on the Rates of Diffusion of Salts in Aqueous Solution. By R. Haskell. *Physical Review*, Vol. XXVII., p. 145.

No. 27.—On the Conductance and Fluidity of Fused Salts. By Harry M. Goodwin and Herbert T. Kalmus. *Physical Review*, Vol. XXVII., p. 322.

No. 28.—The Latent Heat of Fusion of Salts and the Specific Heat of Salts in the Liquid and Solid States. By Harry M. Goodwin and Herbert T. Kalmus. *Physical Review*, December, 1908.

No. 29.—A Revision of the Fundamental Laws of Matter and Energy. By Gilbert N. Lewis. *Technology Quarterly*, Vol. XXI., p. 212; *Philosophical Magazine*, November, 1908; *Annalen der Naturphilosophie*, December, 1908.

No. 30.—Solutions of Metals in Non-Metallic Solvents. III. The Apparent Molecular Weight of Sodium dissolved in Liquid Ammonia. By Charles A. Kraus. *Journal of the American Chemical Society*, Vol. XXX., p. 1197.

No. 31.— I. An Improved Apparatus for the Measurement of Transference Numbers in Solutions of the Halogen Acids and their Salts. By Edward W. Washburn. *Technology Quarterly*, Vol. XXI., p. 164.

No. 32.—Free Energy Changes involved in the Formation of Certain Carbonates and Hydroxides from the Corresponding Oxides. By John Johnston. *Journal of the American Chemical Society*, Vol. XXX., p. 1357.

No. 35.—The Determination of Ionic Hydration from Electromotive Force. By Gilbert N. Lewis. *Journal of the American Chemical Society*, Vol. XXX., p. 1355; *Zeitschrift für Elektrochemie*, Band XIV., S. 509.

No. 36.—Solutions of Metals in Non-metallic Solvents. IV. Material Effects accompanying the Passage of an Electrical Current through Solutions of Metals in Liquid Ammonia. Migration Experiments. By Charles A. Kraus. *Journal of the American Chemical Society*, Vol. XXX., p. 1323.

No. 37.— II. Determination of the Hydration of Ions by Transference Experiments in the Presence of a Non-electrolyte. By Edward W. Washburn. *Technology Quarterly*, Vol. XXI., No. 3, pp. 288–320.

No. 38.—Hydrates in Solution. A review of recent experimental and theoretical contributions. By Edward W. Washburn. *Technology Quarterly*, Vol. XXI., No. 4, 1908.

No. 39.—A System of Qualitative Analysis for the Common Elements. IV. Analysis of the Alkaline-Earth and Alkali Groups. By William C. Bray. *Technology Quarterly*, Vol. XXI., No. 4, 1908.

Other Publications of the Research Staff.

GILBERT N. LEWIS.—The Ionic Theory. *School Science and Mathematics*, Vol. VIII., p. 484.

CHARLES A. KRAUS (with E. C. FRANKLIN).—Experimental Determination of the Heat of Volatilization of Liquid Ammonia at its Boiling Point. *Journal of Physical Chemistry*, Vol. XI., p. 553.

JOHN JOHNSTON.—Ueber die Dissociationsdrucke einiger Metallhydroxyde und Carbonate. *Zeitschrift für Physicalische Chemie*, Band 62, s. 330.

EDWARD W. WASHBURN.—Hydrates in Solution. A critical review. *Jahrbuch der Radioaktivität und Elektronik*, 1908.

ELECTRICAL ENGINEERING.

DUGALD C. JACKSON.—Report to the Massachusetts Highway Commission: being an answer to three questions asked by the Commission, growing out of the Investigation of the New England Telephone and Telegraph Company, March 10, 1908.

DUGALD C. JACKSON.—An Important Committee on Engineering Education. *Technology Review*, July, 1908.

DUGALD C. JACKSON and SAMUEL SHELDON.—Preliminary Report of Joint Committee on Engineering Education. *Proceedings Society for the Promotion of Engineering Education*, Vol. XVI.

DUGALD C. JACKSON.—Contributions to the Discussions of the American Institute of Electrical Engineers and the American Society of Mechanical Engineers. *Transactions of those Societies*, 1908.

HARRY E. CLIFFORD.—Contributions to the Discussions of the American Institute of Electrical Engineers and the Illuminating Engineering Society. *Transactions of those Societies*, 1908.

HARRISON W. SMITH.—Demonstration Apparatus for illustrating Commutation. *Electrician* (London), January, 1908; *Technology Quarterly*, Vol. XXI., No. 2, 1908.

GEORGE C. SHAAD.—Review of Barr's "Principles of Direct-Current Electrical Engineering." *Science*, Vol. XXVIII., No. 717, p. 410, 1908.

GEORGE C. SHAAD.—The Practicability of Electrifying the Hoosac Tunnel: being an abstract of a thesis by Messrs. Hayes and Warren. *Electric Railway Journal*, Vol. XXXII., pp. 1245–1247, 1908.

CHARLES H. PORTER.—Contributions to the Discussions of the American Institute of Electrical Engineers. *Transactions*, 1908.

HAROLD G. CRANE.—Review of Hay's "Continuous Current Engineering." *Technology Quarterly*, Vol. XXI., No. 1, 1908.

WALDO V. LYON.—Problems in Electrical Engineering. New York. McGraw Publishing Co.

WALDO V. LYON.—Notes on the Parallel Operation of Alternators. *Electrical World*, December, 1907.

EVIE J. EDWARDS.—Contact Method of Gas Engine Ignition. *Electrical World*, October, 1907.

BIOLOGY, AND SANITARY RESEARCH LABORATORY AND SEWAGE EXPERIMENT STATION.

WILLIAM T. SEDGWICK.—Typhoid Fever: a disease of defective civilization. Introductory essay to Whipple's "Typhoid Fever: its causation, transmission, and prevention." New York. John Wiley & Sons. 1908.

WILLIAM T. SEDGWICK.—The Conquest of Famines. *Youth's Companion*, Vol. LXXXII., No. 17, 1908.

WILLIAM T. SEDGWICK.—The Call to Public Health. Annual Address in Medicine, Yale University, June 22, 1908. *The Yale Medical Journal*, Vol. XV., No. 1; *Science*, Vol. XXVIII., No. 711, 1908.

WILLIAM T. SEDGWICK and SCOTT MACNUTT.—An Examination of the Theorem of Allen Hazen that for Every Death from Typhoid Fever avoided by the Purification of Public Water Supplies Two or Three Deaths are avoided from Other Causes. Preliminary communication. *Science*, Vol. XXVIII., No. 711, pp. 215–216, 1908.

WILLIAM T SEDGWICK.—Charles Harrington, M.D., an Appreciation. *The Harvard Bulletin*, Vol. II., No. 2, 1908.

WILLIAM T. SEDGWICK.—An Investigation of the Sanitary Condition of the Public Water Supply of Newport, R.I. *Special Report of the Committee on Water Supply to the Representative Council*, Newport, R.I., pp. 47–56, October, 1908.

WILLIAM T. SEDGWICK and SCOTT MACNUTT.—On an Apparent Connection between Polluted Public Water Supplies and the Mortality from

Pulmonary Tuberculosis. *Tuberculosis in Massachusetts*, Chapter XIV., pp. 181–186. Published by the Massachusetts State Committee, International Congress on Tuberculosis, Boston, 1908.

SAMUEL C. PRESCOTT and CHARLES-EDWARD A. WINSLOW.—Elements of Water Bacteriology. Second edition. Revised and rewritten. New York. John Wiley & Sons. 1908.

SAMUEL C. PRESCOTT and CHARLES-EDWARD A. WINSLOW.—The Relative Value of Dextrose Broth, Phenol Broth and Lactose-Bile as Enrichment Media for the Isolation of B. coli. *American Journal of Public Hygiene*, Vol. XVIII., pp. 19–27.

SAMUEL C. PRESCOTT.—Bakteriologische Beaufsichtigung der Handelsmilch und das Ergebnis derselben. *Cent. f. Bakt.*, XL., No. 11–12, p. 359.

CHARLES-EDWARD A. WINSLOW and EARLE B. PHELPS.—Investigations on the Purification of Boston Sewage in Septic Tanks and Trickling Filters. 1905–07. *Technology Quarterly*, Vol. XX., pp. 387–452.

CHARLES-EDWARD A. WINSLOW.—Some Factors in the Spread of Typhoid Fever. *American Journal of Public Hygiene*, Vol. IV., No. 2, pp. 131–136.

CHARLES-EDWARD A. WINSLOW and EARLE B. PHELPS.—Purification of Boston Sewage. Experimental results and practical possibilities. *Journal of the Association of Engineering Societies*, Vol. XL., pp. 28–52.

CHARLES-EDWARD A. WINSLOW (with LAURENCE T. WALKER).—Notes on the Fermative Reactions of the B. coli group. *Science*, Vol. XXVI., pp. 797–799.

CHARLES-EDWARD A. WINSLOW.—A New Method of enumerating Bacteria in Air. *Science*, Vol. XXVIII., pp. 28–31.

CHARLES-EDWARD A. WINSLOW.— See also Samuel C. Prescott.

EARLE B. PHELPS.—See Charles-Edward A. Winslow.

SCOTT MACNUTT.—See William T. Sedgwick.

LAURENCE T. WALKER.—A Culture-tube Rack for Use in Bacteriological Studies involving a Large Number of Cultures. *Technology Quarterly*, Vol. XXI., pp. 12–14.

LAURENCE T. WALKER.—See also Charles-Edward A. Winslow.

CHARLES F. BREITZKE.—An Investigation of the Sanitary Condition of the Gowanus Canal, Brooklyn, N.Y. *Technology Quarterly*, Vol. XXI., pp. 243–280, 1908.

PHYSICS.

CHARLES R. CROSS.—Notes on Mechanics. Revised edition. 1908.

HARRY M. GOODWIN.—Elements of Precision of Measurements and Graphical Methods.

HARRY M. GOODWIN.—Physical Laboratory Notes, Part II. Optics. 1908.

HARRY M. GOODWIN.—Physical Laboratory Notes, Part III. Heat. New edition. 1908.

HARRY M. GOODWIN and ROY D. MAILEY.—On the Density, Electrical Conductivity and Viscosity of Fused Salts and their Mixtures. *Physical Review*, Vol. XXVI., pp. 28–60, 1908.

HARRY M. GOODWIN and HERBERT T. KALMUS.—On the Conductance and Fluidity of Fused Salts. *Physical Review*, Vol. XXVII., pp. 322–329, 1908.

LOUIS DERR.—Electric Motors. Instruction paper for American School of Correspondence, Chicago.

WILLIAM J. DRISKO.—Problems in Physics: Mechanics.

MAURICE DEK. THOMPSON and MERTON W. SAGE.—On the Free Energy of Nickel Chloride. *Journal of the American Chemical Society*, Vol. XXX., p. 714, 1908.

DANIEL F. COMSTOCK.—The Relation of Mass to Energy. *Philosophical Magazine*, Vol. XV., pp. 1–21, 1908.

DANIEL F. COMSTOCK.—The Indestructibility of Matter and the Absence of Exact Relations between the Atomic Weights. *Journal of the American Chemical Society*, Vol. XXX., pp. 683–688, 1908.

GEOLOGY.

THOMAS A. JAGGAR, Jr.—Journal of the Technology Expedition to the Aleutian Islands, 1907. *Technology Review*, Vol. X., No. 1, pp. 1–37.

THOMAS A. JAGGAR, Jr.—Experiments illustrating Erosion and Sedimentation. (Plates.) Harvard University, Museum Comparative Zoölogy, *Bulletin*, Vol. XLIX., pp. 285–306.

THOMAS A. JAGGAR, Jr.—The Evolution of Bogoslof Volcano. American Geographical Society, *Bulletin*, Vol. XL., No. 7, pp. 385–400.

THOMAS A. JAGGAR, Jr.—A Theory of Ore Deposition. Discussion of a review by F. L. Ransome. *Economic Geology*, Vol. III., No. 6, pp. 529–532.

THOMAS A. JAGGAR, Jr.—How should Faults be Named and Classified? *Economic Geology*, Vol. II., No. 1, pp. 58–62.

WALDEMAR LINDGREN.—Notes on Copper Deposits in Chaffee, Fremont, and Jefferson Counties, Colorado. *United States Geological Survey*, Bulletin 340.

WALDEMAR LINDGREN.—The Mining of Silver Ore in the United States. *United States Geological Survey*, Bulletin 340.

WALDEMAR LINDGREN.—Present Tendencies in the Study of Ore Deposits. *Economic Geology*, Vol. II., No. 8.

WALDEMAR LINDGREN.—The Production of Gold and Silver in the United States. Mineral Resources of the United States. *United States Geological Survey*, 1907.

REGINALD A. DALY.—Mechanics of Igneous Intrusion. Third paper *American Journal of Science*, Vol. XXVI., pp. 17–50, 1908.

REGINALD A. DALY.—The Origin of Augite-Andesite and of Related Ultra-basic Rocks. *Journal of Geology*, Vol. XVI., pp. 409–420.

CHARLES H. WARREN.—The Petrography and Mineralogy of Iron, Mine Hill, Cumberland, R.I. *American Journal of Science*, Vol. XXV., January, 1908.

CHARLES H. WARREN.—The Alteration of the Augite-Ilmenite Groups in the Cumberland, R.I., Gabbro. *American Journal of Science*, Vol. XXVI., November, 1908.

CHARLES H. WARREN and CHARLES PALACHE.—Krönkite, Natrochalcite (a new mineral), and other Sulphates from Chile. *American Journal of Science*, Vol. XXVI., pp. 342–348, 1908.

CHARLES H. WARREN.—Ueber das Vorkommen von Hortonolith bei Cumberland, R.I., U.S.A. *Zeitschrift für Krystallographie und Mineralogie*, Munich, 1908.

HERVEY W. SHIMER and M. E. BLODGETT.—Stratigraphy of the Mount Taylor Region, New Mexico. *American Journal of Science*, Vol. XXV., pp. 53–67, 1908.

HERVEY W. SHIMER. Dwarf Faunas. *American Naturalist*, Vol. XLII., pp. 472–490, 1908.

HERVEY W. SHIMER. The Pennsylvania German as Geologist and Paleontologist. *The Pennsylvania-German*, Vol. IX., pp. 411–415, 1908.

MATHEMATICS.

FREDERICK S. WOODS and FREDERICK H. BAILEY.—A Course in Mathematics, Vol. II. Boston. Ginn & Co. 1908.

FREDERICK S. WOODS.—The Teaching of Mathematics to Students of Engineering. From the standpoint of the Professor of Mathematics in the Engineering College. *Science*, Vol. XXVIII., No. 713, pp. 261–263, 1908

EDWIN B. WILSON.—The Equilibrium of a Heavy Homogeneous Chain in a Uniformly Rotating Plane. *Annals of Mathematics*, Second series, Vol. IX., No. 3, p. 99, 1908.

EDWIN B. WILSON.—Logic and the Continuum. *Bulletin, American Mathematical Society*, Vol. XIV., No. 9, pp. 432–443, 1908.

EDWIN B. WILSON.—On the Principle of Relativity. *Philosophical Magazine*, Sixth series, Vol. XVI., No. 93, pp. 419–422, 1908.

EDWIN B. WILSON.—On the Theory of Double Products and Strains in Hyperspace. *Transactions Connecticut Academy*, Vol. XIV., September, 1908, pp. 1–57.

EDWIN B. WILSON.—On the Differential Equations of the Equilibrium of an Inextensible String. *Transactions American Mathematical Society*, Vol. IX., No. 4, pp. 425–439.

EDWIN B. WILSON.—The Number of Types of Collineation. *Jahresbericht Deutschen Mathematiker Vereinigung*, Band XVII., Heft 10, S. 341, 1908.

EDWIN B. WILSON.—Note on Statistical Mechanics. *Bulletin, American Mathematical Society*, Vol. XV., No. 3, p. 107, 1908.

EDWIN B. WILSON.—Symbolic Logic. (Partly book review.) *Bulletin, American Mathematical Society*, Vol. XIV., No. 4, p. 175, 1908.

WILLIAM H. ROEVER.—Brilliant Points of Curves and Surfaces. *Transactions American Mathematical Society*, Vol. IX., No. 3, pp. 245–279, 1908.

NELS J. LENNES and HERBERT E. SLAUGHT.—High School Algebra. Advanced Course. Boston. Allyn & Bacon. 1907–08.

NELS J. LENNES and HERBERT E. SLAUGHT.—High School Algebra. Complete Course. Boston. Allyn & Bacon. 1907–08.

ENGLISH.

ARLO BATES.—The Intoxicated Ghost and Other Stories. Boston. Houghton, Mifflin & Co. 1908.

ALLEN FRENCH.—Salad Plants. *Suburban Life*, March, 1908.

ALLEN FRENCH.—A Garden Lesson. *Woman's Home Companion*, April, 1908.

ECONOMICS.

DAVIS R. DEWEY.—Money and Banking. Round table discussion, twelfth annual meeting of the American Economic Association. *American Economic Association Quarterly*, April, 1908, pp. 104–109.

DAVIS R. DEWEY.—Review of Municipal and Private Operations of Public Utilities. Report to the National Federation Commission on Pub-

lic Ownership and Operation. New York, 1907. *Political Science Quarterly*, June, 1908, pp. 337–339.

DAVIS R. DEWEY.—Review of Oberholtzer's "Jay Cook, Financier of the Civil War." *American Historical Review*, July, 1908, p. 883.

CARROLL W. DOTEN.—Reviews of McPherson's "The Working of the Railroads" and Dewsnup's "Railway Organization and Working." *Economic Bulletin*, April, 1908.

MODERN LANGUAGES.

JOHN BIGELOW, Jr.—Review of Trevelyan's "The American Revolution." *American Historical Review*. Vol. XIII., July, 1908, p. 874.

JOHN BIGELOW, Jr.—The Saber and the Cavalry. *Journal United States Cavalry Association*, Vol. XIX., April, 1908, pp. 690–697.

GENERAL STATEMENT

OF THE

RECEIPTS AND DISBURSEMENTS BY THE TREASURER

FOR THE YEAR ENDING SEPT. 30, 1908

Report of the Treasurer.

To the Corporation of the Massachusetts Institute of Technology:

I have the honor to submit herewith statements showing the financial condition of the Massachusetts Institute of Technology as of September 30th, 1908, and all transactions for the fiscal year ended on that date.

Particular attention is called to the comparisons of income and expense for the past twelve years, given on pages 22 and 23.

The following gifts and legacies have been received during the year, and call for the sincere thanks of the Institute:—

GIFTS, BEQUESTS, ETC. 1907–1908.

M. I. T. Alumni Fund Committee		$35,701.41
Charles G. Weld Fund, for general purposes		15,000.00
Lyman F. Rhoads Estate. "Bursar's Fund"		6,000.00
Anonymous donor, through Dr. Noyes, toward New Technology Union Building	$4,000.00	
Donor, "not to be made public," toward New Technology Union Building	500.00	
F. R. Copeland, toward New Tech Union Building	250.00	
C. C. Jackson, " " " " "	250.00	
Everett Morss, " " " " "	250.00	
Henry Morss, " " " " "	250.00	
Eben S. Stevens, " " " " "	250.00	
Joseph P. Gray " " " " "	100.00	5,850.00
Donor, through Prof. W. T. Sedgwick, for Sanitary Research Fund,		5,500.00
John C. Haynes Estate, general purposes		5,000.00
Dr. A. A. Noyes, for Physico-Chemical Research Laboratory		3,500.00
Charles G. Weld, for Naval Architecture Department		1,467.11
Thomas Gaffield Estate, additional		1,300.00
Charles W. Hubbard, for Research Laboratory of Applied Chemistry, first payment 3 years		1,000.00
J. H. Atwood, Melrose, Mass., a Starratt Pump for the Mechanical Engineering Laboratory valued at		500.00
Arthur Cary		500.00
Guy Lowell, toward Travelling Scholarship in Architecture		500.00
Charles J. Paine, for Naval Architecture Department		467.11
Mrs. Mary G. Pickering, 1 pr. Projection Lanterns, 1 pr. adjustable Rheostats, 2 Metal Slide carriers for use in Huntington Hall		230.85
Mrs. Wm. B. Rogers, for periodicals and magazines		225.00
Estate of Caroline A. R. Whitney, for benefit of Women Students		200.00

Francis Blake, toward purchase of Turbine, M. E. Department	100.00
Eben S. Draper, " " " " " "	100.00
H. F. Mills, " " " " " "	100.00
James P. Tolman, " " " " " "	100.00
Babcock & Wilcox Boiler Company, Gift, through a substantial reduction in the price of boilers.	

The contribution of funds for the current expenses of the Institute received through the Alumni Income Fund Committee continue to be of great assistance to the Institute. As was the case last year, not all of the money contributed from this source has been used for current expenses, but a substantial portion has been applied to permanent equipment. The construction of the new Technology Union has been made possible by an appropriation from these funds supplemented by generous donations from graduates and friends of the Institute. From the amount carried forward from last year's receipts from the Income Fund Committee and the amount since contributed a total sum of $41,809 has been appropriated by the Executive Committee during the past year for the following purposes:—

For one-half the cost of erecting and equipping the new Technology Union	$8,500.00
For installing new boilers and improving the heating and power plant	9,750.00
For fittings and installation of the new steam turbine	2,690.00
For steel testing machine for Mechanical Engineering Laboratory,	500.00
For equipment of the extension of the laboratory of analytical chemistry	650.00
For maintenance and improvement of Athletic Field	1,600.00
For providing for personal conferences between first-year students and instructors	1,600.00
For increase of salaries of the instructing staff	16,600.00
Total	$41,890.00

The Walker Memorial Fund now amounts with accrued interest to $116,388.40.

Respectfully submitted,

FRANCIS R. HART,

Treasurer.

84 STATE STREET, BOSTON, November 30, 1908.

FRANCIS R. HART, Esq.,
Treasurer Massachusetts Institute of Technology.

Dear Sir,—According to your request I have made a careful study of the Bursar's books and accounts and of the form of the Treasurer's annual report. After due consideration I recommend the form of report submitted herewith, which comprises the following schedules:—

First. A summary of the cash receipts, payments and balances of the fiscal year, October 1, 1907, to September 30, 1908.

Second. A summary of income and expenditure for the year. This summary exhibits the receipts from income under three heads: (1) "Income available for general purposes"; (2) "income available only for special purposes"; and (3) "income added to capital of funds." Corresponding subdivisions are exhibited in expenditure, namely: (1) current expenses from income; (2) special expenses from special income; and (3) additions to capital of funds.

Third. A summary of capital receipts and payments. The receipts from capital sources are set forth under four heads: (1) from "gifts and bequests on capital account"; (2) from "securities matured or sold"; (3) from "loans"—notes receivable which were paid by the borrowers; and (4) from fees and deposits in advance. Capital payments include: (1) "securities bought"; (2) loans on notes-receivable; notes-payable paid; and (3) expenditure for new buildings and equipment.

These receipts and payments are supported by detailed schedules on the pages mentioned.

Fourth. An "income and expense" statement (pp. 6 and 7) exhibiting the various sources of income available for paying current expenses, supported by subsidiary tables (pp. 10 and 11) which give further details of income and of expenses compared with corresponding items of the previous year.

In this income and expense schedule the income items represent actual cash receipts which pertain only to the fiscal year 1907–08, while the expense items include cash payments and also audited bills pertaining to the year, which were unpaid when the cash was closed at the end of the year, September 30, 1908. The "excess of expense," $23,131.91, exhibited in this schedule is identical with the net decreases of assets or increases of liabilities during the year as shown on the balance sheet, page 17. A comparison of similar losses (deficiencies of income) for the past twelve years is given on page 23.

Fifth. A balance sheet of September 30, 1908, covering three double pages and exhibiting: (1) securities and other assets; (2) funds and other liabilities; (3) book values of "educational plant"—which are in great part merely nominal values, many of the items having remained on the books at the present figures for twenty years or longer; and (4) the balancing account, heretofore called "M. I. T. Stock" account. The items on this balance sheet are given in full detail, with securities and funds arranged alphabetically in groups, and represent all of the open accounts upon the Treasurer's general ledger at the close of business September 30, 1908.

I recommend that the accounts for the new year be opened upon new ledgers according to this arrangement, funds being kept in a subsidiary "fund ledger" and investments in a subsidiary "investments ledger," each with a summary controlling account in the general ledger only.

Sixth. A statement of the various funds as they stood on September 30, 1908, compared with the corresponding balances September 30, 1907, together with the respective increases of these funds from income, or other sources, and the respective decreases of the funds from payments from scholarships, fellowships, awards, general purposes, etc.

Seventh. A comparison of income and expense as set forth in the Treasurer's cash accounts in his reports of the past twelve years. The year ending September 30, 1908, is included in this comparison with the items arranged according to the classification of previous years. The total income by this comparative statement, $517,878.32, may be reconciled with the total exhibited on "income" statement, $494,630.98 (p. 6). by the following items: Chemical breakage receipts, $12,964.68, deducted from total breakage; receipts from sale of lecture notes, $2,254.26, deducted from printing; income of funds for special purposes, $8,028.40, set up as "special expenses." The total of payments on page 7 differs by the same amounts and is reconciled in the same manner.

Very respectfully,

HARVEY S. CHASE,
Certified Public Accountant.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY. TREASURER'S STATEMENT.

SUMMARY OF CASH RECEIPTS AND PAYMENTS.

OCTOBER 1, 1907, TO SEPTEMBER 30, 1908.

Cash balance October 1, 1907	$29,898.22
Total cash receipts, per cash book	774,510.89
	$804,409.11
Total cash payments, per cash book	721,554.16
Cash balance September 30, 1908	$82,854.95

Cash Balance September 30, 1908.

Cash in Banks	$71,644.64
Cash in Office	11,210.31
Total	$82,854.95

SUMMARY OF INCOME AND EXPENDITURE.

Income.

Income for general purposes (schedule, p. 6)	$494,630.98
Income for special purposes (schedule, p. 8)	23,632.88
Income added to capital of funds (schedule, p. 9)	5,735.74
	$523,999.60
Deficiency of income for general purposes (schedule, p. 7)	23,131.91
	$547,131.51

Expenditure.

For general purposes (schedule, p. 7)	$517,762.89
For special purposes (schedule, p. 8)	18,630.88
Total added to capital of funds (schedule, p. 9)	10,737.74
	$547,131.51

SUNDRY CAPITAL RECEIPTS AND PAYMENTS.

CAPITAL RECEIPTS.

From Gifts and Bequests on capital account (schedule, p. 20)	33,150.00
From Securities matured or sold (schedule, p. 20)	55,125.00
From Loans paid by borrowers	1,116.66
From Fees and Deposits in advance	87,890.00

CAPITAL PAYMENTS.

For Securities bought (schedule, p. 20)	71,432.50
For Loans made ($800) and notes-payable paid ($19,034.75)	19,834.75
For New Tech Union Building, payments to September 30	8,834.42

INCOME AND EXPENSE, 1907-08.

INCOME.

AVAILABLE FOR GENERAL PURPOSES.

From Students' Tuition Fees, 1907-08	$318,394.10	
From Scholarship Fees from Funds	20,787.50	
From Scholarship Fees from State of Massachusetts,	4,000.00	$343,181.60
From State of Massachusetts, gift		25,000.00
From United States grant of 1890		11,666.67
From United States grant of 1862		5,306.68
From Rents, net. (detailed schedule, page 10)		8,985.92
From Interest on Deposits, general		3,295.59
From Gifts, available for Special Salaries, etc. (p. 10)		2,425.00
From General Investments	$82,434.59	
Less: Credits to various funds $61,257.80		
Charges to reduce premiums 2,865.50		
Annuity, Samuel Dorr 1,000.00	65,123.30	
Remainder, available for General Purposes		17,311.29
From Income of various funds, transferred to General Purposes		24,491.82
As follows:—		
James Fund	$6,546.17	
Randall "	3,338.09	
Perkins "	2,000.00	
Dorr, G. B., Fund	1,982.94	
Richardson "	1,495.15	
Saltonstall "	1,280.13	
Edwards "	1,200.00	
Choate "	1,000.00	
Thayer "	1,000.00	
Rotch Architectural Fund	1,000.00	
Dorr, S. E., "	771.54	
Nash "	400.00	
Bartlett "	400.00	
Rogers, R. E., "	307.23	
Armstrong "	200.00	
Blake "	200.00	
Flint Library "	200.00	
Lowell, K. B., "	200.00	
Rotch Architectural Library Fund	200.00	
Lyman Fund	200.00	
Welch "	200.00	
Sawyer "	190.57	
McGregor "	100.00	
Kerr Library Fund	80.00	
From Income of Funds for Professorships and Salaries		4,324.00
As follows:—		
Nathaniel Thayer Fund. Professorship of Physics,	$1,000.00	
James Hayward Fund. Professorship of Engineering	752.00	
William P. Mason Fund. Professorship of Geology	752.00	
Henry B. Rogers Fund. General Salaries	1,000.00	
George A. Gardner Fund. General Salaries	800.00	
Sarah H. Forbes Fund. Salaries	20.00	
From W. B. Rogers Memorial Fund		12,941.00
Viz.:—Income	$13,487.00	
Less charges to reduce premiums	546.00	
From M. I. T. Alumni Subscriptions, 1908		35,701.41
Total income available for Current Expenses		$494,630.98

EXPENSE.

For General Purposes.

Salaries		$400,083.42
Department Supplies and Repairs (details on page 10)	$56,990.76	
Less: Receipts for Breakage and Supplies	12,064.68	44,026.08
Fuel, Water, Gas, and Electricity		23,577.60
Viz.:—Fuel	$17,603.87	
Water	3,284.86	
Gas	2,368.58	
Electricity	320.29	
Repairs, general (details on page 11)		16,626.62
Expense, general (details on page 11)		14,920.31
Printing and Advertising		9,078.24
Viz.:—Printing catalogues and reports	$5,405.32	
Printing lecture notes	1,304.54	
Printing and advertising, miscellaneous	4,622.64	
	$11,332.50	
Receipts from lecture notes	2,254.26	
Fire Insurance		4,526.64
Physico-Chemical Research		3,676.35
Society of Arts expenses		1,247.63
Total Current Expenses		$517,762.89

RECAPITULATION.

Total Expenses for General Purposes, as above,	$517,762.89
Total Income available for General Purposes.	494,630.98
Excess of Expense	$23,131.91

Note.

Included in "Repairs" and "Department accounts" are various expenditures for extensions, improvements, and new equipment which have not been added to assets, but have been charged to expense. Similar charges have been made in previous years which have been considered as offsets or allowances for depreciation upon general equipment.

Two of these items are as follows:—

Turbine. Mechanical Engineering Laboratories	$7,000.00
New Boilers, Condenser, Pump, Installing, etc.	$9,940.00

INCOME AND EXPENSE. SPECIAL PURPOSES.

Income.

	From Gen'l Investments.	*From special sources.*	*Total.*
Austin Fund, for awards	$5,162.50	$390.00	$5,552.50
Cheney Fund, for Reading Room	562.35		562.35
Dalton Fund, for fellowships	219.98		219.98
Letter Box Fund, for scholarships		29.75	29.75
Naval Architecture (Weld)		1,000.00	1,000.00
Perkins Fund, for fellowships	299.36		299.36
Physico-Chemical Fund		4,529.61	4,529.61
Rotch Prize Fund	200.00		200.00
Rotch "Special" Prize Fund	200.00		200.00
Saltonstall Fund, for fellowships	400.00		400.00
Sanitary Research Fund		5,655.00	5,655.00
Savage Fund, for fellowships	571.83		571.83
Swett Fund, for fellowships		412 50	412.50
Teachers' Fund, for awards	4,000.00		4,000.00
	$11,616.02	$12,016.86	$23,632.88

Expenses for Special Purposes.

	Payments for Special Purposes.	*Added to Capital of Funds.*	*Subtracted from Capital of Funds.*
Austin Fund, awards	$4,384.00	$1,168.50	
Cheney Fund, Reading Room	394.40	167.95	
Dalton Fund, fellowships	300.00		$80.02
Letter Box Fund, scholarship	50.00		20.25
Naval Architecture	1,101.27		101.27
Perkins Fund, fellowships	1,200.00		900.64
Physico-Chemical Fund	3,698.39	831.22	
Rotch Prize Fund	200.00		
Rotch "Special" Prize Fund	200.00		
Saltonstall Fund, fellowships	800.00		400.00
Sanitary Research Fund	6,290.83		635.83
Savage Fund, fellowships	250.00	321.83	
Swett Fund, fellowships	400.00	12.50	
Teachers' Fund, awards	1,500.00	2,500.00	
Totals	$20,768.89	$5,002.00	$2,138.01

Total payments	$20,768.89
Subtract, payments from capital	2,138.01
Payments from income	18,630.88
Add, income increasing funds	5,002.00
Total income, as above	$23,632.88

INCOME OF FUNDS FOR GENERAL PURPOSES ADDED TO CAPITAL OF THOSE FUNDS.

Clapp Fund	$211.99
Danforth Fund	25.62
Dickinson "	32.37
Flint "	13.37
Hunt "	5.08
Huntington "	10.97
Loring "	17.34
Mirrlees "	15.98
Nichols "	16.97
Perkins "	37.36
Russell. "	90.00
Saltonstall "	426.71
Upham "	2.41
Vose "	37.87
Total	$944.04

Special Income added to Funds.

Joy Fund	$436.70	
Walker Memorial Fund	4,355.00	
	$5,735.74	
Total from funds for special purposes (p. 8)	5,002.00	
Total added to capital of funds		$10,737.74

Decrease of Funds. Payments in Excess of Income.

Rogers Scholarship	$158.08	
Total from funds for special purposes (p. 8)	2,138.01	
Decrease M. I. T. Alumni Fund*	6,188.59	
Total subtracted from capital of funds		8,484.68
Net increases of funds from income (p. 19)		$2,253.06

*Expenditure from balance of $10,000 brought forward from previous year.

DETAILS OF ITEMS IN INCOME STATEMENT, 1908, COMPARED WITH THE SAME ITEMS IN 1907.

Rents.

	1908.	1907.
Huntington Hall, for Lowell Lectures	$3,500.00	$3,500.00
Land and Building, Clarendon St., on account	4,500.00	8,500.00
Edge Hill Road Estate	563.61	
Cambridge Real Estate	495.86	
Use of Rooms and Gymnasium	346.25	136.00
Total Credits	$9,405.72	$12,136.00
DEDUCTIONS FROM RENT.		
Lunch Room, net loss	219.80	231.78
Rental of Armory	200.00	
Cambridge Real Estate Expenses		71.79
Edge Hill Road Estate Expenses		750.41
Total Debits	$419.80	$1,053.98
Net Credit, Rents	$8,985.92	$11,082.02

Gifts.

Charles W. Hubbard, for Applied Chemistry	$1,000.00	
Arthur Cary	500.00	$500.00
Guy Lowell	500.00	
Mrs. Wm. B. Rogers, for periodicals, etc.	225.00	225.00
Estate Caroline A. R. Whitney	200.00	750.00
A. D. Little		300.00
Mrs. Pickering, books for History Department		100.00
Mrs. Rogers, Geological Department		500.00
Saturday Club of Boston		1,000.00
	$2,425.00	$3,375.00

DETAILS OF ITEMS IN EXPENSE STATEMENT.

Salaries.

Instruction	$313,077.47	$300,847.32
Administration	39,609.32	38,218.62
Labor	47,396.63	44,415.34
	$400,083.42	$383,481.28

Department Supplies and Repairs.

Applied Mechanics	$1,980.80	$1,390.87
Architecture	1,633.90	1,598.15
Biology	1,177.21	1,229.75
Chemistry	15,201.97	14,501.78
Civil Engineering	2,008.40	1,984.42
Drawing	401.70	913.39
Economics	410.73	419.31
Electrical Engineering (Extra equipment in 1907)	3,714.66	7,142.66
English	200.83	199.96
General Library	2,295.14	2,302.10
Geology	1,271.23	1,308.73
Heat Measurement	8.00	232.18
History	649.95	749.88
Mathematics	626.55	583.39
Mechanic Arts	3,061.53	3,447.64
Mechanical Engineering (New Turbine $7,000 in 1908)	10,147.79	4,717.06
Military	477.99	612.63
Mining	3,431.31	3,634.82
Modern Languages	267.89	447.78
Naval Architecture	833.10	830.84
Physical Culture	1,870.26	1,007.34
Physics	5,319.82	5,361.76
	$56,990.76	$54,616.44

General Repairs.

	1908.	1907.
Boiler and Power House:		
Viz.:—Appropriations for Boilers and Fittings	$7,650.00	
Condenser and Pumps	2,290.00	
	$9,940.00	
Sundries	134.35	811.55
Total	$10,074.35	$811.55
Rogers Building	1,243.11	1,815.41
Walker Building	980.74	705.25
Lowell Building	736.05	1,002.82
Engineering Buildings A and B	572.44	554.67
Mechanical Laboratories	464.28	255.17
Gymnasium Building	224.64	69.06
Pierce Building	180.38	346.55
Engineering Building C	100.40	129.23
Miscellaneous	2,050.23	126.84
	$16,626.62	$5,816.55

General Expense.

	1908.	1907.		
Stationery and Office Supplies			$2,398.17	$2,609.76
Sundries			2,292.89	3,067.57
Postage			1,922.20	1,676.42
Telephone Service, Installing Stations, Rentals, Repairs, etc.			1,809.19	1,428.90
Diplomas and Commissions			1,341.90	567.22
Janitor's Supplies			960.06	1,187.41
Washing			889.75	808.86
Engine Room Supplies:				
Oil	$425.02	$480.95		
Waste	90.70	203.51		
Sundries	92.83	105.14	608.55	789.60
Examinations			586.00	470.00
Taxes, Brookline, etc.			458.85	471.27
Removing Ashes			378.55	356.40
Ice			324.00	400.60
Express			251.48	227.11
Graduation Exercises			237.62	276.55
Furniture			107.60	719.07
Window Shades			50.00	
Legal Services			40.53	40.09
Glass			7.35	
Medical Services				1,000.00
Architectural Annual				1,000.00
Alumni Association				75.00
N. E. Trust Co. Deposit Vault				75.00
State St. Trust Co. Deposit Vault			$14,920.31	$17,315.03

Fuel, Watr, Gas and Electricity.

Fuel	$17,603.87	$16,832.38
Water	3,284.86	3,010.30
Gas	2,368.58	2,382.08
Electricity (net)	320.29	243.53
	$23,577.60	$22,468.29

DETAILS OF ITEMS IN INCOME STATEMENT, 1908, COMPARED WITH THE SAME ITEMS IN 1907.

Rents.

	1908.	1907.
Huntington Hall, for Lowell Lectures	$3,500.00	$3,500.00
Land and Building, Clarendon St., on account	4,500.00	8,500.00
Edge Hill Road Estate	563.61	
Cambridge Real Estate	495.86	
Use of Rooms and Gymnasium	346.25	136.00
Total Credits	$9,405.72	$12,136.00
DEDUCTIONS FROM RENT.		
Lunch Room, net loss	219.80	231.78
Rental of Armory	200.00	
Cambridge Real Estate Expenses		71.79
Edge Hill Road Estate Expenses		750.41
Total Debits	$419.80	$1,053.98
Net Credit, Rents	$8,985.92	$11,082.02

Gifts.

Charles W. Hubbard, for Applied Chemistry	$1,000.00	
Arthur Cary	500.00	$500.00
Guy Lowell	500.00	
Mrs. Wm. B. Rogers, for periodicals, etc.	225.00	225.00
Estate Caroline A. R. Whitney	200.00	750.00
A. D. Little		300.00
Mrs. Pickering, books for History Department		100.00
Mrs. Rogers, Geological Department		500.00
Saturday Club of Boston		1,000.00
	$2,425.00	$3,375.00

DETAILS OF ITEMS IN EXPENSE STATEMENT.

Salaries.

Instruction	$313,077.47	$300,847.32
Administration	39,609.32	38,218.62
Labor	47,396.63	44,415.34
	$400,083.42	$383,481.28

Department Supplies and Repairs.

Applied Mechanics	$1,980.80	$1,390.87
Architecture	1,633.90	1,598.15
Biology	1,177.21	1,229.75
Chemistry	15,201.97	14,501.78
Civil Engineering	2,008.40	1,984.42
Drawing	401.70	913.39
Economics	410.73	419.31
Electrical Engineering (Extra equipment in 1907)	3,714.66	7,142.66
English	200.83	199.96
General Library	2,295.14	2,302.10
Geology	1,271.23	1,308.73
Heat Measurement	8.00	232.18
History	649.95	749.88
Mathematics	626.55	583.39
Mechanic Arts	3,061.53	3,447.64
Mechanical Engineering (New Turbine $7,000 in 1908)	10,147.79	4,717.06
Military	477.99	612.63
Mining	3,431.31	3,634.82
Modern Languages	267.89	447.78
Naval Architecture	833.10	830.84
Physical Culture	1,870.26	1,007.34
Physics	5,319.82	5,361.76
	$56,990.76	$54,616.44

General Repairs.

	1908.	1907.
Boiler and Power House:		
Viz.:—Appropriations for Boilers and Fittings	$7,650.00	
Condenser and Pumps	2,290.00	
	$9,940.00	
Sundries	134.35	811.55
Total	$10,074.35	$811.55
Rogers Building	1,243.11	1,815.41
Walker Building	980.74	705.25
Lowell Building	736.05	1,002.82
Engineering Buildings A and B	572.44	554.67
Mechanical Laboratories	464.28	255.17
Gymnasium Building	224.64	69.06
Pierce Building	180.38	346.55
Engineering Building C	100.40	129.23
Miscellaneous	2,050.23	126.84
	$16,626.62	$5,816.55

General Expense.

Stationery and Office Supplies			$2,398.17	$2,609.76
Sundries			2,292.89	3,067.57
Postage			1,922.20	1,676.42
Telephone Service, Installing Stations, Rentals, Repairs, etc.			1,809.19	1,428.90
Diplomas and Commissions			1,341.90	567.22
Janitor's Supplies			960.06	1,187.41
Washing			889.75	808.86
Engine Room Supplies:				
	1908.	1907.		
Oil	$425.02	$480.95		
Waste	90.70	203.51		
Sundries	92.83	105.14	608.55	789.60
Examinations			586.00	470.00
Taxes, Brookline, etc.			458.85	471.27
Removing Ashes			378.55	356.40
Ice			324.00	400.60
Express			251.48	227.11
Graduation Exercises			237.62	276.55
Furniture			195.60	719.07
Window Shades			167.62	68.20
Legal Services			50.00	
Glass			40.53	40.09
Medical Services			7.35	
Architectural Annual				1,000.00
Alumni Association				1,000.00
N. E. Trust Co. Deposit Vault				75.00
State St. Trust Co. Deposit Vault				75.00
			$14,920.31	$17,315.03

Fuel, Water, Gas and Electricity.

Fuel	$17,603.87	$16,832.38
Water	3,284.86	3,010.30
Gas	2,368.58	2,382.08
Electricity (net)	320.29	243.53
	$23,577.60	$22,468.29

MASSACHUSETTS INSTITUTE

BALANCE SHEET,

ASSETS.

INVESTMENTS, GENERAL.

Bonds.

$26,000.00	Am. Dock & Improvement Co. 5s	due	1921	$26,960.00	
105,000.00	American Tel. & Tel. Co. 4s	"	1929	104,700.00	
33,000.00	American Tel. & Tel. Notes 5s	"	1910	31,968.75	
25,000.00	Atchison, Top. & St. Fé R.R. 4s	"	1995	25,000.00	
34,000.00	Baltimore & Ohio R.R. 3½s	"	1925	30,090.00	
14,000.00	Bur. & Mo. River (Neb.) R.R. 6s non-exempt	"	1918	4,000,00	
2,000.00	Bur. & Mo. River (Neb.) R.R. 6s exempt	"	1918	2,000.00	
43,000.00	Chesapeake & Ohio R.R. 5s	"	1939	48,780.00	
4,000.00	Chicago, Burl. & Quincy R.R. 4s	"	1922	3,100.00	
6,000.00	Chi. Junc. & Union S. Yds. 5s	"	1915	6,232.00	
50,000.00	Chi. Junc. & Union S. Yds. 4s	"	1940	49,250.00	
30,000.00	Chi., Mil. & St. Paul R.R. 7s	"	1910	31,137.00	
100,000.00	Chi. & W. Michigan R.R. 5s	"	1921	101,200.00	
3,000.00	Hannibal & St. Joseph R.R. 6s	"	1911	3,000.00	
3,000.00	Illinois Central R.R. 4s	"	1951	3,000.00	
120,000.00	Illinois Steel Co. non-conv. 5s	"	1913	119,586.25	
50,000.00	Interboro Rapid Transit 5s	"	1910	48,625.00	
7,000.00	K. C., Clinton & Spgfld. R.R. 5s	"	1925	6,289.21	
50,000.00	K. C., Ft. Scott & Memphis R.R. 6s,	"	1928	56,783.00	
8,500.00	K. C., Mem. & Birmingham R.R. 4s,	"	1934	8,287.50	
50,000.00	Kansas City Stock Yards 5s	"	1910	50,760.00	
3,000.00	Lake Shore & Mich. Southern 4s	"	1928	3,000.00	
75,000.00	Lake Shore & Mich. Southern deb. 4s	"	1931	75,000.00	
100,000.00	Long Island R.R. 4s	"	1949	96,137.50	
20,000.00	Louisville & Nashville 4s	"	1923	19,750.00	
25,000.00	Mass. Elec. Co. notes 4½s	"	1910	24,500.00	
50,000.00	N. E. Tel. & Tel. Co. 4s	"	1930	50,441.00	
52,000.00	N. Y. C. & H. R. R.R. (L. S.) 3½s	"	1998	46,046.65	
36,000.00	N. Y. C. Equipment 5s	"	1919	34,740.00	
31,000.00	N. Y., N. H. & H. 6s	"	1948	35,602.00	
50,000.00	Northern Pac. Gt. Northern Joint 4s,	"	1921	48,500.00	
50,000.00	Oregon R.R. & Navigation Co. 4s	"	1946	51,110.00	
50,000.00	Oregon Short Line 4s	"	1929	48,500.00	
5,000.00	Ozark Equipment Co. 5s	"	1910	5,000.00	
50,000.00	Rio Grande & Western R.R. 4s	"	1939	49,180.00	
25,000.00	Southern Ry., St. Louis Div. 4s	"	1951	24,875.00	
5,000.00	Terminal Asso. St. Louis 4s	"	1953	5,000.00	
50,000.00	Union Pacific R.R. 4s	"	1947	51,596.00	
25,000.00	Wabash Equipment 4½s	"	1912	24,360.00	
19,000.00	Wabash Equipment 4½s	"	1916	18,259.00	
100,000.00	West End St. Ry. 4s	"	1917	101,680.00	$1,574,025.86

Stocks.

Shares.					
172	Boston & Albany R.R.	par	100	34,456.50	
1	Boston Ground Rent Trust	"	1000	900.00	
64	Boston Real Estate Trust	"	1000	68,605.64	
80	Chi., Mil. & St. Paul R.R. Pf.	"	100	5,738.00	
12	Cocheco Mfg. Co.	"	500	6,000.00	
2	Dwight Mfg. Co.	"	500	1,600.00	
27	Essex Company	"	50	3,780.00	
31	Great Falls Mfg. Co.	"	100	3,472.00	
56	Hamilton Woolen Co.	"	100	5,390.00	
17	Pepperell Mfg. Co.	"	100	2,789.50	132,731.64
	Amount carried up				1,706,757.50

OF TECHNOLOGY.

SEPTEMBER 30, 1908.

LIABILITIES.

FUNDS FOR GENERAL PURPOSES.

Armstrong, George Robert	$5,000.00	
Bartlett, Sidney	10,000.00	
Blake, Stanton	5,000.00	
Choate, Charles	25,000.00	
Dorr, George B.	49,573.47	
Edwards, Martha Ann	30,000.00	
James Fund	163,654.21	
Lowell, Katharine B.	5,000.00	
Lyman, Arthur T.	5,000.00	
McGregor Fund	2,500.00	
Nash, Nathaniel C.	10,000.00	
Perkins, Richard	50,000.00	
Randall, John W. and Belinda L.	83,452.36	
Rogers, Robert E.	7,680.77	
Rogers, William Barton	250,225.00	
Sawyer, Samuel E.	4,764.40	
Thayer, Nathaniel	25,000.00	
Welch, Albion K. P.	5,000.00	
Weld, Charles G.	15,000.00	
Wheeler, Alexander S.	5,000.00	$756,850.21

FUNDS FOR SALARIES.

Forbes, Sarah H., for General Salaries	500.00	
Gardner, George A. " " "	20,000.00	
Haywood, James, Professorship of Engineering	18,800.00	
Mason, William P., " " Geology	18,800.00	
Rogers, Henry B., General Salaries	25,000.00	
Thayer, Nathaniel, Professorship of Physics	25,000.00	108,100.00

FUNDS FOR SCHOLARSHIPS.

Atkins, Elisha	5,000.00	
Billings, Student	50,000.00	
Clapp, Lucius	5,511.83	
Dalton, Graduate Chemical	5,419.37	
Danforth, Isaac W.	5,666.26	
Dickinson	40,841.64	
Farnsworth	5,000.00	
Flint, Charles Lewis	5,347.51	
Hunt, T. Sperry	3,257.00	
Huntington, William F.	5,285.10	
Joy	11,570.47	
Loring, Elisha Thatcher	5,450.79	
Mirlees, James H.	2,915.40	
Nichols	5,000.00	
Nichols, Charles C.	5,441.29	
Perkins, Richard	53,471.43	
Perkins, Willard B.	6,583.25	
Rogers, William Barton	11,577.32	
Russell, Richard Lee	2,339.97	
Saltonstall, Henry	9,600.00	
Savage, James	14,617.61	
Sherwin, Thomas	5,050.00	
Swett, Susan H.	10,595.45	
Upham, Susan	1,312.68	
Vose, Ann White	60,984.61	337,838.98
Amount carried up		1,202,789.19

ASSETS.

				BALANCE
Amount brought up				1,706,757.50
INVESTMENTS W. B. ROGERS MEMORIAL FUND.				
BONDS.				
$25,000.00	Atchison, Top. & St. Fé R.R. 4s	due 1995	$24,470.00	
6,000.00	Baltimore & Ohio R.R. 3½s	" 1925	5,310.00	
7,000.00	Chesapeake & Ohio R.R. 5s	" 1939	7,940.00	
40,000.00	Chi. Junc. & Union S. Yds. 5s	" 1915	41,550.00	
4,000.00	Cin., Ind., St. Louis & Chicago R.R. 6s	" 1920	4,000.00	
37,500.00	Detroit, G.Rapids & Western R.R. 4s,	" 1946	37,500.00	
35,000.00	Fort St. Union Depot 4½s	" 1941	34,825.00	
27,000.00	Kansas City Belt R.R. 6s	" 1916	27,875.00	
4,000.00	K. C., Ft. Scott & Gulf R.R. 5s	" 1911	4,000.00	
1,000.00	Lincoln & Northwestern R.R. 7s	" 1910	1,000.00	
31,000.00	N. Y. C. & H. R. R.R. deb. 4s	" 1934	30,225.00	
1,000.00	N. Y. Central Equipment 5s	" 1919	965.00	
3,200.00	Republican Valley R.R. 6s	" 1919	3,200.00	
24,000.00	Rome, Watertown & Ogdensburg R.R. 5s	" 1922	25,690.00	
1,000.00	Wabash Equipment 4½s	" 1916	961.00	249,511.00
INVESTMENTS WALKER MEMORIAL FUND.				
$30,000.00	Am. Tel. & Tel. Co. 4s	due 1929	30,300.00	
1,000.00	Chi., Bur. & Quincy R.R. 5s	" 1913	1,055.00	
54,000.00	N. Y. C. & H. R. R.R. 3½s	" 1998	47,986.35	
14,000.00	Oregon Short Line 5s	" 1946	16,310.00	
5,000.00	St. Louis Iron Mt. 4s	" 1933	4,812.50	
7,000.00	Wabash Equipment 4½s	" 1916	6,764.45	107,228.30
INVESTMENTS JOY SCHOLARSHIP FUND.				
Mass. Hospital Life Insurance Co.			5,000.00	
Deposits in Savings Banks			6,164.22	11,164.22
INVESTMENTS SWETT SCHOLARSHIP FUND.				
Mass. Hospital Life Insurance Co.				10,000.00
INVESTMENTS RUSSELL FELLOWSHIP FUND.				
$2,000.00	Conveyancers Title Ins. Co. Mort. 4s	1908		2,000.00
INVESTMENTS, REAL ESTATE.				
Clarendon St. Land and Building (Grundmann Studios)			$142,762.94	
Massachusetts Avenue, Cambridge			16,154.38	158,917.32
CURRENT ASSETS.				
Notes Receivable			12,800.00	
Students' Notes Receivable			570.50	
Loan to Copley Society			5,000.00	
Physico-Chemical Research Fund (Debit balance)			225.42	
Cash Balance September 30, 1908			82,854.95	101,450.87
Tota Investments and Current Assets (carried up)				$2,347,029.21

SHEET—*Continued.*

LIABILITIES.

Amount brought up		1,202,789.19
Funds for Libraries and Reading Room.		
Flint, Charles Lewis	5,000.00	
Kerr, William Hall	2,000.00	
Rotch Architectural Library	5,000.00	
Cheney, Ednah Dow, for Margaret Cheney Reading Room,	14,226.79	26,226.79
Funds for Prizes.		
Rotch Prize Fund	5,200.00	
Rotch "Special" Prize Fund	5,200.00	10,400.00
Legacies.		
Gaffield, Thomas, 1906	3,343.18	
Haynes, John C., 1908	5,000.00	
Merriam, Charles, 1907	25,000.00	
Pope, Macy S., 1906	25,028.81	
Upton, George B., 1905	5,000.00	63,371.99
Other Funds.		
Austin, Edward		380,770.22
Bursar's Fund		6,000.00
Dorr, Susan E. (annuity to Samuel Dorr)		19,288.48
Electrical Engineering Laboratory, Augustus Lowell		68,000.00
Richardson, Charlotte Billings, Industrial Chemistry		37,378.78
Rotch Architectural		25,000.00
Saltonstall		43,097.71
Teachers'		113,020.00
Walker Memorial		116,388.40
Miscellaneous Funds and Accounts.		
Cabot Medal Fund		100.92
Dormitory Fund		1,868.96
Letter Box Deposits (Scholarship)		61.25
M. I. T. Alumni Fund, Reserve		3,811.41
Naval Architecture Fund (Weld)		87.81
Roentgen-Ray Experiment Fund		956.50
Sanitary Research Laboratory Fund		705.22
Deposits for Breakages and Supplies, due		1,467.35
Deposits for Breakages and Supplies, in advance		6,875.00
Tuition Fees, in advance		77,015.00
State of Massachusetts, in advance		4,000.00
Accounts Payable		18,174.10
Total Funds and Liabilities (carried up)		$2,226,855.08

ASSETS.

		BALANCE
Total Investments and Current Assets (brought up) .		2,347,029.21
EDUCATIONAL PLANT. *		
Land and Buildings, Book Values.		
Rogers Building	$200,000.00	
Walker Building	150,000.00	
Engineering Building A, Trinity Place	90,000.00	
Engineering Building B " "	57,857.10	
Engineering Building C " "	47,561.08	
Henry L. Pierce Building " "	154,297.05	
Boiler and Power House " "	26,916.74	
Lot No. 1 " "	76,315.69	
Lot No. 2 " "	137,241.60	
Lot No. 3 " "	282,286.35	
Electrical Eng. Building, Augustus Lowell, Clarendon St.	121,790.93	
Mechanic Arts Building, Garrison St.	30,000.00	
Land, Garrison St.	50,840.00	
Gymnasium Building, Exeter St.	12,624.07	
Athletic Field, Brookline	112,964.32	
Technology Union, Trinity Court	8,834.42	
	$1,559,529.35	
Equipment, Book Values.		
In Engineering Building	16,555.24	
In Electrical Engineering Building	87,282.24	
In Mechanical Laboratories	20,628.56	
Total Educational Plant, Book Values		1,683,995.39
Grand Total		$4,031,024.60

* The values of land, buildings and equipment under this head are nominal values which have been carried on the books at these figures for many years. A complete appraisal of all these properties will soon be made, and amounts closely in accord with the actual costs, or with the appraised values, will then be entered in the books.

SHEET—*Continued.*

LIABILITIES.

Total Funds and Liabilities (brought up)			2,226,855.08
Balancing Account,*			1,804,169.52
Viz.:—Balance September 30, 1907		$1,816,023.15	
Cr. Gain from sale Utah & Northern		125.00	
From Alumni Fund of prior year†		6,188.59	
From gifts for new Technology Union Building		5,850.00	
		$1,828,186.74	
Dr. Excess of expense over income	23,131.91		
Physico-Chemical Fund, loss of prior years charged this year	885.31	24,017.22	
Balance September 30, 1908, as above		$1,804,169.52	
Grand Total			$4,031,024.60

* Heretofore entitled "M. I. T. Stock Account." This balance represents (1st) the excess of total investments and current assets, as recorded in the books, over the total of funds and liabilities, and (2d) the total book values of "educational plant," viz:—

Total securities and current assets	$2,347,029.21
Total funds and liabilities	2,226,855.08
Excess of assets	$120,174.13
Book values of "educational plant"	1,683,995.39
Total	$1,804,169.52

† Used for Technology Union Building.

INCREASES AND DECREASES OF FUNDS.

Funds for General Purposes.	*Funds Sept. 30, 1907.*	*Income and other increases of funds.*	*Expenditure and other decreases of funds.*	*Funds Sept. 30, 1908.*
Armstrong, George Robert . .	5,000.00	200.00	200.00	5,000.00
Bartlett, Sidney	10,000.00	400.00	400.00	10,000.00
Blake, Stanton	5,000.00	200.00	200.00	5,000.00
Choate, Charles	25,000.00	1,000.00	1,000.00	25,000.00
Dorr, George B.	49,573.47	1,982.94	1,982.94	49,573.47
Edwards, Martha Ann	30,000.00	1,200.00	1,200.00	30,000.00
James Fund	163,654.21	6,546.17	6,546.17	163,654.21
Lowell, Katharine B.	5,000.00	200.00	200.00	5,000.00
Lyman, Arthur T.	5,000.00	200.00	200.00	5,000.00
McGregor Fund	2,500.00	100.00	100.00	2,500.00
Nash, Nathaniel C.	10,000.00	400.00	400.00	10,000.00
Perkins, Richard	50,000.00	2,000.00	2,000.00	50,000.00
Randall, John W. and Belinda L.	83,452.36	3,338.09	3,338.09	83,452.36
Rogers, Robert E.	7,680.77	307.23	307.23	7,680.77
Rogers, William Barton . . .	250,225.00	13,487.00	13,487.00	250,225.00
Sawyer, Samuel E.	4,764.40	190.57	190.57	4,764.40
Thayer, Nathaniel	25,000.00	1,000.00	1,000.00	25,000.00
Welch, Albion K. P.	5,000.00	200.00	200.00	5,000.00
Weld, Charles G.	0.00	15,000.00	0.00	15,000.00
Wheeler, Alexander S.	5,000.00	0.00	0.00	5,000.00
	741,850.21	47,952.00	32,952.00	756,850.21
Funds for Salaries.				
Forbes, Sarah H. For Salaries,	500.00	20.00	20.00	500.00
Gardner, George A. For Salaries	20,000.00	800.00	800.00	20,000.00
Haywood, James. For Professor of Engineering	18,800.00	752.00	752.00	18,800.00
Mason, Wm. P. For Professor of Geology	18,800.00	752.00	752.00	18,800.00
Rogers, Henry B. For Salaries,	25,000.00	1,000.00	1,000.00	25,000.00
Thayer, Nathaniel. For Professor of Physics	25,000.00	1,000.00	1,000.00	25,000.00
	108,100.00	4,324.00	4,324.00	108,100.00
Funds for Scholarships.				
Atkins, Elisha	5,000.00	200.00	200.00	5,000.00
Billings, Student	50,000.00	2,000.00	2,000.00	50,000.00
Clapp, Lucius	5,299.84	211.99	0.00	5,511.83
Dalton, Graduate Chemical . .	5,499.39	219.98	300.00	5,419.37
Danforth, Isaac W.	5,640.64	225.62	200.00	5,666.26
Dickinson	40,809.27	1,632.37	1,600.00	40,841.64
Farnsworth	5,000.00	200.00	200.00	5,000.00
Flint, Charles Lewis	5,334.14	213.37	200.00	5,347.51
Hunt, T. Sperry	3,251.92	130.08	125.00	3,257.00
Huntington, William F. . . .	5,274.13	210.97	200.00	5,285.10
Joy	11,133.77	436.70	0.00	11,570.47
Loring, Elisha Thatcher . . .	5,433.45	217.34	200.00	5,450.79
Mirlees, James H.	2,899.42	115.98	100.00	2,915.40
Nichols	5,000.00	200.00	200.00	5,000.00
Nichols, Charles C.	5,424.32	216.97	200.00	5,441.29
Perkins, Richard	53,434.07	2,137.36	2,100.00.	53,471.43
Perkins, Willard B.	7,483.89	299.36	1,200.00	6,583.25
Rogers, William Barton . . .	11,735.40	766.92	925.00	11,577.32
Russell, Richard Lee	2,249.97	90.00	0.00	2,339.97
Saltonstall, Henry	10,000.00	400.00	800.00	9,600.00
Savage, James	14,295.78	571.83	250.00	14,617.61
Sherwin, Thomas	5,050.00	200.00	200.00	5,050.00
Swett, Susan H.	10,582.95	412.50	400.00	10,595.45
Upham, Susan	1,310.27	52.41	50.00	1,312.68
Vose, Ann White	60,946.74	2,437.87	2,400.00	60,984.61
	338,089.36	13,799.62	14,050.00	337,838.98

	Funds Sept. 30, 1907.	*Income and other increases of funds.*	*Expenditure and other decreases of funds.*	*Funds Sept. 30, 1908.*
FUNDS FOR LIBRARIES AND READING ROOM.				
Flint, Charles Lewis	5,000.00	200.00	200.00	5,000.00
Kerr, Wm. Hall	2,000.00	80.00	80.00	2,000.00
Rotch Architectural Library	5,000.00	200.00	200.00	5,000.00
Cheney, E. D., for Margaret Cheney Reading Room	14,058.84	562.35	394.40	14,226.79
	26,058.84	1,042.35	874.40	26,226.79
FUNDS FOR PRIZES.				
Rotch Prize Fund	5,200.00	200.00	200.00	5,200.00
Rotch "Special" Prize Fund	5,200.00	200.00	200.00	5,200.00
	10,400.00	400.00	400.00	10,400.00
LEGACIES.				
Gaffield, Thomas, 1906	2,043.18	1,300.00	0.00	3,343.18
Haynes, John C., 1908	0.00	5,000.00	0.00	5,000.00
Merriam, Charles, 1907	25,000.00	0.00	0.00	25,000.00
Pope, Macy S., 1906	25,028.81	0.00	0.00	25,028.81
Upton, George B., 1905	5,000.00	0.00	0.00	5,000.00
	57,071.99	6,300.00	0.00	63,371.99
OTHER FUNDS.				
Austin, Edward	379,601.72	16,230.00	15,061.50	380,770.22
Bursar's Fund	0.00	6,000.00	0.00	6,000.00
Dorr, Susan E.	19,288.48	771.54	771.54	19,288.48
Electrical Engineering Laboratory, Augustus Lowell	68,000.00	0.00	0.00	68,000.00
Richardson, Charlotte Billings, Industrial Chemistry	37,378.78	1,495.15	1,495.15	37,378.78
Rotch Architectural	25,000.00	1,000.00	1,000.00	25,000.00
Saltonstall	42,671.00	1,706.84	1,280.13	43,097.71
Teachers'	110,520.00	4,000.00	1,500.00	113,020.00
Walker Memorial	112,033.40	4,355.00	0.00	116,388.40
	794,493.38	35,558.53	21,108.32	808,943.59
MISCELLANEOUS FUNDS.				
Cabot Medal Fund	100.92	0.00	0.00	100.92
Dormitory Fund	1,868.96	0.00	0.00	1,868.96
Letter Box Fund, scholarship	81.50	29.75	50.00	61.25
M. I. T. Alumni Fund, Reserve	10,000.00	35,701.41	41,890.00	3,811.41
Naval Architecture Fund (Weld)	189.08	1,000.00	1,101.27	87.81
Physico-Chemical Fund	*1,056.64	8,205.96	7,374.74	*225.42
Roentgen-Ray Exp't Fund	956.50	0.00	0.00	956.50
Sanitary Research Fund	1,341.05	5,655.00	6,290.83	705.22
	13,481.37	50,592.12	56,706.84	7,366.65
Grand Totals	2,089,545.15	159,968.62	130,415.56	2,119,098.21

Total increases of funds	$159,968.62
Total decreases of funds	130,415.56
	29,553.06
Increases from capital sources	27,300.00
Increases from income (net)	$2,253.06

*Debit balance.

DETAILS OF ITEMS OF CAPITAL RECEIPTS AND PAYMENTS.

Capital Receipts.

GIFTS AND BEQUESTS. GENERAL PURPOSES.

Charles G. Weld Fund (new)	$15,000.00
John C. Haynes Legacy (new)	5,000.00
Thomas Gaffield Legacy (additional)	1,300.00
	$21,300.00

GIFTS AND BEQUESTS. SPECIAL PURPOSES.

Bursar's Fund. Lyman F. Rhoads	$6,000.00
For New Technology Union Building	5,850.00
Total Gifts and Bequests on capital account	33,150.00

SECURITIES SOLD OR MATURED. GENERAL PURPOSES.

$1,000.00	Burl. & Mo. River (Neb.) R.R. 6%	1918	$1,000.00
1,000.00	New Eng. Tel. & Tel. Co. 6%	1908	1,000.00
50,000.00	Utah & Northern R.R. 1st 7%	1908	50,125.00
2,000.00	Ozark Equipment Co. 5%	1910	2,000.00
			$54,125.00

SECURITIES MATURED. ROGERS MEMORIAL FUND.

1,000.00	Atchison & Nebraska R.R. 7%	1908	$1,000.00
	Total securities sold or matured		$55,125.00

Capital Payments.

SECURITIES BOUGHT. GENERAL PURPOSES.

31,000.00	N. Y., N. H. & H. R.R. 6%	1948	$35,727.50
36,000.00	N. Y. Central Equipment Co. 5%	1919	34,740.00
			$70,467.50

SECURITIES BOUGHT. ROGERS MEMORIAL FUND.

1,000.00	N. Y. Central Equipment Co. 5%	1919	$965.00
	Total securities bought		$71,432.50

BOSTON, Dec. 4, 1908.

Mr. Edward L. Parker, a public accountant, employed by this committee, has examined the accounts of the Treasurer of the MASSACHUSETTS INSTITUTE OF TECHNOLOGY for the year ended September 30, 1908, and has verified the Students' Notes and the cash at office and in banks, and his report is hereto annexed.

We have verified the list of securities held by the Institute.

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

BOSTON, Dec. 4, 1908.

To the Auditing Committee of the
Massachusetts Institute of Technology:

GENTLEMEN,—I have audited the accounts of the treasurer, Mr. Francis R. Hart, for the year ending September 30, 1908.

The accounts are correct, the payments are duly vouched, and the receipts from students' fees and all other income are duly accounted for. The cash at office and in banks, according to the statements from the banks of deposit, is correct. The Students' Notes are on hand. The statement of Assets and Liabilities as shown by the Treasurer's report of September 30, 1908, is in accordance with the books.

Respectfully submitted,

EDWARD L. PARKER,
Public Accountant

COMPARISONS OF INCOME AND EXPENSE FOR TWELVE YEARS.

INCOME.

Year ending September 30	1897	1898	1899	1900	1901	1902	1903	1904	1905	1906	1907	1908
Students' fees	$215,045.00	$216,832.00	$207,118.00	200,744.93	221,583.00	252,987.75	286,660.55	297,344.25	320,585.55	313,816.25	313,107.00	318,394.10
Gift, State of Massachusetts	25,000.00	25,000.00	25,000.00	25,000.00	25,000.00	25,000.00	25,000.00	25,000.00	25,000.00	25,000.00	25,000.00	25,000.00
Rents (net)	15,274.23	11,318.99	16,115.81	12,575.10	8,729.93	5,982.80	10,065.03	10,348.81	10,606.50	10,757.68	11,082.02	8,985.92
Laboratory supplies and breakages,	9,902.17	8,863.02	9,546.57	10,829.84	10,844.99	11,794 01	16,080.40	11,925.99	12,877.43	11,936.36	12,638.78	12,964.68
Interest	5,020.58	9,673.03	12,890.74	22,882.78	8,578.37	8,920.91	5,153.38	3,410.38	2,599.59	4,176.04	4,659.68	3,295.59
U. S. Act of 1890			8,333.34	8,333.34	8,333.34	8,333.34	8,333.34	8,333.34	8,333.34	8,333.34	10,000.00	11,666.67
U. S. Act of 1862			5,717.56	2,188.59	5,468.34	5,501.68	5,223.94	6,293.06	4,191.96	5,306.68	5,306.68	5,306.65
State Endowment Fund	7,666.67	8,000.00										
State Agricultural Fund	5,896.00											
State Mechanics Art Fund		5,131.37										
State Scholarships	4,000.00	4,000.00	4,000.00	4,000.00	4,000.00	4,000.00	4,000.00	4,000.00	4,000.00	4,000.00	4,000.00	4,000.00
Gifts	1,125.00	700.00	2,861.34	600.00	4,814.62	1,225.00	895.75	2,394.15	3,251.81	1,825.00	3,375.00	2,425.00
Totals	288,929.65	289,518.41	291,583,36	287,154.58	297,352.59	323,745.49	361,412.39	369,049.98	391,446.18	385,151.35	389,169.16	392,038.64
Income of funds:												
For general purposes	9,196.43	12,494.60	23,643.98	14,876.18	24,889.57	27,976.52	26,710.42	26,235.12	25,975.19	26,438.67	31,350.33	40,323.11
" scholarships, fellowships, awards, etc.	9,082.04	9,770.15	11,455.15	24,179.51	24,507.83	29,955.15	24,444.87	26,795.15	33,205.27	29,663.58	28,712.65	28,415.90
" salaries	3,942.00	3,504.00	4,304.00	4,304.00	4,314.00	4,324.00	4,324.00	4,324.00	4,324.00	4,324.00	4,324.00	4,324.00
" libraries	540.00	480.00	480.00	480.00	480.00	480.00	480.00	480.00	480.00	480.00	480.00	480.00
Of Rogers Memorial Fund	9,814.00	10,949.00	10,877.63	10,900.48	10,853.00	10,838.00	10,970.50	10,610.11	10,815.00	10,845.75	10,850.50	12,941.00
" Rotch Architectural Fund			1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00	1,000.00
" Rotch Prize funds	450.00	450.00	400.00	400.00	400.00	400.00	400.00	400.00	400.00	400.00	400.00	400.00
" Other funds	781.50	125.00	218.50	125.00	81.37	50.00	75.00	50.00	75.00			
Totals from funds	33,805.97	37,772.75	52,379.26	56,265.17	66,525.77	75,023.67	68,404.79	69,894.38	76,274.46	73,152.00	77,117.48	87,884.01
Miscellaneous income:												
Sale of lecture notes	2,753.28	2,593.87	2,463.60	2,562.72	2,805.30	3,218.10	4,093.27	4,461.15	4,032.15	3,624.04	2,292.26	2,254.26
Boston University	1,150.00	1,150 00	1,150.00	1,150.00	1,150.00	1,150.00	2,898.00	2,650 00	94.50			
Augustus Lowell for Lowell Courses	8,700.00	8,700.00	9,000.00	9,000.00	7,714.41	5,757.15	6,105.70					
Alumni Fund Committee										42,583.61	*36,588.04	35,701.41
Total income	$335,338.90	339,735.03	356,576.22	356,132.47	375,548.07	408,894 41	442,914.15	446,055.51	471,847.29	504,511.00	505,166.94	517,878.32

* Also $10,000 reserved for capital purposes.

COMPARISONS OF INCOME AND EXPENSE FOR TWELVE YEARS.

EXPENSE.

Year ending Sept. 30	1897	1898	1899	1900	1901	1902	1903	1904	1905	1906	1907	1908
Salaries:												
Instruction	$183,337.99	$186,170.02	191,129.25	198,838.30	209,191.14	228,864.05	243,920.91	261,458.83	265,577.73	286,039.37	300,847.32	313,077.47
Administration	20,393.24	24,266.88	22,422.59	23,350.65	25,898.43	32,796.04	37,643.09	37,587.98	39,119.23	39,196.79	38,218.62	39,609.32
Labor	19,013.19	21,518.82	26,368.78	26,883.10	27,920.25	29,841.20	38,009.58	41,602.62	41,992.92	43,268.39	44,415.34	47,396.63
Paid by Gift	500.00	500.00	458.00	500.00	500.00	500.00	500.00					
Total salaries and wages	223,244.42	232,455.72	240,378.62	249,572.05	263,509.82	292,001.29	320,073.58	340,649.43	346,689.88	368,504.55	383,481.28	400,083.42
General expenses, including insurance	14,122.07	17,245.67	25,809.66	19,046.01	21,114.17	19,724.99	34,552.66	22,608.88	19,853.01	17,181.25	20,461.07	19,446.95
Repairs, general	11,232.57	27,206.89	33,678.83	12,406.00	9,381.28	13,648.76	15,986.58	11,911.07	9,973.39	16,843.91	5,816.55	16,626.62
Fuel, water, gas and electricity	11,973.50	10,113.88	13,116.81	13,316.21	17,556.00	17,648.79	32,771.50	27,086.25	23,752.59	21,248.27	22,468.29	23,577.60
Printing and advertising	6,951.33	6,384.10	7,209.11	11,049.06	12,746.05	12,477.18	14,131.93	16,799.49	18,412.66	12,295.17	10,162.72	11,332.50
Department supplies and repairs	34,885.28	34,784.05	39,337.38	41,487.55	44,755.50	39,903.27	49,978.10	66,269.94	45,039.59	58,853.69	54,616.44	56,990.76
Payments from Physico-Chemical Research fund								3,000.00	3,000.00	3,000.00	3,000.00	3,676.35
Rents	380.00	380.00	380.00	380.00	380.00	1,783.63	466.70					
Interest	12,292.05	5,476.17	1,000.00	1,000.00								
Exposition exhibits		326.62	33.41	971.93	927.84	22.55	85.00	3,272.99	313.17			
Mechanical engineering	2,657.89	500.00	4,395.31									
Other departments	5,910.23		143.50									
Miscellaneous		1,453.67				25.00						
	100,404.92	103,871.05	125,104.01	99,656.76	106,860.84	105,234.17	147,972.47	150,948.62	120,344.41	129,422.29	116,525.07	131,650.78
Payments from special funds:												
From Fellowship funds	800.00	800.00	800.00	800.00	800.00	800.00	1,650.00	900.00	2,100.00	1,400.00	1,800.00	1,350.00
" Edward Austin Fund, awards				4,169.36	3,856.55	5,385.00	2,474.72	3,387.50	5,910.15	5,312.50	3,935.00	4,384.00
" Teachers' Fund, awards				1,000.00	1,200.00	3,800.00	500.00	3,400.00	5,700.00	1,530.00	2,350.00	1,500.00
" Rotch Fund, prizes	450.00	450.00	400.00	400.00	400.00	400.00	400.00	400.00	400.00	400.00	400.00	400.00
	1,250.00	1,250.00	1,200.00	6,369.36	6,256.55	10,385.00	5,024.72	8,087.50	14,110.15	8,642.50	8,485.00	7,634.00
Society of Arts, expenses	2,164.60	593.31	777.01	127.84	796.71	1,408.94	169.82	1,775.62	1,235.20	1,389.44	1,008.15	1,247.63
Margaret Cheney Reading Room									49.97	448.43	570.00	394.40
Lowell Institute Courses	8,700.00	8,700.00	9,000.00	9,000.00	7,714.41	5,757.15	6,105.76					
Total expenses	335,763.94	346,870.08	376,459.64	364,726.01	385,138.33	414,786.55	479,346.29	501,461.17	482,429.61	508,407.21	510,069.50	541,010.23
Total income (p. 22)	335,338.90	339,735.03	356,576.22	356,132.47	375,548.07	408,894.41	442,914.15	446,055.51	471,847.29	504,511.00	505,166.94	517,878.32
Excess of expense for year	$425.04	7,135.05	19,883.42	8,593.54	9,590.26	5,892.14	36,432.14	55,405.66	10,582.32	3,896.21	4,902.56	23,131.91