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OF THE

PRESIDENT AND TREASURER

PRESENTED AT THE DECEMBER MEETING OF THE CORPORATION

JANUARY, 1908

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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 preceding year, and upon the larger problems of development with which it is now confronted. In speaking of this matter of development, one occupying only temporarily the office of the presidency naturally feels much hesitation; but I have believed that it would be of interest to you to hear the views of one who has for many years been a member of your Faculty; and I shall, therefore, venture to express myself freely upon our future policies. Let me, however, first recount to you briefly the history of the past year.

CHANGES IN THE CORPORATION AND FACULTY.

The Corporation has during that period suffered the loss of one of its oldest members, Mr. Alexander S. Wheeler, whose services to the Institute give him a pre-eminent place among the many friends to whom it owes its foundation and development. He was a member of this Corporation from 1882 until the time of his death, and a member of the Executive Committee from the date of its formation until the year 1902. A memorial of his services and of our appreciation and gratitude for his devotion is to be presented to you to-day by one of your members who was closely associated with him.

The Corporation has welcomed to its membership three new term members, elected from the nominees of the Alumni Association,—Dr. George E. Hale, of Pasadena, California; Mr.

George W. Kittredge, of New York City; and Mr. Frank G. Stantial, of Everett, Massachusetts.

There have been several changes in your administrative officers. Upon the first of last July, Dr. Henry S. Pritchett, after a service of seven years, retired from the presidency to devote himself to the work of the Carnegie Foundation for the Advancement of Teaching; and I was requested to perform the duties of the office till such time as a permanent president shall be appointed. Mr. George Wigglesworth, upon the first of October, resigned from the position of treasurer, which he has occupied since 1891. The eminent service which he has so freely and generously rendered to the Institute during this long period has been recognized, so far as words can do so, by the resolutions adopted at your last meeting; but every friend of this school has a deep-seated feeling of gratitude which cannot be given adequate expression. The Institute is to be congratulated in having secured as its new treasurer Mr. Francis R. Hart, who brings to the work enthusiasm, devotion to the interests of the Institute, and a wide financial experience. He becomes *ex officio* a member of your body and of your Executive Committee. At the annual meeting in October Mr. James P. Munroe was elected Secretary of the Corporation for the ensuing year.

During the past year five members of the Faculty have withdrawn: Professor William O. Crosby, retiring under the Carnegie Foundation to devote himself exclusively to his geological investigations; Professor George V. Wendell, to take charge of the Department of Physics at the Stevens Institute of Technology; Professor Frank P. McKibben, to take charge of the Department of Civil Engineering at Lehigh University; Professor Richard W. Lodge, to devote himself to private practice; and Professor Douglas W. Johnson, to give all his time to his work at Harvard University as Assistant Professor of Physiography.

Within the Faculty advancements have been made from the grade of Associate Professor to that of Professor as follows: John O. Sumner, Professor of History; Frederick H. Bailey,

Professor of Mathematics; Henry Fay, Professor of Analytical Chemistry.

The following men, formerly Assistant Professors, have been promoted to Associate Professorships: Henry G. Pearson, Associate Professor of English; Ralph R. Lawrence, Associate Professor of Electrical Engineering; Harrison W. Smith, Associate Professor of Electrical Engineering; George C. Shaad, Associate Professor of Electrical Engineering.

Thirteen new members have been added to the Faculty, of whom the four following have come to us from outside positions: Reginald A. Daly, Professor of Physical Geology, formerly of the Geological Survey of Canada; Edwin B. Wilson, Associate Professor of Mathematics, formerly of Yale University; Lewis E. Moore, Assistant Professor of Civil Engineering, formerly of the University of Illinois; Edward E. Bugbee, Assistant Professor of Mining Engineering and Metallurgy, formerly of the University of the State of Washington.

The remainder were previously instructors at the Institute. They are as follows: Leonard M. Passano, Assistant Professor of Mathematics; George L. Hosmer, Assistant Professor of Civil Engineering; Charles B. Breed, Assistant Professor of Civil Engineering; Maurice DeK. Thompson, Assistant Professor of Electro-Chemistry; Henry L. Seaver, Assistant Professor of English; Miles S. Sherrill, Assistant Professor of Theoretical Chemistry; George E. Russell, Assistant Professor of Civil Engineering; Gilbert N. Lewis, Assistant Professor of Physico-Chemical Research; Earle B. Phelps, Assistant Professor of Research in Chemical Biology.

FACULTY ORGANIZATION.

The Faculty has during the past year perfected its organization and has made provision for carrying on more effectively its administrative functions by the creation of the office of Chairman and by the appointment of new committees on Faculty Business, on Faculty Rules, and on the Courses of Instruction.

In the report of the Secretary of the Faculty will be found not only a fuller presentation of these matters, but also certain resolutions of the Faculty in which its opinions are expressed as to the character of Faculty organization and the methods of administration best adapted to the conditions of the Institute. Our Faculty, like that of many other educational institutions, has now become so large that it cannot properly deal with the details of administration; but instead of establishing a single administrative board consisting of a small number of its representatives, it has gradually developed the more democratic, and, it believes, the more effective, plan of placing its numerous and varied functions under the charge of about twenty-five standing committees, which are empowered to take final action upon all special and individual cases that arise, and are expected to take the initiative in submitting to the Faculty for its approval any important changes of policy or procedure that seem desirable. I would especially call your attention to the resolution in which the Faculty, in response to the suggestion of President Pritchett, "expresses its appreciation of the desirability of some form of advisory relation between the Corporation and the Faculty, and its readiness to co-operate with the Corporation in the preparation of a plan for establishing such a relation."

REGISTRATION STATISTICS.

The membership of the Faculty has been increased from 78 to 86, and the number of instructors and assistants from 121 to 124. There are, in addition, 11 research associates and assistants devoting themselves almost wholly to investigation work.

The total registration of students is now 1410, while that at the same time last year was 1397. The proportion of Massachusetts students (55½ per cent.) is nearly the same as in recent years. The number of foreign students has increased from 47 in 1902 to 80 this year, or from 3.0 to 5.7 per cent. of the whole. The proportion of new students who have previously

attended other colleges has increased from 19 per cent. five years ago to 29 per cent. the present year. There is no very marked change in the distribution between the several Courses. The three largest Courses are as in the past those in Mechanical, Civil, and Electrical Engineering, with 226, 210, and 200 students, respectively. Next comes the Course in Mining Engineering and Metallurgy with 118 students, showing this year an increase of 18 students, the largest in any Course. The average age of students entering the first year is 18 years 11 months, one month greater than last year.

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

DEVELOPMENTS IN THE WORK OF INSTRUCTION.

The further history of the past year will be found recorded in some detail in the reports of the general administrative officers and of those in charge of departments, which are submitted herewith. To these I invite your special attention. I can speak here only of the more important developments, especially of those relating to the work of instruction.

The curricula of all the strictly engineering courses have been modified during the past two years by the omission, wholly or in part, of the second-year work in modern languages; and the time gained has been utilized to increase the amount of instruction in English and history, and to give a more thorough drill in fundamental engineering subjects, especially in applied mechanics, structures, and steam engineering. It is felt that few engineers make practical use of their knowledge of modern languages, and that the general and scientific studies that have been substituted are not only more directly useful, but either have a higher cultural value or provide a better mental training.

Important progress in the development of our advanced work has been made by greatly extending and systematizing the subjects of instruction offered to candidates in fifth-year courses leading to the degree of Master of Science. Almost

every department has announced, and is prepared to offer in the next school year, advanced courses of a somewhat more specialized character than can be given to undergraduate students. Thus, in civil engineering further work in the design of structures (particularly those of re-enforced concrete), of railroads, and of hydraulic works, is offered; in mechanical engineering, further study of turbine and gas engines and of machine design is provided for; in architecture, advanced courses in the various branches of architectural design are announced; and similarly in all other departments advanced work has been arranged for. The broad significance of this form of development and its bearing on the character of our undergraduate courses I shall speak of later.

A special inducement to pursue such advanced work has been offered to graduates from other colleges by a recent vote of the Faculty, which permits them to enter at once upon a course leading to the degree of Master of Science without previously taking our Bachelor's degree. This course will, in general, extend over a period of two or three years, varying according to the previous preparation of the college student.

There are, however, no developments of any kind which are so important as those which tend to increase the effectiveness of our undergraduate instruction in meeting the needs of the individual student. I am glad to be able to tell you that this year an important step in this direction has been taken by the initiation of a plan of individual conferences between the instructor and students in certain first-year subjects. Owing to the inadequacy of the funds available for the purpose—for it involves additional instructors of first-rate ability—it has been possible this year to put this plan in force only to a limited extent in the subjects of English and mathematics. It is, I believe, of great importance that this plan be largely extended as rapidly as our facilities admit; for it is undoubtedly true that many of the students who now fail to reach our standards, could overcome their difficulties if they could receive more help in learning how to study and more personal encouragement

and stimulation. The conference plan also develops an attitude of cordiality and mutual helpfulness in both the instructing staff and the student body which is the essence of a healthy college spirit.

The instruction in the Department of Mathematics is undergoing a somewhat radical revision, in which the old divisions into advanced algebra, analytic geometry, differential and integral calculus are in large measure obliterated, and the whole subject is presented, irrespective of this traditional grouping, in a manner most economical and advantageous for the student, and with the help of a large number of concrete applications.

The Department of English is trying the interesting and apparently successful experiment of dividing its students into sections upon the basis of their proficiency. This division makes it possible to give instruction better adapted to individual needs: on the one hand it avoids holding back the brighter students, and on the other it makes it possible to help more effectively those who need it most. A trial of this plan in other subjects of instruction seems advisable.

THE NEEDS OF THE DEPARTMENTS.

The immediate needs of the various departments should not pass unnoticed here, even though they are more fully presented in the separate reports of those in charge.

Nearly all of the departments are in serious need of additional floor-space for laboratories, class-rooms, and places for students to study. The demand for better laboratory accommodations is perhaps most urgent in the Departments of Mechanical Engineering, Mining Engineering, and Chemistry. In the first of these departments some additional provision must be made at once in order that the recently purchased steam turbine and its accessories may be installed; and in the Chemical Department the much larger number of students who will take organic chemistry next year, owing to changes in the course schedules, cannot be accommodated with the present facilities.

Additional equipment is also much needed by several departments. Some of the larger and most essential machines are as follows: a surface condenser, refrigerating plant, impact tester, and a locomotive testing plant are important to the Department of Mechanical Engineering, additions the need of which has been strongly urged by your visiting committee for that Department; new engine and speed lathes and other machines, as well as extensive repairs to the building, are required by the Laboratories of Mechanic Arts; a large storage battery is greatly needed by the Electrical Engineering Department; and a new boiler for the heating and power plant is essential before the beginning of the next school year.

Provision for a Travelling Fellowship is considered especially important by the Department of Architecture in order that the opportunity for foreign study may be open to its most capable graduates.

THE EDUCATIONAL FIELD OF THE INSTITUTE.

It is well, I believe, for the Corporation to take under consideration from time to time those fundamental principles which express the main purposes for which the Institute exists and which should determine the educational field which it is to occupy and the directions in which it is to be developed. In this belief, I present my views for your consideration.

Its Function as an Undergraduate School.

First of all, I believe that it should be clearly recognized that one of its main functions, as an independent scientific school, is to educate for the scientific and engineering professions young men who have previously received only a high-school education. It must remain in large measure a school for undergraduates, and must not allow itself through the influence of the policies of universities to become only a graduate school for the professional training of the former students of other colleges. The question here at issue is not which is more

advantageous—a professional training preceded by a liberal education of an elective character or a co-ordination of the two in a single prescribed course,—but whether or not there is a large field for education of the latter type. Some may prefer to drive tandem, with a loose rein upon the leader, and some to drive abreast; but none wishes his freedom of choice restricted. By the establishment in this community of the Graduate School of Applied Science at Harvard University, and by a similar development at other universities throughout the country, ample provision will doubtless be made, as fast as the demand arises, for the engineering education of college graduates. It should be, on the other hand, the especial care of the Institute to maintain and develop that combination of liberal and professional training for undergraduate students for which it has stood from its foundation. If ever the demand for this type of education should cease, or if ever it be demonstrated that this type when best developed produces only engineers and scientists of an inferior grade, then, and not till then, will it be time to consider the conversion of the Institute into a purely graduate school. To abandon at this stage the educational experiment which the Institute is making, instead of coping with the difficulties in its problem which have become apparent, would be a betrayal of the trust which its past imposes and a severe blow to the educational development of this country. There is as yet no indication that the sources that have directly fed the streams which are inundating our technological schools are drying up, nor is there as yet any adequate experience which warrants us in diverting those streams into a different channel. It is certainly desirable that there be developed the new type of engineering education, in which cultural subjects are given as collegiate courses and the professional training is given in a graduate school. Such a development, indeed, is to be welcomed as a stimulus to us to study the conditions for making our own type of education more effective. We must, however, realize that this is not *our* field of educational service, and we must not allow our attack upon the problems of undergraduate

education to be weakened by theories as to the tendencies of professional education under university conditions.

The second principle which I desire to emphasize is that already indicated by my preceding words, namely, that, as an independent undergraduate school, the educational problem of the Institute is necessarily of a twofold character: we have to develop a plan of education which is adapted to produce not only well trained engineers, but also broad-minded, high-purposed men. We must aim to make the work of the students at the Institute and the conditions of their life outside such as lead to a duly proportioned development in these two directions.

It is sometimes said, however, that in attempting to solve this twofold problem in a four-year undergraduate course, the Institute is undertaking a hopeless task. This contention I would meet by the statement, that, whether or not it be hopeless to give a fully adequate education upon these two sides within the period of four years, it is our present problem to do this in as large a measure as is possible; for to increase further this minimum period of study would close the doors of the institutions of technological education to a large number of young men whose financial resources are already taxed to the utmost. Moreover, the careers of Institute graduates warrant the conclusion that the results attained in the past are as a whole satisfactory; and when the many possibilities of further development in our educational work and the conditions of student life are considered, the future outlook for a fuller success of the four-year course is a bright one. Before conceding the necessity of an extension of this period of study, we must at least consider the possibility of utilizing in part the intermediate summer vacations, which now cover no less than one-third of the whole year; to this matter I shall return when I consider the specific lines of development which are most imperative.

Advanced Courses for Specialization.

The general principle which should determine the character of our four-year course of study—a principle fully recognized

by our Faculty—is that a liberal education be provided such as will develop character, breadth of view, and high ideals of service, and that the professional education be mainly confined to a thorough training in the principles of the fundamental sciences and in scientific method, specific engineering subjects being included only so far as the remaining time permits and as the minimum requirements of professional practice demand. It should be our aim not to turn out a specialist at the end of a four-year curriculum, but rather to provide for specialization in a fifth-year graduate course. By courageously eliminating from our fourth-year curriculum the more technical branches in instruction, however important they may be for the practising engineer, and by making more ample provision for them as subjects to be pursued in graduate courses, we shall, on the one hand, be enabled to make our undergraduate course more educational in the broadest sense, and, on the other hand, to make more evident to the student the practical importance of returning for a fifth year to acquire the more specialized knowledge of the separate engineering professions. This, then, is the direction in which, in my judgment, the courses of study at the Institute should be developed: we will give in our four-year undergraduate course an even broader and deeper training than at present in cultural and fundamental scientific studies,—a training which will still enable those students that are obliged to do so to enter at once upon the practice of their professions, handicapped somewhat, it may be, by the lack of technical experience, but with a sound knowledge of principles and a developed mental power which will gradually enable them to overcome this disadvantage; and, on the other hand, we will develop graduate courses of such a character as will obviously remedy this deficiency of insufficient specialization and will attract such graduates of this institution and of other scientific schools as are financially able to continue their education. We shall thus create a type of graduate school in which is offered advanced training for Bachelors of Science rather than for Bachelors of Arts.

Opportunities for College Graduates.

But these are by no means the only fields which the Institute should occupy. Some of the other directions in which our development should be continued or extended also deserve consideration.

We must, while not permitting any sacrifice of the instruction of our undergraduate students, encourage the graduates of colleges to enter the higher years of our regular courses and our advanced courses, and offer them such additional facilities as their different preparation demands. Future experience alone can determine whether such graduates will receive a better education in the graduate schools of universities in courses attended often not only by themselves, but by college men without definite professional aim, or in scientific schools working side by side in the undergraduate courses with men earnestly devoted to preparation for their profession. The presence together of these two groups of men is certainly mutually advantageous: the graduate student from another institution tends to broaden the interests of his undergraduate associate; and the latter imbues the former with that spirit of hard work and seriousness of purpose which attendance at the scientific school has inspired. For these reasons we must not fail to provide suitable courses and conditions of work for the college graduates who are coming to us in constantly increasing numbers.

Five-year Courses for the Bachelor's Degree.

More important, however, than the offering of increased opportunities for college students is a more ample provision within this institution itself for the education of such students coming directly from the preparatory schools as are able to devote more than four years to general and fundamental studies. In emphasizing the importance of maintaining our undergraduate four-year course, I should be sorry to give the impression that that period is considered a fully adequate one. On the

contrary, I believe the Institute should at once meet the demand for a broader education of its students by a development of a three-year Course in General Science, which shall contain, partly as required work and partly as electives, all or nearly all those subjects of instruction now included in the first two years of the various Courses of the Institute, so that the latter may be completed in two years more by students who have finished the three-year science course. This plan would enable three years instead of two to be devoted to the humanistic branches of study, to the nature sciences, and to the fundamental physical sciences. It would in large measure provide the breadth of scholarship which the college course is designed to supply, and would do this by the methods and in the atmosphere of the scientific school. Owing to the facts that a long list of electives in general studies is already offered to our third-year students, and that many of the scientific subjects that would naturally be included are already given by one or other of our science departments, this course in general science could be arranged for at comparatively small additional expense. It would be desirable, however, that one new professor be appointed, who might offer courses in philosophy, psychology, and logic.

Another similar opportunity for a broader education and a more thorough training can be provided through the announcement of more definite five-year schedules in each of the larger engineering branches. Such five-year courses would also make provision for those conscientious, thoughtful students who have the mental ability to do our work satisfactorily, but cannot do so at the rate and under the pressure which our four-year curriculum involves. These matters are under consideration by the Faculty.

Courses for Research and Advanced Study.

Development is also of the greatest importance in the direction of larger opportunities and inducements for research work and advanced studies in the pure and applied sciences which

form the basis of our curriculum. An institution of learning which does not contribute through the researches of its instructing staff and graduate students to the advancement of science cannot secure the highest grade of teachers, cannot keep its courses of instruction upon the plane of broad and deep scholarship, and cannot retain its educational prestige. I have alalready spoken of one kind of advanced course which we are already developing,—one which would provide the more specialized instrucion in engineering subjects which industrial advances are making more and more imperative. Such a course, which hardly needs to be of more than one year's duration, leads to the degree of Master of Science. There is, however, a second kind of advanced course which is even more essential to the development of the highest type of scientist or engineer. This is a course in which the student, while pursuing more advanced studies in the underlying sciences, devotes himself mainly to the original investigation of problems in pure or applied science. It is investigation work of this sort which tends to develop the creative power of the man and his ability to handle new problems relating to the improvement of industrial processes and engineering methods. Such a course, when of two or three years' duration, may lead to the degree of Doctor of Philosophy or Doctor of Engineering. The Institute has already made encouraging progress in this direction; but the number of students engaged in such work has thus far been small. This matter of research work, both with reference to advanced students and the members of our own instructing staff, I shall consider more fully a little later.

THE PROBLEMS OF DEVELOPMENT.

Let me next speak of what may be called the larger problems of development—of those lines of action which are essential to the fuller accomplishment of our educational purposes as I have set them forth.

It is scarcely necessary to mention that one of the most

important of these problems is the selection of a permanent president who has a true conception of the educational ideals of the Institute, combined with the high character, soundness of judgment, and power of initiative and of energetic execution that will make him an effective agent in the realization of those ideals. The qualifications for the office are so numerous and varied that their combination in a single person is extremely rare; and all such persons are in great demand for the highest executive positions. With the consideration of this matter the Executive Committee is still actively engaged.

Another matter of the greatest moment is the reaching of a decision as to the permanent location of the Institute, in order that its future development may be assured and its immediate needs adequately provided for. I shall not, however, discuss this question, for I know that you fully realize its vital significance. You have appointed a Committee of your body to deal with it; and that Committee will doubtless take action, and report to you as promptly as possible. It will of course be appreciated that the first preliminary to any action must be a careful consideration of the means for financing the undertaking, and that the present monetary situation makes this impracticable. Friends of the Institute should, however, realize that again in its history the time has arrived when provision must be made for far-reaching improvements in the physical conditions under which its work is carried on. New buildings must be erected, new laboratories provided, and new equipment secured, in order that the Institute may retain its leadership in technological education. And these are not matters that can be much longer deferred.

Reduced Tuition Fees and Increased Scholarship Funds.

Next in importance to this matter of making provision for our immediate needs and future development comes the question of reduced tuition fees or increased scholarship aid. The inadequacy of our endowment, combined with the high cost of the kind of instruction furnished by the Institute, made it seem nec-

essary a few years ago to increase our tuition fee to $250. This increase will, I earnestly hope, be regarded as only a temporary expedient for which a remedy must be found at the earliest moment. The present high tuition not only is shutting out a large group of promising young men from the advantages of a scientific and engineering education, but is imposing upon another large group a financial burden which they are scarcely able to bear, and which forces them to live and to work under conditions unfavorable to their health and social development. Any of the administrative officers of the Institute could recount numerous instances where men have been obliged to withdraw from the Institute because they could not raise the last fifty dollars of their tuition, or where they have been living on thirty or forty cents a day in order to meet it. Our high tuition is, moreover, sending young men more and more to the other less expensive collegiate institutions. Many of these take the full courses of study there, but there is a large and increasing number who for reasons of economy replace the first year or first two years of the Institute course by corresponding work at another institution, and then enter the second or the third year of the Institute. There is involved in this plan a lack of continuity and of adequate preparation which is unfortunate.

While we are not interested in bringing about any large increase in the number of our students, we are concerned in drawing to us young men of the highest quality. We must, therefore, not permit the financial resources of applicants to be the principle of elimination in any greater measure than is absolutely essential. There is, in my opinion, no form of educational expenditure which produces so large a return to the community as the higher training for the scientific and engineering professions of those comparatively few young men whose character and ability are such as to enable them to rise to positions of leadership. And this type is, I believe, most commonly developed among families which have sufficient means to send their sons to the high school, but yet have trained them to work in the summers and at other odd times to earn

money towards their own support. Boys from poorer families are unfortunately not likely to have the opportunity of even a high-school education, or the home surroundings or antecedents which conduce to intellectual development, while those from richer families are apt to lack the earnestness of purpose and the inclination to subordinate the pursuit of pleasures to thorough preparation for a life of service which is acquired by the boy who has already learned to work. It is, however, just such families of small means which are finding it exceedingly difficult, if not impossible, to meet the high expense of technological education.

This difficulty may be met in one of two ways,—by a general reduction of our tuition fee or by providing larger funds for scholarship aid to individual students. Under the existing conditions a combination of the two methods seems most advisable. To reduce our tuition fee for all our students would involve such a large reduction of our income that it probably cannot be immediately considered; but it might be practicable to adopt the plan of reducing the tuition fee for first-year students. Assuming a first-year class of three hundred and thirty students, a reduction in the fee of only $50 would involve a decrease of $16,500 in our annual income; but this might be partly offset by the increase which it would probably cause in the number of first-year students. The advantages of this reduction in tuition for first-year students are proportionally far greater than a corresponding reduction for those of the higher years—desirable as the latter is. It would enable a larger number of properly prepared students to enter the Institute; and the most deserving of these, after they had demonstrated their ability by their first year's work, could be assisted to continue by grants from our scholarship funds and those of the State, which can not be awarded with proper discrimination to boys in advance of their coming to the Institute. Moreover, as the student gets older and has had more training, it is easier for him to get remunerative employment in the summer vacations. It will, too, diminish the tendency for students to go to other institu-

tions for a single year or two merely for reasons of economy. Finally, it is the most equitable and from a financial standpoint the safest course for the Institute to pursue in effecting a reduction of its tuition charges, since the first-year instruction is less costly than the more specialized instruction of the higher years.

This plan would, however, remedy only in part the difficulties of our high tuition; for our scholarship funds are not adequate to meet the needs of our deserving students in the higher years. This is fairly evident merely from the statement that the scholarship grants to undergraduate students formed last year only nine per cent. of the total tuition fees paid by them. Ampler funds must therefore be secured either through an appeal to the generosity of private donors or through further grants from this Commonwealth, which cannot afford to allow the opportunity of a higher technological education to remain closed to such of its youth as are fully qualified to receive it.

Requirement of Summer Work.

Coming now to matters more closely related to the work of instruction, I will first consider the extension of the required work of the Institute courses for a period of four or five weeks into the summer. Such an extension can best be made, not by lengthening our present term, but by providing, in the summers at the end of the first two school years, summer schools which our regular students are required to attend and to which they will be admitted free of charge. The importance of this extension of our regular work can be fully appreciated only by those who are intimately acquainted with the difficulties and defects of our present system of instruction, but the main aspects of this matter can be readily understood. The educational problem of the Institute, as has already been stated, is to give students with only a high-school preparation a liberal education, a thorough training in fundamental scientific subjects, and sufficient technical knowledge to enable them to enter at once upon the practice of their profession. Under

the present conditions, as I have already said, we must for most of our students attempt to do this as far as possible in a period of four years. The opportunities of the four-year period have, however, not yet been fully utilized. Our summer vacations form one-third of the whole year; and during this time most of our younger students are unoccupied or are at work in places from which they derive no educational advantage. The assignment of even four or five weeks of the summer vacations after the first and second years to those portions of our work which consist largely in the acquirement of technical skill and experience, such as laboratory practice, shop-work, drawing, and work in the field and in industrial establishments, would so relieve the present overcrowded curriculum that an amount of good entirely out of proportion to the time gained could be accomplished. The time gained would, I am sure, be devoted by the Faculty not to further specialization in the engineering branches, but to some increase in general studies and to more thorough training in the fundamental principles of the sciences underlying the professional work. The attempt would be made to concentrate the attention of the student upon fewer subjects at one time, to demand more thought and less learning of lessons, and to emphasize important principles through the solution of numerous problems by the student. The pressure of the studies of the school year would be somewhat diminished; while the work of the summer school, being largely in laboratory, shop, or field, and concentrated upon one or two subjects, would not continue the mental strain to any great extent. The plan would involve increased expense to the Institute, for it would be necessary to pay the salaries of the instructors engaged in the summer schools for an additional month. Aside from this, the only important objection to it seems to be the added tax that it imposes upon the resources of certain students in forcing them to meet the expenses of living in Boston for a longer period and in shortening the time which they can devote to remunerative work. This makes it, in my opinion, out of the question to charge an additional tuition fee for such required

summer courses; but it is not a sufficient argument for postponing a step which is so essential to the effectiveness of our work.

Research Work by the Instructing Staff.

An extension of opportunities for investigation both in pure and applied science by members of our staff and by advanced students is a matter which, though secondary to the considerations directly affecting the instruction and general welfare of undergraduate students, is nevertheless of the greatest importance in its effect on the relation of the Institute to the scientific and technical development of this country. It ought to be our especial aim to get into the closest touch with the scientific problems of the manufacturer and the community, and to assist in the solution of them. Professors and instructors on our staff are already doing a vast amount of work in this direction, partly through the thesis work of students, and partly through their employment as experts. But this work is often performed under conditions which make a thorough-going investigation impossible; and, because of its personal character, it fails to be identified with the Institute and recognized among its contributions to scientific progress. In my opinion, we should in all departments give each of our assistants and instructors a reasonable proportion of free time for research purposes, we should afford him adequate laboratory facilities, and should then insist as a condition of his promotion and advancement in salary that he make and publish scientific or technical investigations. Almost all our instructors already have some available time that could be devoted to research work, so that the carrying out of this suggestion does not involve a proportionate increase in our staff. That time is, however, at present so limited, so disconnected, and so apt to be encroached upon by other work that the man feels little encouragement to enter upon an investigation. If that amount of time could be increased and made definite by the assignment of days or half-days for research work, there would result not only an incalculable gain to himself as a teacher, investigator, and scholar, but also

added reputation to the Institute because of its larger contributions to science.

Establishment of Research Laboratories.

Another method of promoting investigation work at the Institute is through the establishment of research laboratories in connection with the departments. For each such laboratory of an income of about $5,000 needs to be guaranteed for at least a few years. Two laboratories have already been started which are devoted to research in physical chemistry and in sewage disposal, and their contributions to pure science in the one case and to questions of municipal sanitation in the other have attracted much attention throughout the country. The Departments of Chemistry and of Geology have recommended two new laboratories of this kind,—a Research Laboratory of Applied Chemistry and a Research Laboratory of Physical Geology,—the former to be devoted to the study of chemical problems of general importance to the manufacturer, and the latter to the investigation of geological processes and disturbances of economic significance. The Departments of Applied Mechanics and Mechanical Engineering are also in need of research assistants to carry on more systematically such investigations as have long been in progress and to prepare the results for publication. The formal organization of research laboratories accomplishes much more than the same expenditure of money for uncorrelated investigations by the individual members of the departments. It calls attention to the activity of the Institute in this field, raises its scientific standing, attracts advanced students, who are often just as effective research workers as inexperienced assistants, offers facilities and inducements for advanced study and investigation to our younger instructors, and forms a nucleus of development in this important direction. I recommend that the Visiting Committees of the Departments give this matter their attention.

THE PROBLEMS OF STUDENT LIFE.

The problems of the outside activities of our students are, I believe, in the main solving themselves satisfactorily under the guidance of the administrative officers of the Institute. To our last President, Dr. Pritchett, is due in large measure the development of the conditions that make for a broader and fuller student life. His establishment of the Tech Union, which is the center of the social activities of students, his promotion of a rational system of athletics, his interest in the appointment of a Dean of the Faculty and a Medical Adviser, his institution of general convocations of students at which they are addressed by distinguished speakers, and other results of his own personal participation in student affairs, form a most worthy and enduring memorial of his service to the Institute. Credit for the progress in this direction must also be given to our Dean and our Bursar. The work of the former, as the general consulting officer for students, and of the latter in his sympathetic administration of his financial office and his effective management of the Tech Union, and the participation of both in the social gatherings of students have done much to develop a loyal, manly, democratic spirit such as exists in few colleges.

The Tech Union, great as are the benefits which it has brought to our student life, is, however, miserably inadequate as the social gathering place of our fourteen hundred students; and the same is true of the present temporary gymnasium as a means of providing for their physical welfare. One of the strong reasons for a prompt decision as to our future location is that the Walker Memorial Building can then be at once erected, whereby suitable social and dining halls and a properly equipped gymnasium will be provided.

There is, however, also a need of some provision for the housing of those of our students who cannot live at home or with friends, or in fraternity houses. Perhaps one-fifth of the whole body of students live in undesirable surroundings, in cheap boarding-houses, where opportunities for student fellow-

ship and for the development of a healthy social life do not exist. I strongly dissent from the view sometimes expressed that our obligations to the young men who spend with us four of the most critical, formative years of their lives are solely on the intellectual side; and the situation I have just mentioned is one, I think, for which we must soon find a remedy. It is one, too, which is especially appropriate for the Corporation and Alumni to deal with directly. In attacking this problem, it is desirable to proceed slowly and in an experimental way. A plan that might be followed is one which the Dean has suggested,—that of erecting two or three student houses, each accommodating twenty-five to thirty students, upon the Institute's vacant land in Brookline, adjoining the Athletic Field. The establishment of large dormitories accommodating a hundred or two hundred students does not offer a satisfactory solution of the problem; for there is a lack of the close fellowship and of the *esprit de corps* which is developed in smaller compact groups. The Greek-letter fraternities have demonstrated the type of student association which is attractive to young men. These have been extensively developed here during the past ten years; and, whatever may be true of them in the atmosphere of the college campus, they are on the whole successful here with the earnest kind of student who attends the Institute. The fraternity houses, however, owing to the large expense connected with the maintenance of such isolated private houses in the city, fail to provide for many of the students who most need such social opportunities as they afford. In buildings erected upon Institute land in the suburbs, it should be possible with proper financial management to provide board and room at a cost of six dollars a week, a sum which would be within the means of a much larger proportion of our students. There is every reason to believe that, with the interest in this undertaking already shown by the Dean and certain members of the Corporation, the Alumni, and the Faculty, this experiment would be successful.

CONCLUSION.

I might go on to discuss some of the more specific developments which it is desirable for the Institute to introduce, such as better provisions for training teachers in those branches of science and engineering with which we are most closely identified, definite arrangements for offering our professors leave of absence in the sabbatical years, or for a half-year in every four years, and the like; but I have already made too great a demand on your attention. In closing, permit me, however, to make one further suggestion. From my conversations with members of the Corporation I know that many of them earnestly desire to be of greater assistance to the Institute through closer contact with its work. I believe now that a great service might be rendered if special committees were appointed to promote some of the various lines of development to which I have alluded in this report. You have already appointed a Committee on the Site. It might be well to appoint also a Committee for the Promotion of the Welfare of Students, which could deal with the question of student houses, with other plans relating to their social, cultural, and physical life, and with further provision for scholarship aid to alleviate the hardships imposed by our high tuition. Still another Committee might be appointed for the Promotion of the Work of Instruction. This Committee would consider such matters as the extension of the personal conferences between instructors and students, the introduction of required summer work in the undergraduate courses, provision for research work by the junior members of the instructing staff, and enlargement of the scope of instruction in any desirable direction, it being understood that any such plan of educational development shall have first received the endorsement of the Faculty. These committees should, I believe, be in the closest relations with the Executive Committee with reference to all questions involving financial arrangements or radical changes of policy, and with the officers and committees of the Faculty in all matters relating to the

work of instruction or to the interests of students. They should frequently hold joint meetings with the representatives of the Faculty, thereby establishing the closer contact with that body which is so desirable. They should attempt to provide for the realization of such improvements as seem to them advisable and to that end should be given the necessary authority. The development of plans might well receive preliminary consideration in these committees alone, final actions of importance being taken in joint session with the Executive Committee in order to secure the proper correlation between the work of the different representatives of the Corporation.

ARTHUR A. NOYES.

DECEMBER 11, 1907.

Reports of Administrative Officers.

REPORT OF THE SECRETARY OF THE FACULTY.

The Faculty has considered the question of the allotment of time which would be set free by a reduction of the Modern Language requirement in any Course, which was referred to a committee during the previous year, and it has been decided that, of the time which would be released by the removal of one year of Modern Language, sixty hours should be added to the time now allowed for European History and English Literature.

In the Courses in Mechanical Engineering and Naval Architecture the second-year requirement in Modern Language has been discontinued. In the Course in Electrical Engineering it has been diminished by two hundred hours, a requirement of seventy hours remaining in the first term, which is to be devoted to an advanced course in the language taken during the first year.

The Faculty has approved the occasional substitution, in many of the professional Courses, of equivalent work in Spanish or Italian for the requirements in French or German, when adequate reasons are presented.

The special committee on Faculty Organization, appointed to report on a plan presented by the President, for changes in the conduct of Faculty business, has made its report, and the Faculty has adopted the following resolutions as an expression of its opinion on the general principles involved:

(1) That it is advisable that the Faculty *as a whole* continue to deal with questions of educational policy.

(2) That it is advisable that the Faculty through its officers and committees continue to carry on the work of administra-

tion, consultation, and correspondence, so far as these are connected with the studies, the registration, and the records of students.

(3) That it is advisable that the administrative work of the Faculty continue to be carried on by its officers and by its various standing committees rather than by a single administrative board or council chosen by the Faculty.

(4) That it is advisable that the Faculty meetings be relieved from certain business which can advantageously be transacted by committees, and that more definite provision be made for the preparation and presentation to the Faculty itself of matters which should receive its consideration.

(5) That it is advisable that in each term two or more conferences of the instructing staff of the respective departments be held for the discussion of matters of departmental policy and the improvement of methods of instruction, in order that interest and initiative may be developed in the instructing staff as a whole, and that a definite and recognized influence in matters of policy may be more generally exercised.

(6) That the Faculty, in response to the suggestion made by the President, express its appreciation of the desirability of some form of advisory relation between the Corporation and the Faculty, and its readiness to co-operate with the Corporation in the preparation of a plan for establishing such a relation.

Of other recommendations made by this committee, and approved by the Faculty, the following may be mentioned:

That there be a new standing officer of the Faculty known as Chairman.

That there be a new standing committee, known as the Committee on Faculty Business, whose duty it shall be to bring before the Faculty questions of general policy, reports of work at other institutions, and other matters for general discussion.

That there be a new standing committee known as the Committee on Courses of Instruction, to which all proposed changes in undergraduate course schemes shall be referred, before adoption by the Faculty.

Much attention has been given by the Faculty, and by a special committee of the Faculty, to the matter of courses of study for college graduates; and at a recent meeting of the Faculty schedules of elective studies were approved for graduate work in nearly all of the professional departments. Provision is also made whereby a college graduate who has completed essentially all of the work below the fourth year in some one of the professional Courses may arrange a two years' course leading to the degree of Master of Science, without taking the Bachelor's degree.

A special committee has been appointed to consider the question of requiring work during a portion of the summer vacation.

The Faculty has considered and approved the introduction of the general plan of providing, in close correlation with the instruction in first-year Mathematics and English, for regular conferences in which instructors in these two subjects shall meet their students individually or in groups of three or four students.

The Faculty Committee on Entrance Examinations is at present perfecting plans for obtaining more accurate information in regard to the fitness for our work of those who take our entrance examinations, in order that the examination records of *each* applicant may be supplemented by a statement from the school which he last attended.

ALLYNE L. MERRILL,
Secretary of the Faculty.

REPORT OF THE DEAN.

New students met the Committee of Advisers in the General Library on the Monday and Tuesday preceding the opening of the term, and through the co-operation of the undergraduates the work of registration was much facilitated. The student Young Men's Christian Association also assisted in

revising the lodging and boarding house lists, the Secretary of the society making personal investigation of many of the rooms on the city register.

A slight variation in the method of aiding first-year students in their choice of Course was introduced last year. At a general meeting of all first-year students, Professor Tyler outlined the characteristic features of each professional Course at the Institute, and gave sound advice in regard to a deliberate and thoughtful choice of the future line of work. Professor Noyes spoke on the importance of the general and non-professional studies at the Institute. Appointments were then made by the Dean for conferences with the Heads of Departments.

A general comment should be made on the change which has gradually taken place in the amount of initiative taken by the students in matters relating to their social life and outside activities. The very general use of the room known as the "Union" is beginning to show results. The men are much better acquainted with each other, and gatherings in connection with student activities have a larger attendance than formerly. The Institute Committee of the students is becoming a more effective and active body of men. The Walker and Civic Clubs and the different professional societies are doing more effective work in their chosen lines. Clubs based on the section from which the men have come tend to widen the acquaintance of students outside of their class or department, and it is gratifying to note that the students are in the habit of inviting members of the Faculty to unite with them informally at their various gatherings and suppers.

To the end of bringing about a closer personal relation between students and teachers, there has been organized in the Mathematical and the English Departments a series of individual conferences with reference to the instruction given in those departments. This movement is simply an extension and development of methods already employed by these two departments in their first-year instruction; but by the addition of new

instructors it has been possible in the Mathematical Department to have smaller sections, and to secure for every student in the first year time for personal conference with his instructor. This work in the Mathematical and the English Departments is simply an attempt to reinstate the conditions which prevailed at the Institute when the classes were smaller.

STATISTICS OF ILLNESS FOR THE SCHOOL YEAR 1906–07.

Fourth-year Class.

There were three hundred and eleven students, regular and special, in the fourth-year class. Of these twenty-two were reported ill during the school year 1906–07. Classified by diseases, there were the following cases: abscess, 1; boils, 1; broken ankle, 1; grippe, 1; indigestion, 2; operation on foot, 1; sprained ankle, 1; tonsillitis, 1; typhoid fever, 2; not specified, 11.

Third-year Class.

In this class there were three hundred seventy-six students, and of this number thirty-eight were reported ill during the year. The following cases were reported: fever, 2; fistula, 1; grippe, 3; hemorrhoids, 1; injury to hand, 1; measles, 2; nervous exhaustion, 1; neuralgia, 1; pleurisy 1; scarlet fever, 3; scarlatina, 1; tonsillitis, 1; trouble with eyes, 4; unspecified, 16.

Second-year Class.

The regular and special students in this class numbered three hundred thirty-two, of whom nineteen were reported ill during the year. There were the following cases: accident, 1; diphtheria, 1; grippe, 3; injury to hand, 1; laryngitis, 1; measles, 1; sore throat, 1; serious condition of blood, 1; tonsillitis, 3; trouble with eyes, 1; unspecified cases, 5.

First-year Class.

The first-year class numbered three hundred forty-six. Of this number thirty-one were reported ill during the school year. Classified by diseases there were the following cases: appendicitis, 1; blood poisoning, 1; broken arm, 1; cold, 1; dislocated elbow, 1; grippe, 4; inflammation of heel, 1; jaundice, 3; nose-bleed, 1; pleurisy, 1; scarlet fever, 1; sprained elbow, 1; tonsillitis, 1; trouble with eyes, 3; trouble with knee, 1; unspecified cases, 9.

SUMMARY.

	No. in Class.	No. Ill.	No. of Deaths.
Fellows and Graduates	32	0	0
Fourth Year	311	22	0
Third Year	376	38	0
Second Year	332	19	0
First Year	346	31	0
Total	1,397	110	0

ALFRED E. BURTON,
Dean.

REPORT ON THE TECH UNION.

The Tech Union, started some years ago by Dr. Pritchett, with an idea of giving to the students something of social life, which had in the past been so lacking at the Institute, has more than justified all expectations. Previous to the establishment of the Union there were no rooms where students could meet socially, and the class and society dinners held at the hotels were practically the only meetings of a social nature for the students, and this privilege was denied many of the societies because of the expense. An interest in some form of athletics brought men together, but the number was comparatively small. There were, in fact, few of the opportunities offered by other institutions of learning for the men to get together, to know each other, to receive the benefit that comes from association with their fellow-students. The Union has changed all this, and has done more for the students socially, more to create a love of the Institute and a loyalty for it than many of us realize. Poor as the quarters are at the Union, yet, hung with the gifts of various graduating classes, that show a loving loyalty; the Tech Show pictures that remind us of many happy hours; and the trophies of the Athletic Field, reminders of friendly class contests and of joyous victories over other rivals, the Union has come to mean much to our undergraduates. All class dinners are held there, Field day, Show and Tech Fresh-

man dinners; and the Young Men's Christian Association Receptions are now annually given there, while the Instructors Club and many of the Societies hold monthly meetings. For three years most of the Saturday evenings have been given up to a "Kommers" with a twenty-five cent dinner, at which a number of well-known men have talked to the students on various subjects of general interest, and these meetings have been largely attended, 160 to 200 being not unusual. A daily noon lunch is served in the main room, which is well patronized: student waiters are employed, who are thus given a chance to help out their expenses. For several years past on Christmas Eve an entertainment with refreshments and some small gifts has been furnished by friends of the students, at which some hundred and seventy-five students have been present, thus getting some little of the Christmas cheer. During the past year there have been served 23,703 noon lunches, or an average of 140 per day, at an average price to the students of nineteen cents, and seventy-six class and society dinners averaging thirty-nine cents. The Union is also used for all the Tech Show rehearsals, for business meetings of clubs and societies. There are, in fact, few afternoons and evenings when some use is not made of the rooms by students. This work of the Union has been most pleasant to those having it in charge, and we cannot but believe that all at the Institute are beginning to feel that it is accomplishing much good. I believe it has become of sufficient importance, and has achieved enough success to justify the authorities of the Institute in taking charge of the work officially, and in making some definite provision for its continuance and oversight in the future.

FRANK H. RAND.

REPORT OF THE INSTRUCTOR IN PHYSICAL TRAINING.

During the past year there have been no important changes in this department. The work has been carried on along the same general lines as before.

At the beginning of the year a physical examination was given to all students who desired it, and about eighty men presented themselves. These men were given anthropometric charts, showing their physical development and condition in comparison with the tabulated reports of hundreds of other students of similar ages.

Regular gymnasium work began November 12th. There were two classes a day, on Mondays, Wednesdays, and Fridays from 4.10 until 5.00, and from 5.10 until 6.00 P.M. The classes were fairly well attended, and much interest was taken in the work throughout the year. The regular gymnasium work closed April 13th, and the annual gymnastic exhibition was very successfully given.

A second physical examination was given to about fifty men so that their exact improvement might be noted.

The Cabot medals for improvement in Physical Training were awarded to the following men: Everett E. Turkington, '07; John F. Johnston, '07; George Schobinger, '08; Eleazar Myers, '08; and Frederick M. Heidelberg, '09.

WINFIELD C. TOWNE,
Instructor in Gymnastics.

REPORT OF THE MEDICAL ADVISER.

There have been no important changes in the medical work at the Institute in the last year. Consultation hours have been held on two afternoons a week throughout the year; and, as usual, the students have fully occupied this time, and the time of consultation had frequently to be extended

to accommodate all those who came for advice. The average extra time needed was forty-five minutes more than the appointed hour. For a small part of the year no extra time was required, but on several occasions one and a half to one and three-quarters extra hours were needed. 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:—

	1905.	1906.	1907.
Total number of office visits made	406	345	409
Total number of different students seen	191	195	196
Greatest number of students seen per day			11
Least number of students seen per day			2
Average number of students seen per day			7
Number of students making more than one visit			48

The amount of the medical work remains very constant from year to year, and under the present arrangement does not seem likely to increase in the future. The great majority of the men made only a single visit, usually for the treatment of some acute and promptly curable condition. The men who came more than a few times were usually patients who required repeated dressings of some surgical injury.

A classified list of the diseases treated and the number of each will be found at the end of the report. A great variety of illnesses was treated, the most numerous being diseases of the digestive apparatus, of the nose and throat, and surgical cases. About a dozen men suffered from severe illness, such as appendicitis, scarlet fever, malaria, jaundice, pleurisy, Bright's disease; two men had to leave the Institute on account of pulmonary tuberculosis; a small number of students were referred to specialists for the treatment of the eye, ear, and skin. A small number of students were referred to the Institute free beds at the Massachusetts General Hospital for the treatment of severe acute illness.

In addition to the work at the Institute office, I have seen about sixty men at my private office and a much smaller number

at their homes. In addition to sick students, ten healthy men were examined for the United States Civil Service or for athletic teams.

The Medical Adviser wishes to call attention once more to the fact that there are a certain number of men each year who get tired and whose work suffers early in the fall term, either because they have had little or no vacation in the summer or because they have begun their work with too great enthusiasm and too little regard to their health. It seems very desirable that the officers of instruction who have a chance to advise the students about their work should tell them that some rest in the summer is necessary after an active year's work, and also point out that the year's work is really a long distance run, not a sprint race, and that they must not use up too much energy at the start.

The number of contagious diseases at the Institute this year is, as usual, very small. The Medical Adviser is supposed to see and approve of the return of every man who has been out with a contagious disease, to prevent these men from cutting short the necessary period of quarantine. The men often do not report to the Medical Adviser on their return, and the good results in spite of the negligence must be due to the care of their home physicians in advising their return.

This year for the first time each man who asked to be excused from Military Drill on account of illness or disability was required to report promptly to the Medical Adviser for his opinion in the matter. This has increased the work of the medical office but little, and has proved useful in several ways, by bringing some men to me who really needed advice about their health, and by preventing the absence of others from drill without a good excuse.

Three talks on personal hygiene were given by the Medical Adviser to the whole Freshman class. With increased experience it has been possible to adapt these talks more and more each year to the definite needs of the student body. The following subjects have been taken up: bathing, exercise, food, sleep,

care of the eyes, the use of tobacco and alcohol, minor ailments, and the prevalence and dangers of venereal disease.

This last year I have included a talk upon the emergency treatment of injuries to which some of the students are especially exposed while they are at the Institute and afterwards, in the mine, the chemical laboratory, the machine shop, or the field. The subjects taken up included suffocation or poisoning by gases and the emergency treatment of burns, cuts, bruises, and hemorrhage; the method of carrying on artificial respiration was demonstrated.

This year for the first time there were made up under my direction for use in the mechanical and other laboratories several boxes containing gauze, absorbent cotton, bandages, and simple antiseptics to be ready for the emergency treatment of slight accidents such as cuts, bruises, burns, etc.

DISEASES TREATED BY THE MEDICAL ADVISER.

Stomach and Bowels	32	Genito-urinary Cases	17
Nose and Throat Cases	36	Lungs	14
Skin	17	Heart	11
Eye	18	Ear	5
Surgical Cases	56	Miscellaneous	38
Specific Infectious Diseases	15		

FRANKLIN W. WHITE,
Medical Adviser.

REPORT OF THE LIBRARIAN.

During the year ending September 30, 1907, the total number of items added to the record of accessions in the Libraries of the Institute amounts to 4,890, an increase of 899 over last year. The following table shows what proportion of these accessions were obtained by purchase, by binding, and by gifts:—

TOTAL ACCESSIONS, 1906–1907.

By Purchase	1,353
By Binding	1,407
By Gift, Volumes	1,028
By Gift, Pamphlets	1,102
Total	4,890

The cost of the purchase of books and the administration of the Libraries, exclusive of salaries, as shown by bills approved in this office, amounts to $6,059.94, this sum being composed of the following items:—

BILLS APPROVED 1906-07.

Books and Binding	$4,907.20
Periodicals	1,849.27
Supplies	303.47
Total	$6,059.94

The net accessions to the Library, calculated by deducting from the gross accessions the number of books lost or destroyed, and of books or pamphlets counted twice, amount to 3,466 volumes, 684 pamphlets, and 148 maps, an increase of 75 volumes, 260 pamphlets, and 12 maps over last year.

The apparent large discrepancy between the gross accessions and the net accessions is due to the binding of a large number of pamphlets for the Geological Library, so that in that Library there appears to be a net decrease of 162 pamphlets. When a pamphlet is bound, it becomes, technically speaking, a volume, and these pamphlets, after being bound and being counted as volumes, are deducted from the total accessions, as they had been previously recorded in the list of pamphlets.

The particulars of the growth of the several Libraries of the Institute in numbers of volumes, pamphlets, and maps, with the amount expended for each Library, and the present total contents, is shown in the following tables:—

TABLE OF THE NET INCREASE WITH THE COST OF THE SAME DURING THE YEAR 1906–07, AND THE TOTAL CONTENTS OF THE LIBRARIES OF THE INSTITUTE, SEPTEMBER 30, 1907.

LIBRARIES.	Net Increase.				Total Contents.	
	Volumes.	Pamphlets.	Maps.	Cost.	Volumes.	Pamphlets and Maps.
General Library:						
General	155	31	—	$107.86	7,239	5,069
English	104	—	—	136.15	3,476	44
Military Science	27	—	—	2.00	367	9
Walker Memorial	—	—	—	—	485	—
Other Departments	8	—	—	43.20	47	1
Totals General Library	294	31	—	$289.21	11,614	5,123
Architecture	105	10	—	282.17	4,040	251
Biology	133	86	—	261.84	3,403	720
Chemistry	391	171	—	823.65	10,686	2,035
Electrical Engineering	92	16	—	192.62	1,317	72
Engineering	873	303	—	1,253.45	13,610	4,876
Geology	458	—162*	147	130.82	3,220	2,811
History and Economics	396	23	—	377.48	12,291	3,588
Margaret Cheney Room	7	—	—	17.55	676	13
Mathematics	99	45	—	179.11	1,743	262
Mining	310	54	1	511.33	4,500	723
Modern Languages	48	6	—	30.96	1,719	56
Naval Architecture	43	13	—	125.82	1,238	119
Physics	217	88	—	431.19	8,104	1,165
Totals	3,466	684	148	$4,907.20	78,161	21,814

The total number of cards now in the General Catalogue is 86,269, there having been added during the year 5,469 cards. There were 1,268 orders issued for the purchase of books and periodicals, and 2,124 orders were sent to the binders. The following table will show the circulation of books outside the Library, so far as a record has been kept:—

*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.

CIRCULATION.

General Library	890 volumes.
Architectural Library	1,806 "
Biological Library	211 "
Chemical Library	796 "
Engineering Library	790 "
Mining Library	464 "
Physics Library	1,569 "

The number of serial publications received during the year has increased from 1,042 to 1,079, and the estimated cost from $2,690.87 to $2,814.37, of which $1,966.24 is chargeable to the appropriation for periodicals.

The number of periodicals and other serials sent to each department and the amounts chargeable to the several accounts are indicated on the following table. The costs are estimated from bills approved during the year.

TABLE OF PERIODICALS AND OTHER SERIAL PUBLICATIONS RECEIVED DURING THE YEAR 1906–07, CLASSIFIED BY DEPARTMENTS AND METHOD OF PAYMENT.

LIBRARIES.	Number Received.					Estimated Cost.			
	Gifts.	Charged to Department.	Periodical Account.		Totals.	Dept. Account.	Periodical Account.		Totals.
			Subs.	Exch.			Subs.	Exch.	
General	42	18	29	31	120	$51.92	$101.26	$52.00	$205.18
Architecture	9	6	32	2	49	25.71	148.00	2.00	175.71
Biology	33	21	33	9	96	90.14	256.75	8.00	354.89
Chemistry	12	47	31	15	105	170.22	204.36	27.00	401.58
Electrical Engineering	7	7	14	5	33	10.85	72.69	10.00	93.54
Engineering	46	72	54	66	238	178.92	220.51	121.00	520.43
Geology	14	8	11	12	45	28.28	91.04	18.00	137.32
History and Economics,	62	47	41	5	155	101.88	141.18	8.00	251.06
Margaret Cheney Room,	—	6	—	—	6	17.20	—	—	17.20
Mathematics	2	4	16	2	24	9.97	73.28	3.00	86.25
Mining	11	10	25	31	77	29.49	105.56	67.00	202.05
Modern Languages	3	1	18	1	23*	2.16	79.62	2.00	83.78
Naval Architecture	5	11	6	4	26	45.92	20.23	8.00	74.15
Physics	17	17	23	25	82	78.47	104.76	28.00	211.23
Totals	263	275	333	208	1,079	$841.13	$1,619.24	$354.00	$2,814.37

*10 kept in the General Library.

In the Institute of Technology the division of the Libraries into Departmental Libraries is carried out to its fullest extent, and it is often asked how much duplication this involves. It is difficult to record this for the books purchased, but the record of the daily receipt of periodicals furnishes an easy means of determining the amount of the duplication of that class of publications. During the past year two or more copies have been received of thirty-five periodicals, the additional copies costing $136.46.

The General Library has been open for readers during term time until 10 o'clock in the evening. The average attendance for 112 days from 5 to 7 P.M. was 10.2 per day, and 5.3 per day from 7 to 10 P.M., the total attendance for these periods being 1,142 and 599, respectively. The total number of days that the Library was open in the evening was greater than this, but the record of attendance prior to December 1 is unavailable.

Gifts of books are frequently received by libraries, but it is rare for any one to remember that the cost of placing a book on the shelf equals, on the average, the cost of purchasing; and for that reason, probably, gifts towards the maintenance of a library are seldom received. It is, therefore, a special pleasure to record two such gifts from our constant benefactor, Mrs. William Barton Rogers. During the spring she gave us $500 for the binding of books and pamphlets in the Geological Library, where a large number of unbound books had acccumulated. And at the close of the year covered by this report she presented for use in the Librarian's office a Hammond typewriter of the latest and most approved pattern, which was an especially welcome addition to the equipment at that particular time.

Gifts of books to the Library are always welcome, and among the many valuable ones that have been received during the year the following should be especially noted. From Dr. Charles G. Weld we have received 12 volumes on Naval Architecture; from General H. L. Abbot, the valuable "Report of the Board of Consulting Engineers for the Panama Canal," with text and maps; from the Council of the Royal Society, London, 6 vol-

umes of their "Proceedings," including 5 of the earliest ones; from Messrs. William Denny & Brothers, Dumbarton, Scotland, a volume on "Turbine Steamers"; from Francis H. Appleton, Esq., of Salem, "Ship Registers of Salem and Beverly, 1789–1900"; from the Hon. John A. Sullivan, M.C., Moore's Digest of International Law, 8 volumes; from the Trustees and Family of the late Dr. James Young, of Kelly, Glasgow, Scotland, "Bibliotheca Chemica," 2 volumes; from Henry M. Whitney, Esq., 14 volumes of mining journals; from Mrs. Rogers, 8 volumes on various subjects; from Mr. Louis Weissbein, of Boston, 3 volumes on Art and Architecture; from M. J. Sturn, Esq., of Chicago, one volume on the Organization, Construction and Management of Hospitals.

Professors Breed, Hosmer, Gill, and Derr, and Messrs. J. R. Freeman, W. T. Hall, and G. W. Rolfe have contributed bound volumes of their writings; and Messrs. D. C. Heath & Co. and G. P. Putnam & Sons have contributed various text-books in the modern languages.

It is the constant endeavor of the Librarian to improve the administration and equipment of the Libraries so far as funds and opportunity will permit. An important step in this direction was completed during the year 1906–07. This was the copying of the cards in the old catalogue for the Chemical Department and the completion of the subject catalogue of the Chemical Library. This was accomplished largely through the skill and industry of the Assistant-in-Charge, Miss Harriet J. Buck. Unfortunately, ill-health has prevented Miss Buck's return to the Institute this year, but we are fortunate in having Miss Florence G. Finley, S.B. (Simmons), to take her place. Three of the Libraries of the Institute now have complete subject catalogues. To complete the subject catalogue for all the Libraries of the Institute will require a number of years, but progress is being made in that direction as rapidly as circumstances will permit.

ROBERT P. BIGELOW,
Librarian.

REPORT OF THE REGISTRAR.

The total number of members of the Instructing Staff as shown by the Annual Catalogue this year, including those at the Mechanical Laboratories, but excluding the Research Associates and Assistants, and those who are announced annually as lecturers only, is 210. Counting all, there are 253. Not taking into account the Research Associates and Assistants and Lecturers, the number of members of the Instructing Staff to that of students in regular attendance bears the proportion of 1 to 6.7. Last year it was 1 to 6.9.

The number of students has risen, this year, from 1,397 to 1,410. The gain is in the fourth-year and second-year classes. In the third-year and first-year there is a loss in the number of students. The number of regular students is larger than that of last year, and the ratio of regular students to specials is likewise larger.

The number of new students is 527, as compared with 535 last year. The percentages of new students, for these two years, are 37 and 39, respectively.

The number of college graduates enrolled is 182, which includes twenty candidates for advanced degrees. The number last year was 200. The numbers of colleges and universities represented by students this and last year, including both graduates and non-graduates, are 85 and 88, respectively. The number of new students from other colleges this year is 155, as compared with 154 last year.

Instead of the slight drop on the professional Courses which was noted last year, there has been a gain in each one of the courses, except Civil Engineering, where the number is the same as last year, and Naval Architecture. There has been a slight loss in the number who are enrolled in the Department of Naval Architecture. For the first time, regular students are registered in the Course of General Science.

Forty-three states of the Union and one territory besides

the District of Columbia, Hawaii, Porto Rico, and the Philippines, are represented on the list of students. While North Carolina, Idaho, and Louisiana are not represented at the Institute by students this year, Arkansas, New Mexico, and Oklahoma, each of which had no representative last year, are now represented. The number of foreign students at the Institute (80) has again risen, and in place of the 29 foreign countries represented last year at the Institute there are now 31.

Of the total number of 1,410 resident students, 781 are from Massachusetts, or 55.5 per cent. of the whole, or 0.5 per cent. more than last year or the year before. All the counties of the state send students to the Institute.

Of the cities and towns of the state, 128 are on the list. A table shows the number of cities and towns of each county sending five or more students, and also gives the aggregate number from each county. Middlesex County sends 238; Suffolk, 218; Essex comes third with 105; Norfolk, fourth with 95.

The registration in the Summer School (283) was greater than last year by 54: the number of students (58) from other colleges or schools was larger by 19 than last year. There was a marked increase in the number of registrations for the purpose of making up failures or deficiencies, while there was a decrease in those to anticipate work. Courses were anticipated principally in Mechanic Arts, Descriptive Geometry, Architectural Design, Languages, Mechanical Drawing, and Surveying.

The total number of students assisted from Institute funds during the past year was 158, and the amount awarded was $18,500. In addition to this, 65 students were aided by the state, of whom 45 were not aided by the Institute; therefore, 203 students received scholarship assistance.

The number in the graduating class of last June was 208. Of these, 127 received the degree after attending the Institute four years. Of the 81 who received the degree in other than four years, 52 were students from other colleges who attended the Institute from one to three years. Again it is noticeable,

as it was last year, that somewhat more than one-half of the college graduates spent two years in completing their courses, and more than one-quarter spent three years. Only two received the degree in less than two years.

This year a study has been made of the distribution among the four classes, of the students who have entered the Institute from other colleges. Of these 155, twenty-one per cent. spent one year at college; nineteen per cent. spent two years; fourteen per cent. three years; and thirty-nine per cent. four years. Of the 33 who spent one year at college, 22 entered the second year, and 11 the first year. Of the 30 who spent two years at college, 9 entered the third year, 19 the second year, and 2 the first year. Of the 21 who spent three years at college, 16 entered the third year, and 5 the second year. Of the 61 who spent four years at another college, 3 entered the fourth year, 44 the third year, 13 the second year, and 1 the first year. Irrespective of the years spent at college, of the 155 who entered, 4 entered the fourth year, 73 the third year, 62 the second year, and 15 the first year.

As the work of the clerical force organized by the Income Fund Committee was completed, except for the collection of subscriptions, this office was transferred to the Alumni Association to form the office of this society. The Institute has assigned the use of one of the rooms in the Rogers Building to this office, and regular work has been carried on during the past year. This office has co-operated with the Registrar's Office in maintaining catalogues of the graduates and former students of the Institute. Three catalogues are maintained, arranged alphabetically, by classes, and geographically.

A mailing system has been developed, which is of value both to the Institute and to the Alumni Association, and has been used by various class associations. This office has also assisted the Registrar's Office at the opening of the terms and during the examination periods, when the pressure of work is considerably greater than during the rest of the year.

THE CORPS OF INSTRUCTORS.

The following table shows the distribution among the several classes of instructors, in comparison with last year:—

	1906-07.	1907-08.
Professors	39	43
Associate Professors	18	18
Assistant Professors	21	25
	78	86
Instructors	69	72
Assistants	52	52
	121	124
Research Associates	8	8
Research Assistants	3	3
	11	11
Lecturers	31	32
Total	241	253

STUDENTS BY CLASSES.

The aggregate number of students for 1907–08 is divided among the several classes, as follows:—

Resident Fellows	3
Candidates for advanced degrees	17
Regular students, Fourth Year	208
" " Third "	187
" " Second "	211
" " First "	276
Special students	508
Total	1,410
Non-resident Fellows	5

The following table shows the division of the whole body of students among the several years:—

Class.	Regular.	Special.	Total.
Resident Fellows and Advanced Students	20	—	20
Fourth Year	208	118	326
Third Year	187	179	366
Second Year	211	160	371
First Year	276	51	327
Total	902	508	1,410

THE COURSES OF INSTRUCTION.

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

Year.		Civil Engineering.	Mechanical Engineering.	Mining Engineering and Metallurgy.	Architecture.	Chemistry.	Electrical Engineering.	Biology.	Physics.	General Science.	Chemical Engineering	Sanitary Engineering	Geology.	Naval Architecture	Total.
4th Year Class	Reg.	48	57	15	14	12	31	4	3	—	13	3	—	8	208
	Sp.	22	13	16	19	19	25	1	3	—	5	5	—	—	118
3d Year Class	Reg.	35	43	11	12	5	44	4	3	1	11	9	—	9	187
	Sp.	39	30	25	12	13	31	5	5	1	9	3	—	6	179
2d Year Class	Reg.	38	49	27	5	5	48	2	6	—	14	11	—	6	211
	Sp.	28	34	24	20	9	21	1	—	—	7	8	—	8	160
Total . . .	Reg.	121	149	53	31	22	123	10	12	1	38	23	—	23	606
	Sp.	89	77	65	51	31	77	7	8	1	21	16	—	14	457
		210	226	118	82	53	200	17	20	2	59	39	—	37	1,063

The following table shows the number of regular students in the foregoing table, in comparison with the corresponding figures for the next ten preceding years:—

Year.	Civil Engineering.	Mechanical Engineering.	Mining Engineering and Metallurgy.	Architecture.	Chemistry.	Electrical Engineering.	Biology.	Physics.	General Course.	Chemical Engineering.	Sanitary Engineering.	Geology.	Naval Architecture.	Total.
1897	109	119	38	71	60	90	8	9	10	36	7	1	26	578
1898	93	108	52	64	64	94	6	8	12	38	7	1	33	574
1899	99	113	60	53	58	84	8	7	11	30	14	1	38	575
1900	89	127	69	53	50	87	6	4	8	34	17	1	38	582
1901	102	129	76	40	35	96	6	13	9	30	14	1	39	590
1902	129	133	83	43	58	118	2	20	9	30	12	1	65	703
1903	132	161	91	53	55	126	4	23	6	27	14	1	72	765
1904	140	158	77	41	46	98	4	13	—	32	22	1	49	681
1905	134	149	54	44	36	100	1	13	—	29	13	—	38	611
1906	119	131	39	39	24	101	4	11	—	30	18	—	25	541
1907	121	149	53	31	22	123	10	12	1	38	23	—	23	606

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	36	52	22	21	10	—	32	—	5	—	14	3	2	10	207
Totals	688	863	366	330	376	1	640	54	71	96*	168	60	14	155	3,877*
Names counted twice, students graduating in two different years . . .															17
Bachelors of Science															3,860*
Masters of Science, not included in the above															26
Doctors of Philosophy, not included in the above															1
Total . . .															3,887*

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

YEARLY REGISTRATION.

The following table shows the registration of successive years from the foundation of the Institute:—

Year.	No. of Students.	Year.	No. of Students.
1865–66	72	1887–88	720
1866–67	137	1888–89	827
1867–68	167	1889–90	909
1868–69	172	1890–91	937
1869–70	206	1891–92	1,011
1870–71	224	1892–93	1,060
1871–72	261	1893–94	1,157
1872–73	348	1894–95	1,183
1873–74	276	1895–96	1,187
1874–75	248	1896–97	1,198
1875–76	255	1897–98	1,198
1876–77	215	1898–99	1,171
1877–78	194	1899–1900	1,178
1878–79	188	1900–1901	1,277
1879–80	203	1901–1902	1,415
1880–81	253	1902–1903	1,608
1881–82	302	1903–1904	1,528
1882–83	368	1904–1905	1,561
1883–84	443	1905–1906	1,466
1884–85	579	1906–1907	1,397
1885–86	609	1907–1908	1,415
1886–87	637		

The special students this year constitute thirty-six per cent. of the whole body, as against forty-one per cent. last year and forty-two per cent. the year before.

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

Year.	Total.	Course.												
		I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.	X.	XI.	XII.	XIII.
1st	2	–	–	–	–	–	–	–	–	–	–	–	–	–
2d	4	–	3	–	–	–	1	–	–	–	–	–	–	–
3d	6	–	2	1	–	–	2	–	–	–	–	–	–	1
4th	10	3	2	1	1	1	1	–	1	–	–	–	–	–
5th	2	1	–	–	–	–	–	1	–	–	–	–	–	–
	24	4	7	2	1	1	4	1	1	–	–	–	–	1

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

	First Year.	Second Year.	Third Year.	Fourth Year.	Total.
Mathematics	363	383	150	3	899
Chemistry	344	112	96	78	630
English	328	292	43	–	663
French	211	–	26	–	237
Physics	–	366	327	54	747
German	94	57	56	–	207
Mechanic Arts . . .	–	146	54	84	284

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

Year.	(1) Total No. of Students.	(2) No. of Students in the catalogue of the previous year who remain in the Institute.	(3) No. of New Students entering before issue of catalogue.	(4) Of those in column (3) the following number are regular First-year Students.	(5) No. of New Students not of the regular First - year Class.
1898–99	1,171	769	402	278	124
1899–1900	1,178	764	414	275	139
1900–1901	1,277	789	488	312	176
1901–1902	1,415	844	571	396	175
1902–1903	1,608	949	659	432	226
1903–1904	1,528	1,042	486	249	237
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

GRADUATE STUDENTS.

Twenty graduates of colleges or universities are, this year, candidates for advanced degrees. One hundred sixty-six are pursuing undergraduate courses. The colleges and universities represented by the one hundred eighty-six graduates are shown in the following table:—

Colleges and Universities.

Acadia	1
Adelbert	1
Adrian	1
Albright	1
Allegheny	1
Amherst	4
Anatolian	2
Arkansas	1
Armour Institute of Technology	2
Beloit	1
Bethany	1
Boston College	1
Bowdoin	4
Brown	5
Bucknell	1
Canisius	1
Central Technical, London University	1
Central	1
Charleston	1
Chicago	4
Colby	2
Colorado	2
Cooper Union	1
Cornell	1
Dakota Wesleyan	1
Dalhousie	2
Denison	1
De Pauw	2
Fairmount	1
Franklin and Marshall	1
Georgetown University	1
Hamline	1
Hampden-Sidney	1
Harvard	16
Havana (Cuba)	1
Haverford	1
Illinois	1
Indiana	2
Iowa	3
Iowa State	1
Johns Hopkins	6
Kansas	1
Lehigh	1
Leland Stanford Junior	1
Louisiana	1
Marietta	1
Marquette	1
Maryland Agricultural	1
Massachusetts College of Pharmacy	1
Massachusetts Institute of Technology	10
Missouri	1
National (Buenos Ayres)	1
Nebraska	1
Northwestern	1
Ohio Wesleyan	1
Oklahoma	1
Oregon	1
Pennsylvania	2
Princeton	11
Purdue	1
Randolph-Macon	1
Richmond	1
Rochester	2
Rose Polytechnic	1
Sacred Heart	1
Saint Johns	1
Saint Louis	3
Saint Marys	1
South Carolina	1
South Dakota	1
Southwestern Presbyterian	1
Spanish	1
Texas	6
Throop Polytechnic	1
Trinity, Cambridge University	1
United States Naval Academy	16
Virginia	2
Virginia Polytechnic	1
Washington and Jefferson	4
Wesleyan	2
West Virginia	1
Whitman	2
Williams	4
Wisconsin	1
Yale	6
	187
Counted twice	1
Total	186

NEW STUDENTS FROM OTHER COLLEGES.

This table shows the distribution of new students from other colleges among the classes of the Institute and the number of years previously spent at college:—

Class, by Year, Joined at Institute.	One year at Coll.	Two years at Coll.	Three years at Coll.	Four years at Coll.	Five years at Coll.	Six years at Coll.	Total.
First	11	2	—	1	—	1	15
Second	22	19	5	13	3	—	62
Third	—	9	16	44	4	—	73
Fourth	—	—	—	3	—	1	4
Graduate	—	—	—	—	1	—	1
Total	33	30	21	61	8	2	155

WOMEN STUDENTS.

The number of women pursuing courses with us is thirteen. Of these one is a college graduate. Of the total number three are regular students of the third year, and one of the second year. Nine are special students. Of the four regular students of the upper classes three take Course IV., Architecture; and one, Course V., Chemistry. Of the special students, seven devote themselves to Architecture and one to Chemistry, while one is a first-year student.

AGES OF STUDENTS.

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

Period of Life.	1906–1907.		1907–1908.	
	Half-year Groups.	Yearly Groups.	Half-year Groups.	Yearly Groups.
16 to 16½ years	—	—	1	—
16½ to 17 "	5	5	4	5
17 to 17½ "	14	—	14	—
17½ to 18 "	29	43	34	48
18 to 18½ "	51	—	45	—
18½ to 19 "	49	100	54	99
19 to 19½ "	51	—	41	—
19½ to 20 "	33	84	30	71
20 to 20½ "	12	—	14	—
20½ to 21 "	11	23	9	23
21 to 22 "	8	8	16	16
	263	263	262	262

The results appear in the table above in comparison with the corresponding results of 1906–07.

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

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

Under 20½	3
Between 20½ and 21	7
" 21 " 21½	14
" 21½ " 22	26
" 22 " 23	63
" 23 " 24	51
" 24 " 25	21
" 25 " 26	7
26 and over	16
Total	208*

The average age was 23 years.

STATISTICS OF GRADUATION.

Table to show the number of years spent at the Institute by students graduated with the class of 1907.

Total number of degrees of Bachelor of Science awarded June, 1907, 208.

Number receiving degree at end of one year	2
" " " " " two years	31
" " " " " three "	19
" " " " " four "	127
" " " " " five "	26
" " " " " six "	3
	208*
Number entering from other colleges	60

Of the college men 40 were graduates and 20 non-graduates.

STUDENTS FROM OTHER COLLEGES.

Yrs. at the Inst.	*Graduate.*	*Non-graduate.*	*Total.*
1	2	0	2
2	25	6	31
3	11	8	19
4	2	5	7
5	0	1	1
	40	20	60

RESIDENCE OF STUDENTS.

The following tables show in detail and for the school as a whole the residence of students for the current year and for the last six years.

* Including one as of the Class of 1906.

A TABLE TO SHOW THE NUMBER OF STUDENTS IN EACH YEAR, FROM 1901, COMING FROM EACH STATE OR TERRITORY.

STATES AND TERRITORIES.	1901.	1902.	1903.	1904.	1905.	1906.	1907.
North Atlantic.							
Connecticut	42	43	44	48	50	36	29
Maine	30	35	34	26	22	18	23
Massachusetts	837	935	869	889	807	764	781
New Hampshire	31	34	23	36	32	26	27
New Jersey	6	8	13	16	11	15	17
New York	79	96	104	94	71	84	82
Pennsylvania	36	44	52	56	58	55	57
Rhode Island	38	40	28	19	24	23	28
Vermont	15	12	11	5	5	4	5
Total	1,114	1,247	1,178	1,189	1,080	1,025	1,049
South Atlantic.							
Delaware	3	4	3	2	1	2	1
Dist. of Columbia	14	17	15	17	13	12	10
Florida	1	2	2	4	3	3	3
Georgia	4	6	4	6	8	4	2
Maryland	16	27	25	18	19	17	18
North Carolina	6	6	7	1	–	1	–
South Carolina	2	4	–	–	1	3	2
Virginia	5	7	7	4	7	8	9
West Virginia	1	–	–	–	1	2	3
Total	52	73	63	52	53	52	48
South Central.							
Alabama	2	1	1	1	1	2	4
Arkansas	1	1	1	–	1	–	2
Kentucky	9	11	9	8	5	5	5
Louisiana	1	2	2	5	1	2	–
Mississippi	–	–	4	4	4	5	3
Tennessee	4	3	5	2	2	3	6
Texas	7	9	11	13	16	15	16
Total	24	27	33	33	30	32	36
North Central.							
Illinois	44	49	44	43	42	37	31
Indiana	11	14	6	10	10	15	12
Iowa	8	8	6	9	13	14	16
Kansas	1	1	1	4	7	6	5
Michigan	12	10	9	9	10	7	8
Minnesota	10	10	9	11	13	14	8
Missouri	19	20	22	25	29	17	14
Nebraska	3	5	4	5	4	2	3
North Dakota	–	1	1	1	–	3	4
Ohio	27	43	37	35	34	30	26
South Dakota	2	1	3	2	–	1	3
Wisconsin	11	11	13	14	12	7	12
Total	148	173	155	168	174	153	142
Western.							
California	9	15	19	18	23	21	14
Colorado	6	10	11	16	17	12	10
Idaho	1	–	–	–	–	–	–
Montana	4	3	2	5	3	3	3
Nevada	–	–	–	–	1	1	1
New Mexico	–	1	1	2	–	–	1
Oklahoma	–	–	–	–	–	–	1
Oregon	2	4	7	8	5	2	3
Utah	7	2	3	3	2	3	3
Washington	4	3	3	2	2	5	12
Wyoming	–	1	–	–	2	5	1
Total	33	39	46	54	55	52	49

States and Territories.	1901.	1902.	1903.	1904.	1905.	1906.	1907.
Hawaii	–	–	1	1	1	2	2
Philippine Islands	–	–	–	4	2	3	1
Porto Rico	1	2	2	4	5	2	3
Total	1	2	3	9	8	7	6
Total for the United States	1,372	1,561	1,478	1,505	1,400	1,321	1,330

A Table to show the Number of Students in Each Year, from 1901, coming from Each Foreign Country.

Foreign Countries.	1901.	1902.	1903.	1904.	1905.	1906.	1907.
Argentine Republic	–	–	–	–	–	1	2
Armenia	–	–	1	1	3	2	2
Australia	–	2	3	1	3	3	3
Austria	1	–	–	–	–	–	–
Belgium	–	–	–	–	–	1	1
Bermuda	2	1	1	–	1	1	–
Brazil	4	5	3	3	1	–	2
British Columbia	–	–	–	–	–	1	–
Cape Colony	–	–	–	–	–	1	1
Central America	–	–	–	1	–	–	–
Chile	1	1	1	1	2	1	1
China	1	1	2	8	8	7	9
Costa Rica	–	–	–	–	–	–	2
Cuba	1	2	3	4	4	4	4
Denmark	1	1	1	1	1	1	1
Ecuador	–	–	–	1	–	2	2
Egypt	–	–	–	–	1	2	2
England	3	3	4	4	5	6	4
France	1	–	–	1	1	–	–
Germany	3	1	2	–	–	–	–
Honduras	–	–	–	–	–	1	–
India	–	–	1	1	2	1	1
Ireland	–	1	1	–	2	2	3
Italy	–	–	–	–	2	–	2
Jamaica	1	–	–	1	–	1	–
Japan	2	1	2	1	3	5	3
Korea	–	–	–	2	–	–	–
Malta, Island of	–	–	1	1	–	–	–
Manitoba	–	1	1	–	–	–	–
Mexico	7	10	8	4	7	12	12
New Brunswick	2	2	1	2	4	3	2
Nova Scotia	6	8	9	4	1	4	3
Ontario	3	2	2	5	6	6	4
Panama	–	–	–	–	–	–	1
Paraguay	–	–	–	–	–	–	1
Peru	–	–	–	–	1	1	2
Poland	–	–	–	–	–	–	1
Quebec	2	–	1	2	1	1	–
Russia	1	–	–	–	–	–	2
Scotland	–	1	1	2	1	1	1
Sweden	–	–	–	1	–	–	–
Syria	–	–	1	1	–	–	–
Transvaal	–	–	–	1	3	3	3
Turkey	1	4	–	2	1	1	2
Uruguay	–	–	–	–	2	1	1
Total	43	47	50	56	66	76	80
Total in school	1,415	1,608	1,528	1,561	1,466	1,397	1,410

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	3	4
Arkansas	–	–	1	–	–	1	1	2
California	–	1	–	2	2	6	8	14
Colorado	–	1	3	2	–	6	4	10
Connecticut	–	7	–	3	6	24	5	29
Delaware	–	–	–	–	1	1	–	1
Dist. of Columbia,	1	1	–	2	5	9	1	10
Florida	–	–	1	–	–	1	2	3
Georgia	–	–	1	–	–	1	1	2
Hawaii	–	–	–	–	–	–	2	2
Illinois	1	4	4	5	4	18	13	31
Indiana	3	3	2	–	1	9	3	12
Iowa	–	3	6	2	–	11	5	16
Kansas	–	2	–	–	–	2	3	5
Kentucky	–	1	1	–	2	4	1	5
Maine	–	3	3	3	6	15	8	23
Maryland	–	2	5	2	2	11	7	18
Massachusetts	7	116	98	141	191	553	228	781
Michigan	1	2	–	2	1	6	2	8
Minnesota	1	–	–	–	–	1	7	8
Mississippi	–	–	1	1	–	2	1	3
Missouri	–	4	2	–	1	7	7	14
Montana	–	1	–	–	–	1	2	3
Nebraska	–	1	–	–	–	1	2	3
Nevada	–	–	–	–	–	–	1	1
New Hampshire	–	1	3	4	3	16	11	27
New Jersey	–	4	3	1	2	10	7	17
New Mexico	–	–	–	–	–	–	1	1
New York	–	8	13	13	15	49	33	82
North Dakota	–	–	–	1	1	2	2	4
Ohio	2	4	3	4	3	16	10	26
Oklahoma	–	–	1	–	–	1	–	1
Oregon	–	–	–	–	1	1	2	3
Pennsylvania	1	11	9	8	1	30	27	57
Philippine Islands,	–	1	–	–	–	1	–	1
Porto Rico	–	–	–	–	–	–	3	3
Rhode Island	–	3	7	2	7	19	9	28
South Carolina	–	–	–	–	–	–	2	2
South Dakota	–	1	–	–	–	1	2	3
Tennessee	–	–	1	–	1	2	4	6
Texas	–	4	3	2	1	10	6	16
Utah	–	–	–	–	1	1	2	3
Vermont	–	–	–	–	–	–	2	2
Virginia	–	–	2	2	1	6	3	9
Washington	–	–	–	–	2	4	8	12
West Virginia	–	1	1	–	1	3	–	3
Wisconsin	–	1	–	2	3	6	6	12
Wyoming	–	–	–	–	–	–	1	1
Foreign Countries.								
Argentine Repub.	–	–	–	–	–	–	2	2
Armenia	–	–	1	–	1	2	–	2
Australia	–	1	–	–	–	1	2	3
Belgium	–	–	–	–	–	–	1	1
Brazil	–	–	–	–	2	2	–	1
Cape Town	–	–	–	–	–	–	1	1
Chile	–	–	–	–	–	–	1	1
China	–	1	–	–	–	1	8	9
Costa Rica	–	–	–	–	1	1	1	2
Cuba	–	1	–	–	1	2	2	4
Denmark	–	1	–	–	–	1	–	1
Ecuador	–	–	–	–	1	1	1	2
Egypt	–	–	–	1	–	1	1	2
England	–	1	1	–	–	2	2	4
India	–	–	–	–	–	–	1	1
Ireland	–	–	–	–	–	–	3	3
Italy	–	1	–	–	–	1	1	2
Japan	–	1	–	–	–	1	2	3
Mexico	–	1	2	2	–	5	7	12
New Brunswick	–	–	–	–	–	–	2	2
Nova Scotia	1	–	–	1	1	3	–	3
Ontario	–	–	1	–	–	1	3	4
Panama	–	–	–	–	1	1	–	1
Paraguay	–	–	–	–	1	1	–	1
Poland	–	–	–	–	–	–	1	1
Peru	–	–	–	–	1	1	1	2
Russia	–	–	–	–	1	1	1	2
Scotland	–	1	–	–	–	1	–	1
Transvaal	–	–	–	–	–	–	3	3
Turkey	1	–	–	–	–	1	1	2
Uruguay	–	–	–	–	–	–	1	1
Total	20	208	187	211	276	902	508	1,410

RESIDENCE OF MASSACHUSETTS STUDENTS.

(1) From Counties.

County.	No. of Towns.	No. of Students.	County.	No. of Towns.	No. of Students.
Barnstable	1	5	Middlesex	29	238
Berkshire	6	15	Nantucket	1	2
Bristol	8	28	Norfolk	18	95
Dukes	2	3	Plymouth	15	28
Essex	23	105	Suffolk	4	218
Franklin	3	4	Worcester	12	18
Hampden	3	18	Total	128	781
Hampshire	3	4			

(2) FROM CITIES WHICH SEND FIVE OR MORE STUDENTS.

Boston	201	Springfield	12	Arlington	5
Newton	46	Hyde Park	11	Barnstable	5
Brookline	39	Salem	10	Beverly	5
Cambridge	28	Quincy	8	Gloucester	5
Somerville	28	Winchester	8	Marlboro	5
Lowell	18	Framingham	7	Medford	5
Malden	17	Revere	7	Natick	5
Lawrence	15	Wellesley	7	Reading	5
Taunton	15	Chelsea	6	Stoneham	5
Lynn	14	North Adams	6	Weymouth	5
Waltham	13	Wakefield	6		
Newburyport	12	Abington	5		

SUMMER SCHOOL.

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

	1906	1907
Air, Water and Food Analysis	4	0
Analytic Geometry	20	29
Applied Mechanics	19	19
Carpentry and Wood Turning	4	12
Chemistry, Inorganic and Analytical	39	47
Chipping and Filing	9	8
Descriptive Geometry	35	37
Design	9	18
Forging	16	16
French	9	14
German	10	16
Integral Calculus	14	6
Machine-Tool Work	27	27
Mechanical Drawing	21	14
Mechanical Engineering Drawing	19	20
Mechanism	18	13
Metal Turning	1	1
Organic Chemical Laboratory	0	11
Pattern Work	3	14
Physical Laboratory	10	9
Physics	39	30
Precision of Measurements	6	4
Shades and Shadows	1	4
Surveying	14	35

ADDITIONAL STATISTICS.

	1906	1907
Number from other colleges and schools attending	39	58
Number not referring to any other college or school	4	1
Number from Massachusetts Institute of Technology	186	224
	229	283
Number who registered, but did not attend	14	10
Number who applied, but cancelled registration	2	3
Registrations for failures or deficiencies	166	347
Registrations to anticipate work	220	186

STATISTICS OF ADMISSION.

Of the 1,410 students of the present year, in regular attendance, 527 were not connected with the school in 1906–07. Of these 252 were admitted as regular students of the first year upon the basis of their entrance examinations. The 275 remaining comprise (1) those who had previously been connected with the Institute, and have resumed their places in the school; (2) those who were admitted provisionally without examinations; (3) those who were admitted by examination as regular second-year or as special students; (4) those who were admitted on the presentation of diplomas or certificates from other institutions of college grade. In addition to the 252 who were thus admitted to the first year on examination, and have taken their place in the school, 62 were admitted on examination, but have not entered the school.

In the case of the 277 persons who were admitted on examination, and have joined the school as regular students or as special students, the results of the examinations, embracing both those of June and those of September, were as follows:—

	Regulars.	*Specials.*
Admitted clear	146	2
" on one condition	60	7
" on two conditions	30	6
" on three conditions	15	7
" on four conditions	1	3
	252	25

Of the 722 persons who presented themselves in June for examination, 28 Complete, 23 Final, 68 Preliminary, and 16 Partial candidates, a total of 135, were rejected. In September 14 Complete, 13 Final, and 11 Preliminary candidates were rejected. 293 candidates, including those for advanced standing, attended the September examinations.

96 college entrance examination board certificates were submitted.

WALTER HUMPHREYS,
Registrar.

Reports of Departments.

DEPARTMENT OF CIVIL AND SANITARY ENGINEERING.

The staff of instruction has suffered a great loss the past year by the resignation of Professor Frank P. McKibben, who resigned to accept the position of Head of the Department of Civil Engineering at Lehigh University. Professor McKibben had a long and honorable service with the Institute. He was graduated in the Class of 1894, and has been continuously in the service of the Institute since that time, rising from the grade of assistant to that of associate professor. Professor McKibben devoted his summers largely to practical work, and cultivated to a high degree, that combination of the theoretical and practical which made him so valuable a member of the staff. He left us to the great regret of all his colleagues in the Department and in the Faculty, and with our best wishes for his continued success in the higher position to which he has been called.

Professsor McKibben's position has been filled by the appointment as assistant professor of Mr. L. E. Moore. Professor Moore graduated from the Department of Mechanical Engineering of the University of Wisconsin in the Class of 1900, and studied Structural Engineering at the Institute with the Class of 1902. He has had considerable practical experience, having been employed by the Illinois Central Railroad in its bridge department and in the abolition of grade crossings, by the Phœnix Bridge Company, and other concerns; he has also had experience in teaching in the University of Wisconsin and the University of Illinois and is well qualified to take up the work heretofore carried on by Professor McKibben.

The Department has also been strengthened by the promotion of Mr. R. D. Bradbury to be Instructor in Civil Engineering. Mr. Bradbury is a graduate of the Institute in the Class of 1906, having come here from the University of Missouri. He has devoted most of his spare time to gaining practical experience, and during the past summer has been employed by Mr. S. E. Thompson on expert work connected with reinforced concrete construction.

Messrs. G. L. Hosmer, C. B. Breed, and George E. Russell have been promoted from the grade of instructor to be assistant professors in Civil Engineering. Professor Breed devotes himself to the instruction in Railroad Engineering, Professor Hosmer to that in Topographical Engineering, Geodesy and Astronomy, and Professor Russell to that in Hydraulics, Stereotomy and Structures.

A new staff of assistants was engaged from the Class of 1907, and on the whole the staff of the Department is as large and fully as efficient as it has ever been.

During the past summer Professors Mott and Russell have been engaged in the work of investigating the traffic conditions in the city of Boston for the Boston Transit Commission, in accordance with an act of the legislature requiring an investigation of this character. Professor Mott also delivered a summer course of lectures on Hydraulics at Columbia University during July and August.

Professor Hosmer devoted the summer to practical work in the employ of Mr. W. S. Johnson, Consulting Engineer, of the Class of 1889.

Professor Breed has been engaged as an expert for the city in the case of the abolition of grade crossings at Lynn, in connection with which work he has made plans and given testimony relating to the case.

Professor Moore spent the past summer in the employ of the Illinois Central Railroad on the abolition of grade crossings in Chicago.

Mr. J. W. Howard occupied the summer in the employ of

the Harbor and Land Commission, in surveying work of various kinds.

The class graduating in Civil and Sanitary Engineering in June, 1907, numbered 38, which is the largest number ever graduated from the Institute, with the exception of the year 1906.

There has been, as usual, a large demand for men, and almost all of the graduates are occupied in engineering work, while positions were offered sufficient for a much larger number. This demand for men continued until late into the summer, 145 positions having been offered between March and September. At the present time, owing to the recession in business, a readjustment is taking place and some of our graduates are temporarily losing their positions. The past few years, indeed, have been rather demoralizing for young men entering any of the engineering professions, on account of the fact that the demand for men has been so great that even poor men have had no difficulty in securing positions at high salaries. A readjustment of these conditions will not be without advantage, as it will make more room for the best men, and will enable them in the future to advance even more rapidly, while the poor men will feel an added spur to "make good."

APPLICATIONS FOR MEN, APRIL TO AUGUST, INCLUSIVE.

	1903	1904	1905	1906	1907
Railroad	39	9	47	27	19
Structural	19	7	16	43	22
Teaching	7	7	7	22	42
Hydraulics	3	9	33	16	9
Civil Service Examinations	—	—	—	31	12
Miscellaneous	24	15	32	24	41
Totals	92	47	135	163	145

Additional evidence of the success of our graduates in passing competitive examinations comes to attention from time to time. In a recent examination for an important position the man who stood first was an Institute man, the men who stood second and third were Cornell men, and the man who stood fourth was an Institute man. The latter now occupies the position, the

others having declined. One of our graduates also passed a competitive examination for civil engineer in the Navy, with high rank, and has been appointed to this important position. No change has been made in the curriculum since the date of my last report, but the change therein mentioned, due to the cutting out of one year of Modern Language, now becomes operative in the third year, and will enable an improvement to be made in some branches of our professional instruction. No attempt, however, will be made to cover a wider field than has been covered in the past. The additional time which has been gained will be utilized in giving more time to emphasizing fundamental principles, and not in covering additional ground.

No change has been made in the conduct of the field work in Surveying, to which I referred in my past report. If funds can be provided, I believe it would be desirable to concentrate this field work in the summer, and I would respectfully call the attention of the Corporation to the considerations which were brought forward in my last report in connection with this matter.

The Department is crowded for space,—a fact to which I have referred in previous reports. We now have as many students as we can handle to advantage in the rooms which are at our disposal. The library, moreover, is very crowded, with scarcely any room for tables. When the question of a new site for the Institute is finally decided, these matters will, of course, be adjusted, and the Department of Civil Engineering will no doubt be given an opportunity to expand, which it has not at present.

During the past year a number of interesting investigations were made by students in this Department as thesis work. Several students, with the assistance of means furnished by the Transit Commission, carried on a series of tests with reference to earth pressure; these tests will be continued during the present year, and it is hoped that additional results of interest will be obtained. Messrs. Hastings and Morrill made some tests of steel angles in tension, a continuation of work

begun in the previous year; and the results were incorporated in a paper by Professor McKibben, presented by him before the American Society for Testing Materials. Other tests were made on reinforced concrete.

GEORGE F. SWAIN.

DEPARTMENTS OF MECHANICAL ENGINEERING AND APPLIED MECHANICS.

Inasmuch as these Departments are called upon to provide a very considerable amount of instruction for the students of all the engineering Courses, the total number of students is always very large, and besides the class-room, the drawing-room, and the regular laboratory work, a large amount of investigation is carried on, partly in connection with the regular laboratory work, but mainly in connection with the thesis work, not only of Course II., but also of some of the other Courses.

The result is that the resources of these Departments, and especially of the laboratories, have, for a number of years, been taxed to their utmost, as the supply of additional apparatus, and of space, has not kept up with the needs.

Notwithstanding the changes that have been made from time to time in the Course in Mechanical Engineering and the constant improvements and developments continuously effected in each of the professional subjects taught, in the endeavor to meet the needs of the modern developments in engineering practice, the latter have become so rapid that it has been found necessary by the Department to gain more time for a number of subjects; and accordingly, one year of study of Modern Language has been dropped, and the time thus gained has enabled us to increase the number of hours devoted to Literary subjects, Applied Mechanics, Steam Engineering, Power Plant Design, and Electrical subjects.

These changes in the Course take effect for the second-year class of the present school year, and constitute a very considerable improvement in the course of study.

The Corporation having made a special appropriation for the purchase of a superheater, and of a steam turbine, steps were taken to secure them, with the result that an independent superheater has been already installed, and that the steam turbine has been ordered, and is expected during the second term of the present school year. The superheater is capable of superheating ten thousand pounds of steam per hour, at two hundred and fifty pounds pressure, two hundred and fifty degrees Fahrenheit. It will enable us to use superheated steam in many of our investigations on the flow, and on the properties of steam.

The steam turbine, which has been ordered, is of five hundred kilo-watt capacity, and is fitted with a hydraulic brake instead of a generator, though it is so arranged that a generator can be added, whenever, for any reason, it may be thought desirable.

The turbine is manufactured and furnished by the Westinghouse Machine Company, who made us a very liberal donation, thus bringing the cost nearly within our means, while the difference has been kindly contributed by certain members of the Visiting Committee of the Department.

The turbine will enable us to study experimentally, and on a practical scale, many problems connected with the performance of this important motor, including questions of steam losses, leakages, etc.

Besides the superheater and the steam turbine, the following smaller apparatus has been added, viz.:—

(1°) A thirty-six-inch hydro-extractor, for the purpose of studying experimentally the laws of running balance of machinery having a high rotative speed.

(2°) A Starrett mine pump, presented to the Department by the makers.

(3°) A compressor, owned by the Mining Department, and loaned to the Mechanical Engineering Department.

(4°) An additional cement testing machine.

(5°) A Thomas calorimeter.

Though much additional apparatus is needed, the following are the most pressing needs at the present time:—

(1°) A surface condenser of a capacity of eleven thousand five hundred pounds per hour.

(2°) A refrigerating plant.

(3°) An impact testing machine.

Besides these we need a stationary plant for testing locomotives. There are several such plants in existence, and, while we frequently make investigations by means of road tests of locomotives, such a plant would enable us to increase very much our usefulness to the engineering public.

The practice of these laboratories in carrying on a considerable amount of investigation of modern engineering problems has been, as usual, continued, partly in connection with the regular laboratory work, but mainly in connection with the thesis work.

Among investigations now being carried on in connection with regular laboratory work may be mentioned:—

(*a*) Friction of air flowing in pipes, and losses due to elbows and bends. The amount of experimental data available upon this subject, at the present time, is very small.

(*b*) Investigation of the flow through orifices of steam with different amounts of moisture, under small differences of pressure.

In this connection may be mentioned, also, the following portions of the thesis work of last year:—

(*a*) The investigation of locomotive driving springs has been continued.

(*b*) The investigation upon re-enforced concrete beams has been continued.

(*c*) Investigation of the effect of water upon the fire-resisting properties of fire brick.

(*d*) Investigation of the variation in the angular velocity during one stroke of a reciprocating engine.

(*e*) There were a number of tests of Producer Gas Plants under one hundred and fifty horse power and one of five hun-

dred kilo-watt capacity. There was also a design of a producer-gas power station, including buildings, foundation, wiring, and all accessories.

(*f*) A special investigation, which is now being carried on by a candidate for an advanced degree, consists in determining the velocity and the energy of a jet of steam issuing from a flared nozzle. The apparatus to be used in this work was so designed as to make it possible to weigh directly the reaction of the jet.

Experiments are to be conducted with different boiler pressures and with nozzles of different lengths. The first nozzle experimented upon will be one of seven-eighths-inch diameter at the throat, two and fifty-seven hundreths inch diameter at the large end, and eighteen inches in length.

Besides the gifts already mentioned, the following should be noted:—

(*a*) Complete sets of blue prints of Locomotives have been presented to the Department by the Baldwin Locomotive Works and by the American Locomotive Company.

(*b*) Considerable valuable literature has been provided at our request, for the use of the students, by the following firms: the American Locomotive Company, the Baldwin Locomotive Works, the Crosby Steam Gage Company, the Carnegie Steel Company, the Draper Company, the Jones & Laughlin Steel Company, the B. F Sturtevant Company, the Walworth Manufacturing Company, and the R. D. Wood Company.

(*c*) Valuable modern apparatus has been sent to the Department for use in connection with the work in the drawing-room by the Fitchburg Machine Tool Company, the B. F. Sturtevant Company, and the Napier Motor Company of America.

While the results of investigations of modern engineering problems made in these laboratories are of very considerable value to the engineering and industrial public, such investigations are, at present, subject to the requirements of the regular laboratory work, to the limitations of time imposed upon thesis work, and to the necessary employment thereon of undergraduates, who are thus gaining the ability to investigate. It would be

very desirable, therefore, to have certain special assistants, of the grade of instructor, who should not be called upon for any work connected with giving instruction to undergraduates, to carry on prolonged investigations. It would be necessary to provide for their exclusive use a considerable amount of apparatus, so that they would not have to depend upon the employment of apparatus at such times as it could be spared from its other uses. In the case of some of the larger pieces of apparatus, however, which it would not be feasible to duplicate, the use which they could make of them would have to be subject to the requirements of the regular work of the school. Moreover, it would be necessary to make such arrangements as to enable these investigations to proceed continuously, without being interrupted by the summer vacation.

In addition to the above, it would be necessary to provide the means of preparing the results for publication, and of publishing them. Indeed such a provision would be very desirable, even under present conditions, as the duties of the assistants and instructors who are engaged in the regular work of the school do not leave them time enough for such work.

It is evident that we need a considerable amount of additional apparatus, to provide for the regular laboratory work, and also for the thesis work of our large classes, to enable us to undertake, in the laboratory, the solution of many modern engineering problems, with which we are not equipped to deal at present, and for purposes of investigation.

More room is also needed, for new apparatus, to relieve present crowding, to furnish room for students to carry on thesis work on apparatus brought in from outside, to provide storage room for large and miscellaneous apparatus to be used on thesis work conducted outside, and to provide room for stripping machines for the purposes of Machine Drawing.

GAETANO LANZA.

DEPARTMENT OF MINING ENGINEERING AND METALLURGY.

The number of students in the Mining Department is about the same as last year, the number in the fourth year having fallen off a little, and that in the second year having increased.

The demand for graduates of the Mining Department has been extraordinarily large this year, not only for young engineers to take positions in the mines and works, but for teachers and professors to teach the subjects in the mining schools of the different states. It has been impossible to supply the demand. Just now, since the hard times have come, the demand is slackening a little, and some of the men who were placed before are losing their positions.

Many students have received work for the summer at mines and mills in the West and Northeast, so that they can get a valuable insight into mining and metallurgical operations while they are still taking their course at the Institute. The effect of this is very advantageous.

The Mining Course is undergoing a general rearrangement at the present time, the object being to eliminate all inconsistencies that have crept in, and to get the time distributed to the best advantage for the student.

In the Ore-dressing Laboratory two new pulsator classifiers and a new pulsator jig have been installed. They are the property of Professor Richards, but are placed at the disposal of the students. These machines bid fair to create something of a revolution in ore-dressing works. A canvas cover has been tried on the round table with good success. This may prove a valuable innovation for the mills. There is in contemplation the purchase of a new Johnston vanner of the kind that is at present used at the Utah Copper Company's mill, which has shown remarkable perfection of work. A newly designed top for a Wilfley table has been put in, which is ex-

pected to yield better results than those previously employed. A small new Hansell hand jig has been installed. Two compressors for compressing air have been purchased and installed for general use in mining and metallurgy. An accelerated motion adopted in the Lake Superior mills for the jigs has been adapted to the use of the laboratory, and a very successful jig has resulted.

The general plan of work in the Metallurgical Laboratory has remained about the same; several important changes, however, have been made in the details. The students now receive general schemes outlining the work to be done, the observations to be made, and records to be taken; at a fixed time after a run, reports upon it have to be handed in. This new requirement has added greatly to the value of the work.

With all laboratory exercises, it has been the rule so far to take an account of stock of the metal in order to determine the yield by the process in the end products and intermediary products, and thereby the percentage of metal lost. In the blast furnace work and roaster work the ground covered by the reports has been extended to include measurements of temperatures and analyses of gases, which permits making a thermal balance of a smelting operation and determining accurately the changes of temperature necessary to obtain a satisfactory roast. The usual method of estimating temperatures by the eye is thus controlled by the use of the pyrometer. The thermo-electric pyrometer of LeChatelier has been supplemented by the optical pyrometer of Fery.

The Metallurgical Laboratory has received the necessary equipment for developing microphotographs. This makes the work independent of the dark room of other Departments. Mr. C. R. Hayward spent some time last summer in the metallographical laboratory of Columbia University, New York City, to become familiar with the methods of work in use there, and thus improve upon our own plant and mode of instruction.

Professor Richards has continued his researches in the direc-

tion of ore dressing, and is from time to time installing new apparatus for this purpose along the line of classification of ores. Some very valuable conclusions have been reached in these investigations, and the apparatus is placed at the disposal of the students, so that they can make researches also along these lines.

Professor Richards has accepted work in the Western mills for the purpose of keeping him in touch with the present state of the art of concentration of ores in the largest and best equipped mills of the country. This line of work is on the increase at the present time. Professor Locke made a long trip during the summer, studying the mines of the North and East in order to keep himself in touch with the present state of the art.

For research work there have been acquired a Friedrich gas reverberatory furnace in which the temperature is under absolute control, an Heraeus electric resistance tube furnace for temperatures up to 1400° C. in any kind of atmosphere, and a Siemens millivoltmeter. The tendency of the laboratory is to develop the research side of the work by providing apparatus which allow control of temperatures.

The Summer School of Metallurgy last summer visited the Maryland Steel Company at Sparrows Point, Md., the Pennsylvania Steel Company, and the Central Iron and Steel Company near Harrisburg, Penn., the great iron mines near Lebanon, Penn., and the new concentrating plant, coking plant, and blast furnaces at Lebanon. At this place they also visited the puddling plant of the American Iron and Steel Company and the foundry of the Lebanon Steel Casting Company. At Bethlehem they visited the works of the New Jersey Zinc Company and the Bethlehem Steel Company, and at Northampton, Penn., the Atlas Cement Works. Then they went up to Hazleton and visited an anthracite mine and breaker of the Lehigh Coal Company. Lastly from New York City they visited the Balbach Lead Smelting and Refining Company, the Nichols Copper Company, the Raritan Copper Company, and the Atha Steel Company.

The library has received a new wall-case for folio periodicals and books. Professor Richards has presented to the library sixty-five books and pamphlets, and Mr. Arthur Winslow (III. '81) has deposited a large assortment of books, periodicals, and pamphlets which have been of much use to the Department and its members.

There is to be mentioned the old problem of lack of space. The ore-treatment, which is much developed at the Institute, is cramped for room. The study of the properties of metals and alloys requires a great deal more space than is available at present, and the research division ought to have a separate laboratory which can be kept clean, a thing that it is impossible to do where ore and metals are being subjected to experimental work.

Two valuable theses have been prepared during the last year, one by Messrs. Davis and McMillin, developing a new idea in concentrating tables. Their work reflected great credit upon them, and covered the ground extremely well. The other was by Messrs. Coupal and Hampton in which they ran a blast furnace, making not only the usual account of stock metal and of all metals and values contained in the ore, but also a complete thermal balance of the heat generated by combustion and the heat absorbed in the furnace.

Professor Richard W. Lodge has just resigned his position of Assistant Professor of Mining Engineering and Metallurgy, in which capacity he has had charge of instruction in Assaying, of some of the Metallurgical Laboratory work and the general oversight of the John Cummings Laboratory of Mining Engineering and Metallurgy. As he began in October, 1888, this makes nineteen years of service he has completed. Professor Lodge's work with the students has been good, and his insistence upon positive knowledge and strict accuracy have been a valuable adjunct to the Course. He carries with him the best wishes of the Department.

Professor Edward E. Bugbee has come to us as Professor Lodge's successor. He was graduated at the Institute in the

Class of 1900, and has since held various positions. He was Assistant at the Institute for the school year 1900–01, Chemist with the Brookfield Mining Company from June to October 1901, Assistant at the Institute from October to February 1903, Special Agent for the United States Census (Mining Investigation) from February to September 1903, Assistant Professor of Mining Engineering and Metallurgy in Iowa State College from September 1903 to September 1906, Assistant Professor in Mining Engineering and Metallurgy in the University of Washington from September 1906 to March 1907, and Assistant Geologist in the United States Geological Survey from March 1907 to date. Professor Bugbee therefore brings to the Institute the fruits of his experience in the field and in other schools.

A temporary change has been made in advancing Mr. Reed to the position of Instructor in the Assaying Department. Mr. Angelo Heywood has been appointed Assistant in Ore-dressing and Mr. Grant of Dalhousie University has been appointed Assistant in the Metallurgical Laboratory.

ROBERT H. RICHARDS.

DEPARTMENT OF ARCHITECTURE.

The last year was one of peculiar interest to this Department. The fourth-year class was unusually large and of more than average ability.

The *Technology Architectural Record* was launched as a quarterly magazine, and has already proved itself well worth the labor expended upon it. It has been the means of a strong reawakened interest in the Institute among our alumni, as shown by the many letters received in approval of this effort.

The American Institute of Architects at its Fortieth Annual Convention at Washington in January of this year gave active evidence of its interest in the architectural schools through its Committee on Architectural Education. As expressed in the

Committee's report: "Through co-ordination, a unification of standards, and co-operation, we believe that in a few years the education offered in this country might be looked upon as final except for the absolutely necessary element of study and cultivation through travel and research amongst the inimitable monuments of the pagan and Christian past." The result of the acceptance of the report was a meeting held by the Committee in New York in the May following, to which were invited the heads of the architectural schools of Columbia, Cornell, Harvard, Pennsylvania, and the Institute of Technology. They all responded. The most tangible result of that meeting was to inaugurate a system of competitions between the schools, and the experiment was made to hold the first one during the summer vacation. The difficulty of control of vacation work has proved, however, that it is not practicable to carry out this plan, and at another meeting held last month it was decided instead to have the competitions a part of the school curriculum. Preparations are now being made to accomplish this. The Department is much interested in the success of the experiment.

The last year was also the first in which the Perkins Travelling Fellowship was awarded to a woman. The successful competitor was Miss Ida A. Ryan, '05. The jury was composed of Mr. R. S. Peabody, President of the Boston Society of Architects, Mr. J. Randolph Coolidge, Jr., its Chairman on Education, assisted by the staff of the Department. Three other competitors were given honorable mention. Miss Ryan sailed for Europe in October.

We have much to be grateful for in the active support of the Boston Society of Architects. In April the studio of the Department was the scene of the Society's monthly dinner and meeting, which was held there for the purpose of awarding the prizes, the gifts of the Society, won in the annual competition among the fourth-year students. Mr. Peabody presided and presented the prizes; E. F. Lewis and Winsor Soule shared the one for regular students. The prize for special students was given to A. N. Rebori. In another way the sympathy of the Boston

Society was shown when Sir Aston Webb was a visitor in Boston. The Society gave a reception to him and Lady Webb in the library and drawing-rooms of the Department, and there were no more appreciative guests on that occasion than our students. The informal address made to them by Sir Aston will always be a most interesting memory.

The two Rotch prizes of two hundred dollars each were given, according to the will of Mr. Arthur Rotch. One prize was awarded to E. F. Lewis, a graduate in the regular Course, the other to R. B. Barnes, a special student of two years' standing.

M. H. Whitehouse, the holder of the 1906 Travelling Scholarship, returned from Europe at the end of his year's study. There was held in the Department an exhibition of his work, the quality of which fully proved his ability to profit by the opportunity given him.

The usual Summer School of the Department was held during July and August with sixteen students in attendance. The Institute, we believe, is the only school offering a regular summer course in Architecture, and the gradual increase in attendance since the beginning, indicates its value to college graduates, and to specially prepared students already in the Department, in gaining a year in the regular course in design. A number of teachers of drawing in secondary and trade schools have also taken advantage of the summer courses to supplement their regular work.

As affecting our present work, I beg to present to your consideration two important matters. First, the desirability of requiring in the near future five years' attendance in this Department to attain the Bachelor's degree. Beginning fifteen years ago, the necessity of a longer school training for our students became evident and the effort of the Department was directed to that end. President Walker's entire sympathy was with such an extension, as may be seen in his reports; but conditions at that time did not seem ripe for such a change. Since then we have set forth the importance of such a movement whenever opportunity offered. Until now our experience alone

governed our desires in this matter, but now there have come pressing demands from the architectural profession for a higher standard of graduation from the schools, which, if met, makes it imperative to lengthen the Course. The quality of the work done in our graduate year stands out very conspicuously above that of the undergraduate. This is due to the uninterrupted and continuous study of purely professional work at the time when the student is exactly ripe for it. The fifth year of the regular Course should offer practically the same opportunities that the graduate year does now. Every student needs this year in which to broaden out his professional work and to get a perspective view of what he has accomplished in his close application to the tabular views of the preceding years. It is his opportunity to apply to practice the theory which occupies so much of his previous training or to round out his equipment, if he so desires, by taking other of the many courses which the Institute has to offer.

The training of our first year might well be accomplished in a preparatory school so far as concerns its direct influence on our professional work. The degree is really given for three years of professional work. Adding another year simply places the degree where it belongs, and puts us more nearly on a par with the requirements of the other professions, no one of which demands more skilful, thorough, broad training than that of Architecture. It is always from our graduate class that architects make their first demands for assistants. Much may be gained of course by raising the standard of admission, but it is the standard of graduation that tests the schools, and we wish to have set for the whole Department that standard which is now limited to [illegible].

The other matter refer[illegible] our Travelling Scholarship. In 1906 a friend of the Department who wished to remain anonymous gave the sum of twelve hundred dollars for a travelling scholarship for that year. The accumulated interest of the Perkins Fund amounted to an equal sum in 1907, and the scholarship was continued. Our resources

are now at an end. The Department begs either that the Executive Committee may see fit to make an annual allowance of twelve hundred dollars for this purpose or that the same amount be allowed from the Austin Fund. We believe that much good would accrue not only to the school, but also to the beneficiary of this scholarship if it were stipulated that at the end of his year of foreign study he should return to the Department as an instructor for some stated time, perhaps a half-year. To the school is really owed some practical recognition of the splendid opportunity given for foreign study. Such a scholarship cannot be measured in money. It counts for position, standing, reputation to its beneficiary. His services for the profession immediately have an increased value, because the scholarship represents recognition of unusual ability. It should not be felt an obligation by the beneficiary, but a favor, to be allowed the opportunity to make the Institute a practical return, and there could be no better way of doing this than to show to those who hope to have similar opportunities some day how best to profit by them.

To our students this instruction would come at the opening of the school year, just at the time when the aid of fresh young talent would be most inspiring. To the young instructor the value of such an opportunity to teach cannot be overestimated. He learns to know himself and his own capabilities. He puts his own knowledge into training. He finds unsuspected weak points in his armor, and, when found wanting, he will endeavor to elevate his own standard for any position he may occupy later.

But better than all would be the good effect on the Institute of the successful scholar returning to the Department for this short time to teach the causes of his success. Both teacher and pupil would have a higher appreciation of what the Institute stands for. They would learn that to graduate means much more than to get through and to get out; rather that it is to begin to show work which is worthy of Institute training, and which must be proven at the Institute itself. A practical

illustration such as the above would carry weight when simple theoretical consideration would amount to nothing.

The income of the Perkins Fund amounts every four years to one thousand dollars, and is then available for a travelling fellowship, but the Department has no other scholarship endowment. It shares with the other Departments from the funds that have been left so generously for the common good, and in addition to this the Institute does all that its means permit. Cornell, Columbia, Harvard, Pennsylvania, St. Louis, have each one or two scholarships, and the Institute, the oldest of them all, should not be less favored.

FRANCIS W. CHANDLER.

DEPARTMENT OF CHEMISTRY AND CHEMICAL ENGINEERING.

The work of the year has again been characterized by progress in the development of plans previously conceived rather than by the introduction of pronounced changes. The revised Courses in Chemistry and Chemical Engineering are now in full operation, and the real test of their efficiency will begin with the post-graduate activities of the class of 1908. There seems at present to be good reason to hope that the verdict of the coming years will be favorable.

In one respect, however, the past year has been remarkable in the history both of the Institute and of the Department, namely, in the conferring of the degree of Doctor of Philosophy upon three graduate students, Messrs. R. B. Sosman, Raymond Haskell, and M. A. Stewart, who completed their investigations in the Research Laboratory of Physical Chemistry during the year. The examinations for this degree, both oral and written, were held in May, and were conducted by members of the Faculty of this Department, and those of Physics and Mathematics, and the degrees were conferred at the graduation exercises in June. Professor Noyes, under whose direction the men had carried on their investigations, presented the

candidates as Chairman of the Faculty. This was peculiarly fitting, since the occurrence at this time of this important event in the development of the advanced work on the part of the Institute is due largely to his foresight and zeal in the establishment and administration of the Research Laboratory of Physical Chemistry. It is to be hoped that this marks only the beginning of this sort of valuable service to science on the part of this laboratory, and of other research laboratories of which mention is made below.

It was noted in the Report of last year that a beginning had been made toward a greater development of research work in Technical Chemistry, and two research assistants had been appointed, to work under the direction of Professor Walker. This work has led to results which are both interesting and important for the interpretation of the phenomena which accompany, or constitute, the corrosion of irons and steels.

It was intended at the outset to take up at once the study of the practical phases of the problem, but these investigations had progressed but a little way when it became plain that the fundamental principles underlying the phenomena of corrosion required additional study, and the research was, therefore, turned temporarily in that direction. Two phases of the subject have now been practically completed. The first constitutes, in part, the matter presented as a thesis by Mr. Colby Dill last June for the degree of Master of Science, and has to do with the influence of stress upon the corrosion of iron. It is thought that Mr. Dill's work conclusively proves that stresses which produce strains not exceeding the elastic limit of the metal (which includes the majority of cases in engineering practice) are without effect upon the potential of the metal, and do not influence corrosion. Beyond this limit a marked increase in potential was noted, but this exists only as long as the stress is applied, and under these conditions other, and at present indeterminate, influences appear to be superimposed upon those of stress. The nature of these factors is one of the questions awaiting further study.

The second portion of the work, which has been carried on by Miss Anna M. Cederholm and Mr. Leavitt N. Bent, has been devoted to an explanation of the mechanism of the reaction as a result of which corrosion of iron and steel takes place.

The result of the work of the year is a confirmation of the electrochemical theory, which assumes that corrosion is an electrochemical phenomenon depending only on the difference of potential between two points and the resistance in the circuit. In addition, it has been shown that oxygen is the most important agent in causing corrosion and that the speed of corrosion of iron in water is a linear function of the partial pressure of the oxygen in the atmosphere above the water. The investigation as a whole constitutes a definite advance in our knowledge of the nature of this phenomenon, which is of such far-reaching importance to all engineering interests, and has revealed other phenomena which give promise of additional light, if further investigated. Some of these are now under examination. It is also intended to return to the practical phases of the problem, applying the results of the work of last year; and some of these investigations are already in progress.

An investigation, by a method devised some time ago by Professor Walker, of a process for annealing sterling silver without deterioration due to oxidation, blistering, pitting, etc., has also been completed. Practically all the large silver manufacturing establishments are now operating in accordance with the principles which were made clear for the first time by this investigation.

This progress of a single year appeared to justify the continuance of this plan for technical research, and it is a source of gratification to the Department that it was found possible to make an appropriation from the Charlotte B. Richardson Fund for the employment of research assistants during the current year. Meanwhile the Department is in consultation with those who have a knowledge of the conditions and requirements in the technical field, and is making progress in the formulation of a plan, which it hopes to present soon for consideration, look-

ing toward the possible establishment of a Research Laboratory of Technical Chemistry, which should be of importance alike to the Institute and to the technical interests which it would aim to serve. It is hoped that a definite decision as to the practicability of such a laboratory may be reached during the year.

The Research Assistantship in Organic Chemistry, the funds for which were in large part provided by Mr. Arthur D. Little, as noted in the last Report, is now held by Mr. Richard G. Woodbridge, Jr., and work is in progress under the direction of Professor F. J. Moore. Professor Mulliken has continued his research work on the systematic detection and identification of the organic compounds, and he, as well as Professor Moore, has directed a number of investigations in the organic field, which were carried out by students, both graduate and undergraduate.

A second invitation was received from Messrs. Harrison Bros. and Company to nominate a second-year student to participate in their summer course in Applied Chemistry. Mr. John A. Christie, of North Adams, a student in the Chemical Course, was proposed and accepted; and he, with Mr. Howard E. Batsford, who took the first year of the course last year, spent a considerable portion of the summer in Philadelphia, and both found the experience highly profitable.

In order to lessen the disadvantages incidental to the distribution of the branches of the departmental work among the various buildings, and to promote interest in and a discussion of this work on the part of all the members of the instructing staff, a series of departmental conferences was held during the year in which the work of each of several of the larger subdivisions was described by the instructor in charge and subsequently discussed informally. These conferences were apparently productive of good results. They are to be continued during the present year, and will probably include a consideration of improvements in details of methods of instruction, and also of the relations of the departmental work both to that of

the preparatory schools and to certain of the vocations for which the courses are intended to prepare the student. In the latter connection, the Department was fortunate in arranging for a short series of talks by Mr. M. C. Whitaker, General Superintendent of the Welsbach Light Company's factories, which were open to all Institute students, and proved to be helpful and valuable. Mr. Whitaker and Messrs. Charles W. Hubbard, Henry Howard, and Spaulding Bartlett also rendered helpful service by informal talks to the senior students in the Courses in Chemistry and Chemical Engineering near the close of the year. It is intended to continue, as opportunity may offer, thus to enlist the services of friends of the Department to bring directly before our students certain phases of the post-graduate professional experiences upon which they are entering, which can be best presented by those who are in the midst of these activities. It is also gratifying to note an increased interest and participation, on the part of the members of the Department, in technical affairs, and in the scientific societies of the country, which can hardly fail to result in a broader outlook and improved instruction.

The changes in the personnel of the instructing staff of the Department have been numerous, but are confined to the junior members. In all, ten instructors and assistants resigned, of whom seven were Institute graduates. Of the thirteen new assistants and instructors, nine are Institute graduates, of whom one has just taken his doctor's degree in Germany, the others being graduates of Harvard University, the University of Toronto, the University of Minnesota, and Clark College, respectively.

During the year the Department has added materially to its equipment of apparatus which has been officially standardized at the National Bureau of Standards, or the German Reichsanstalt, and is now well provided with standard sets of weights, measuring apparatus, and thermometers. The stock of platinum has been increased, and it is now possible to diminish what has often been a burden to the student, the outlay for

platinum utensils. These can now be loaned under conditions which secure a proper return for the capital invested. Dr. Gill has also introduced a card system of student and stock accounts which greatly lessens the expenditure of time and labor, particularly in the crowded period at the close of the terms. Steps have also been taken looking to the completion of certain valuable sets of periodicals in the Chemical Library, as opportunities for purchase may offer, and the library has been safeguarded by fire-proofing the partition between it and the adjoining laboratory. The material for this work was contributed by a friend of the Institute.

The Department is again confronted with a serious problem in connection with its available laboratory space. The increase in the number of students taking courses in Analytical Chemistry and in Organic Chemistry, as a result of the changes in the Courses in Mining Engineering and Chemical Engineering, has already caused serious inconvenience to the work in Organic Chemistry, and in order to make provisions for instruction of a still larger number next year it seems inevitable that overcrowding of another branch of the Department must result. In addition to these emergency requirements, there still remains the earnest desire for a reunited Department, for increased accommodations for instructors, for enlarged special laboratories, and for more small laboratories, which has often been expressed, and which finds its source in the conviction of all concerned that, when it is possible to provide these facilities, the efficiency of our work will be notably increased.

H. P. TALBOT.

THE RESEARCH LABORATORY OF PHYSICAL CHEMISTRY.

Investigations are now being carried on in this laboratory by sixteen men, of whom ten are devoting their whole time to research work. A number of these men are candidates this year for the degree of Doctor of Philosophy. This degree was

conferred last June on three of the research workers in the laboratory, Messrs. Raymond Haskell, Robert B. Sosman, and Morris A. Stewart.

Last May the laboratory suffered a painful loss in the sudden death of one of its research associates, Mr. Guy W. Eastman, a man of high character and promise.

Several members of last year's research staff have accepted technical or academic positions elsewhere. Their places have been filled by the appointment to the research staff of Professor Carl L. von Ende (Ph.D., Göttingen), Mr. John Johnston (B.Sc., St. Andrews), and Mr. Roger D. Gale, (S.B., M. I. T.). Mr. Robert B. Arnold (S.B., Rose Polytechnic) enters as a candidate for the degree of Doctor of Philosophy.

Dr. Gilbert N. Lewis, who has recently been appointed Assistant Professor of Physico-Chemical Research, is acting as director of the Research Laboratory for such time as Professor Arthur A. Noyes devotes himself to the duties of the presidency of the Institute.

This year, in addition to the seminar for research reports, the members of the laboratory meet weekly under the direction of Professors Noyes and Lewis to discuss the progress of the various investigations in the laboratory and the immediate problems to which they give rise. Two other seminars are also conducted, one by Dr. William C. Bray on Applications of Physical Chemistry to Inorganic Chemistry, and one by Professor Lewis on Free Energy and Chemical Equilibrium. These seminars are attended not only by members of the Research Laboratory, but also by many instructors and advanced students from other Departments and by several advanced students of Harvard University. The course in glass blowing is again offered by Mr. Charles A. Kraus, and the opportunity of acquiring proficiency in this useful art is being taken by a large number of men from several Departments of the Institute.

During the past year a gift of $500 has been received from the William E. Hale Research Fund. In addition, Professor

Noyes has received a grant of $2,000 from the Carnegie Institution for assistance in prosecuting the researches on the conductivity of aqueous solutions at high temperatures.

The results of the numerous investigations in this field which have already been completed in this laboratory have recently appeared in a comprehensive memoir, published by the Carnegie Institution. The work is being continued in several new directions. A new form of conductivity bomb, capable of withstanding very high pressures, has recently been constructed. In this bomb the vapor-pressures, density, and compressibility of water up to the critical point are being studied, as well as the influence of pressure upon the electrical conductivity of solutions. Closely allied investigations are being made upon electrical transference in mixed salt solutions, the solubility of salts in water at high temperatures, and the dielectric constant of water up to its critical point.

In another field of investigation which is receiving special attention in this laboratory several investigations are under way. These are directed towards the determination of the common electrode potentials, and of the free energy of important chemical reactions. Through experiments carried on during the past year Professor Lewis has succeeded in determining with precision the potential of the hydrogen electrode and its dependence upon pressure and temperature and upon the concentration of hydrogen ion. Mr. Ledyard Sargent measured by a new method the potentials between a number of common solutions, thus removing one of the chief obstacles to the exact determination of electrode potentials.

Professor Goodwin and Dr. Herbert T. Kalmus have finished an extensive investigation of the latent heat of fusion of salts, and the electrical conductivity, viscosity, and density of fused salts. They are now commencing an equally fundamental research upon the specific heats of gases at very high temperatures.

The general scheme of Qualitative Analysis, developed by Professor Noyes and Dr. Bray, is nearly completed in as far as

it concerns the common metals, and is now being extended to include the acid radicals.

Other investigations are being brought to a successful conclusion. Mr. Kraus is publishing a series of articles comprising the results of his highly original researches upon the solutions of metals in liquid ammonia. The powerful centrifugal machine for the study of electromotive forces generated in a rotating electrolyte, and the calorimeter for determining the heats of reaction at 100°, are now completed and in operation. Both pieces of apparatus were constructed with the aid of grants from the research funds of the American Academy of Arts and Sciences.

At the request of the New England Association of Chemistry Teachers a course of lectures has been established under the Lowell Teachers School of Science on the principles of Physical Chemistry and their application in the teaching of elementary Chemistry. The lectures are being given in this laboratory by Professor Lewis, and are attended by about sixty science teachers. It is hoped that the course will serve to demonstrate, in this field also, the very practical nature of the modern ideas which are comprised in the science of Physical Chemistry.

GILBERT N. LEWIS.

DEPARTMENT OF ELECTRICAL ENGINEERING.

The Electrical Engineering Course of the Institute was the first formal course of electrical engineering study established in the country. The only other course in Electrical Engineering which rivals it in age, the one maintained at Cornell University, was established, it appears, a few months later than the course at the Institute. The first students graduating from each of these two courses were in the class of 1885. In each instance the Electrical Engineering Course was the offspring of the Physics Department and remained so for some years, with the Professor of Physics in charge of the work in Electrical Engi-

neering; and the Institute is indebted to Professor Cross for the high reputation which was promptly created for the electrical engineering instruction here afforded.

The Course in Electrical Engineering was separated from the Physics Department a number of years ago. Dr. Louis Duncan was then appointed Professor of Electrical Engineering in charge of the Department of Electrical Engineering. After his resignation Professor Clifford was given acting charge of the Department. My appointment to the position of Professor of Electrical Engineering in charge of the Department was made in the late summer of 1906, but it was provided at that time that I should not enter upon the duties of the position at the Institute before the opening of the second term. Professor Clifford kindly consented to continue his relations in charge of the Department through the first term of the Institute year then about to open.

The past Institute year signalized the inception of some important modifications in the Electrical Engineering Course. Certain changes made in the Civil Engineering and the Mechanical Engineering Courses, especially the shifting of Applied Mechanics to an earlier place in the Courses, opened the opportunity to modify similarly the Electrical Engineering Course. The modifications were presented to the Faculty by the Department, and they have now been in large measure adopted to go into effect with second-year students during the present year. A brief statement of the proposed modifications was published in the *Technology Review* for July, 1907.

In considering the plan of these modifications, resort was made to the valuable advice of the visiting committee of the Corporation and the special advisory committee of the Department. The latter committee consists of Professor Elihu Thomson, Mr. Charles L. Edgar, Mr. Louis A. Ferguson (M. I. T., '88), Mr. Hammond V. Hayes, and Mr. Charles F. Scott, all distinguished and widely known electrical engineers or executives. This committee had been appointed by the Corporation in the academic year 1905–06 at the suggestion of Professor

Clifford. It was intended that the committee should serve as an advisory committee for the Department, and I have found that the members of the committee take great interest in the educational problems of the Department. I have therefore not hesitated to call upon them for counsel and advice.

The teaching staff of the Department seems to me to be reasonably well balanced, except that it is desirable to adjust the relations of the younger members of the laboratory staff so that there will be less change in the personnel at the end of each year. I think that this can be accomplished. As the advantages of the modifications in the Course become effective, I believe that the teaching will become even more effective than heretofore. Each member of the Department who holds faculty rank has an important and absorbing field of effort which he is making his own. At the same time, measures are being put into effect to keep the instructors and assistants in touch with the more experienced teachers. The criticism that is likely to be made of the arrangement of the teaching force resides in the fact that there are relatively too many assistants in proportion to the number of men of the immediately higher ranks.

Certain changes in the teaching force followed in the train of the resignation of Professor W. L. Puffer from the position of Associate Professor of Electrical Engineering, which took place in the summer of 1906 shortly before the opening of the Institute year. Professor George C. Shaad of the University of Wisconsin was appointed to fill the vacancy and to take up most of the teaching theretofore carried on by Professor Puffer. Professor Ralph R. Lawrence at the same time took undivided charge of the Electrical Engineering Laboratory. Professor Shaad was given the title of Assistant Professor of Electrical Engineering at the time of his appointment, and he has since been advanced to the grade of Associate Professor of Electrical Engineering.

My part in the teaching at my former location (the University of Wisconsin) has of late years related mostly to the phenomena of alternating currents and alternating current ma-

chinery; but Professor Clifford's lectures prove that he has the teaching of this branch well in hand, and I have therefore here turned my attention toward lectures, recitations, and quizzes for the fourth-year men in subjects relating more directly to the executive and administrative aspects of engineering affairs. Opportunity for this work is afforded in the new arrangement of the curriculum of the Course, and the Faculty have granted to me a privilege of substitution which I can utilize until the modified Course comes into effect.

Promotions and appointments were made in the Department during the course of the year as follows:—

Professor Ralph R. Lawrence and Professor Harrison W. Smith have been promoted from the position of Assistant Professor of Electrical Engineering to the position of Associate Professor of Electrical Engineering; Mr. H. G. Crane and Mr. W. V. Lyon have been promoted from the position of Assistant to the position of Instructor; Mr. C. W. Green (University of Wisconsin, '07), Mr. A. E. Harrold (Pennsylvania State College, '07), Mr. R. G. Hudson (M. I. T., '07), Mr. C. C. Knipmeyer (University of Michigan, '07), and Mr. G. B. Thomas (Ohio State University, '07) have been appointed to the positions of Assistant in Electrical Engineering.

The Department staff and equipment continue to hold an important part in the useful work of the Lowell Institute School for Industrial Foremen.

The life of the teaching of electrical engineering subjects to undergraduates is rooted in the laboratory and the way in which the laboratory instruction is administered. It is therefore a particular satisfaction to commend to your attention the admirable way in which the standardizing and electrical testing laboratory and the electrical engineering laboratory are operated respectively by Professor Laws and Professor Lawrence.

Both of the laboratories are in most respects well equipped for undergraduate instruction, but each needs additional apparatus to make practicable the assignment of more students to each working section. This is needed for the purpose of

more satisfactorily providing for the electrical work of the students in the Courses in Civil, Mechanical, and Mining Engineering, and also for the purpose of relieving the "tabular view." But the crying defect in the Department equipment is the absence of an adequate storage battery from which perfectly steady currents may be drawn. I have heretofore furnished to you (at the request of the Chairman of the Visiting Committee) an estimate of the cost of an adequate storage battery, and I earnestly hope that money may soon be found for the purchase and installation of the battery, as I believe it would add a great deal to the effectiveness of the laboratories.

Special apparatus is also needed in the equipment, such as an electrostatic voltmeter reading to reasonably high potentials, apparatus for magnetic measurements, additional tools for the mechanician's shop, etc. An enlargement of the annual appropriation made to the Department, so that it will care for items of this character, is highly desirable.

Each of these laboratories needs more space. The Standardizing Laboratory is in very cramped quarters, and it seems to me that it could profitably occupy as much as twice its present allotment of space.

The Electrical Engineering Laboratory is a joint occupant in a main room of impressive size and shape, but a considerable part of the space in this room is occupied by the Institute electric power plant, and the laboratory is in possession of no more space than it needs in this room. There is a crying need for several additional smaller rooms for use in connection with the work of this laboratory, where apparatus may be set up for those extended tests which relate to many of the fourth-year theses and which are essential to the more substantial work of research carried on by advanced students.

The Department is also in need of one or more additional class-rooms assigned to its particular work. This large Department has only one class-room assigned solely to its own work,—all of its other class-rooms being subject to more or less constant use by other Departments, the assignments to which use

are entirely outside of the control of the Electrical Engineering Department. This condition interferes with the arrangement of suitable conferences and informal quizzes in connection with the laboratory work and lectures. The Department also needs a room assigned to use as a seminar room. This would be useful for advanced classes which often cannot be arranged to meet at inflexible hours arranged beforehand in a "tabular view," and it would also serve a good purpose as a room for holding informal weekly conferences of the teaching staff.

It is also to be earnestly hoped that the Department may soon be put in quarters where the professors can have more commodious and well ventilated and lighted offices, in order that consultations with students and others can be carried on under congenial conditions.

The instruction of advanced students may be profitably extended and developed in the Department. A demand exists in the circles of the electrical industries for young men with a wider vision and a keener analytical training than can be achieved in the undergraduate classes, and the abler men of each graduating class could wisely extend their study in the engineering school so as to embrace one, or even two, and in exceptional cases three, years of graduate study. This should be study in which the student is thrown more distinctly on his own responsibility and resources (stimulated by appropriate lectures and conferences) than is possible with the students in the larger undergraduate classes. It should include such an extent of broad, deep, and thorough study of some one subject, accompanied by a reasonable degree of independent research, as the number of years allotted to the work will allow; and this should be accompanied by the pursuit of one or two collateral branches with less intensiveness.

I believe our Department of Electrical Engineering is capable of carrying on this advanced instruction with marked success, and that doing this will be profitable to many able students who may pursue the work. It is also generally recognized that well-executed advanced instruction carried on in a depart-

ment reflects fire and enthusiasm upon the undergraduate students who are following the courses of the department.

Professor Clifford is now offering advanced lectures on the phenomena pertaining to alternating currents and high electrical potentials, and Professor Shaad is giving some advanced instruction relating to the design and operation of electric plants, besides the opportunities which exist for advanced work and research in the laboratories. This work can be extended with advantage to the students of the Department, and attention will be given to its development with full consideration of the best interests of the undergraduate work.

In connection with the development of advanced work of a character which will carry our students of established purpose and highest ambitions to a wider vision and keener training, it is desirable as occasion warrants to gather together an ideal equipment and library for research in all the branches of the wide field of Electrical Engineering. I referred to this last February in connection with the annual estimates for the Department, and shall have occasion to refer to it again. I will here point out that the electrical engineering library particularly needs more liberal support than has been possible to afford it from the annual department appropriations.

Finally, I wish to call your attention to the question of rank and pay. Men who hold the rank of Assistant Professor or Associate Professor in Electrical Engineering may be reasonably thought of as picked men of high ideals, possessing fine training and experience as men and engineers, whose ability and industry bid fair ultimately to lead them to more important distinctions and positions. Such men are not over-plentiful in engineering life, and when they are connected with industrial affairs they are likely to command unusual consideration and generous salaries, because they are capable of successfully supporting unusual responsibilities.

In considering the question of college salaries it is not commonly remembered that the men who hold the rank of assistant or associate professor in an engineering department bear re-

sponsibilities of a different kind, but which are certainly no less exacting when they are fully and properly executed, than those borne by the men of comparable age who are actively engaged in the industries. The men in academic life possess many compensations for the advantages which may be sought in engineering practice or the executive positions of industrial life, but the responsibilities required of them are heavy and the cost and effort requisite to maintaining an adequate knowledge of the progress of engineering in their respective branches are large. It seems to me that these are matters that could properly receive careful attention when fixing the rate of salaries of assistant professors and associate professor in the Department.

The Department has been the recipient of a number of gifts during the year. The following corporations contributed gifts: the American Telephone and Telegraph Company, the General Electric Company, the Holtzer-Cabot Electric Company, the Kellogg Switchboard and Supply Company, and the Western Electric Company. The important gift of a Sullivan Universal Shunt Box for use in insulation testing was made by Mr. Henry A. Morss (Course VI., class of '93).

DUGALD C. JACKSON.

DEPARTMENT OF BIOLOGY.

With the increase of knowledge, the changing needs of the times, and the development of the Institute as an educational organism, constant care is required to keep the curriculum of any Department as perfectly adapted as possible to the work which it has to do. In one of the youngest, most plastic, and most rapidly growing sciences, such as Biology, changes must be especially frequent, both to keep abreast with the times and to secure the most effective articulation of its work with that of other Departments. No changes of importance have recently been made in the curriculum of the first two years; but in the third and fourth, which had become unde-

sirably crowded with subjects, a choice must henceforward be made between professional studies in pure Biology or in applied, although, whichever line of work is chosen, some attention must still be paid to the other. In the third year these optional studies cover only six hours a week, but in the fourth year they amount to twelve hours. The choice allowed in the third year lies between Comparative Anatomy of Invertebrates and Surveying and Plotting. The former, while nearly indispensable for the student of pure Biology, is of comparatively little service to the sanitary or industrial biologist, for whom surveying and plotting is a general study of great value in those portions of his professional work where he must co-operate with sanitary engineers, landscape architects, and public health officials. In the fourth year the student will henceforward be expected to make a definite choice between studies in pure or applied Biology and to keep close to the line of his choice. In pure Biology he must pursue chiefly Zoölogy and Physiology; in applied Biology, sanitary or industrial branches. Through the former he should become fitted for investigation or teaching, through the latter for sanitary or industrial research and for participation in practical affairs connected with projects of sanitation, municipal sanitary establishments (such as purification plants for water or sewage), public health laboratories, the fermentation or food-preserving industries, etc. There is reason to believe that no institution in the United States now offers facilities superior to ours for training in these branches of applied Biology. Moreover, the maintenance of such courses and facilities supplements and strengthens the work of the Institute in Sanitary Engineering and Sanitary Chemistry. In both of these lines its leadership has long been acknowledged, and it was fortunate that when Bacteriology arose and the center of sanitary interest shifted to Biology the Institute was prepared to continue that leadership.

The development and differentiation of the curriculum just described demands more and better instruction; and if graduate work is also to be added (as is proposed in the new plans for

graduate students), more teachers, more room, and more apparatus will be required immediately. Without these the new work cannot be done. Even now, new apparatus estimated to cost $500 is needed for the best work in Microscopy; for that in Industrial Biology and Bacteriology a special room for experiments on a large scale is urgently required; larger annual appropriations for books and supplies are wanted in every sub-department; and one or two regular assistants for the elementary classes are a necessity. Most of the members of our staff are underpaid and have to add to their incomes in various ways in order to live in any comfort. The time has now come when a separate building ought to be provided for the various branches of our work. A Biology building, giving abundant light and air, and including appliances for research and instruction in Microscopy, General Biology, Zoölogy, Physiology, Bacteriology, Sanitary Science, Industrial Biology and Public Health Problems such as the Hygiene of Heating and Ventilation, School Sanitation, Industrial Hygiene, Factory Sanitation and other subjects; in other words, a building devoted to the investigation and the application of those sciences which deal directly with living matter and living things, would form a fitting component of a group of buildings for a school of pure and applied science, and would stand for that better conduct of life, that scientific humanism, which is and always must be the goal of scientific and technical education. For such a building and its equipment the sum of $100,000 would probably suffice, and I recommend that as soon as possible that sum be appropriated for the purpose.

The teaching staff of the Department has been somewhat changed during the year. Dr. Arthur W. Weysse, after several years of successful service as Instructor in Zoölogy, has withdrawn, owing to the heavy demands upon his time and strength at Boston University, where he is now Professor of Biology and in charge of the Department. Dr. Robert P. Bigelow will henceforth give instruction in Anatomy and Protozoölogy instead of in Theoretical Biology, the lectures in the

latter subject being now divided between Professor Winslow and Dr. Frederick A. Woods.

In addition to his regular duties, Professor Sedgwick has during the year made investigations of sanitary problems of public interest in Pittsburg, Penn., Jersey City, N.J., and Boston and Salem, Mass. He has also made, with the assistance of Professor Prescott, an elaborate investigation of, and report upon, the sanitary condition of the public water supply of Newport, R.I., for the Board of Health of that city.

Professor Prescott continues to act as adviser to a number of large establishments dealing in food and milk supplies or concerned in the fermentation industries, and from his close contact with these practical problems in the field brings to the technical instruction of our students in Industrial Biology and Bacteriology the latest ideas and an intimate knowledge of the processes actually employed. He still maintains a private laboratory (The Boston Bio-Chemical Laboratory) in which practical work in Economic Biology is continually going forward, and access to which forms an important educational asset for our students.

Professor Winslow has recently devoted much attention to Industrial Hygiene and Factory Sanitation, and some of the results of his experiences in that field have been immediately applied in his teaching, not only in our own classes, but through public addresses, and by a short series of lectures on Industrial Hygiene, given by invitation of the Department of Mining Engineering to students of that subject. He has also made sanitary investigations of importance in Jersey City, N.J., and Montreal, Canada. Perhaps most important, however, has been his continued service as Biologist-in-Charge of the Sanitary Research Laboratory and Sewage Experiment Station, a report upon the work of which immediately follows.

Mr. Earle B. Phelps, a graduate of the Institute from the Course in Chemistry and afterwards Assistant Chemist to the State Board of Health at the Lawrence Experiment Station and elsewhere, has from its beginning served with fidelity and

ability as Research Chemist and Bacteriologist at the Sanitary Research Laboratory and Sewage Experiment Station. In view of his good work and attainments Mr. Phelps has now been promoted to an Assistant Professorship of Research in Chemical Biology and, while most of his duties will still remain at the Albany Street laboratories, he will from time to time give instruction to our students and aid in directing their investigations.

Dr. Percy G. Stiles continues to give instruction in Physiology and Personal Hygiene, although since his promotion to an Assistant Professorship of Biology at Simmons College he is able to devote only a limited portion of his time to Institute work.

WILLIAM T. SEDGWICK.

SANITARY RESEARCH LABORATORY AND SEWAGE EXPERIMENT STATION.

In February of the present year another gift of $5,000, the fifth 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, and especially the purification of sewage "by cheap and simple methods before it is cast into rivers, harbors or lakes." Work has now been continued under this annual donation for four and a half years, and during all this time the principal task set before us has been steadily kept in view, namely the possibility of purifying "by cheap and simple methods" the sewage of large cities and especially the sewage of Boston. We have gone carefully over the whole field, considering the advantages and disadvantages of the various methods hitherto known and, having decided more than two years ago that the so-called "trickling," "percolating" or "continuous" filters, first introduced into actual municipal practice in England, seemed likely to offer the best solution for a great American seaboard city, we have since that time been making

elaborate tests upon large outdoor filters of this type, running these under actual conditions of winter and of summer weather, applying to one crude sewage, and to another sewage subjected to various preliminary treatments, and to both sewage distributed and aërated in various ways. During the last summer (1907) these large experimental filters were brought to rest, carefully dissected and studied in all their parts, and then reconstructed and started again in October upon a new, and, as is hoped, final series of tests.

Our experiments, an account of which is already in press, have led to conclusions of great interest, and to a demonstration of the practicability of purifying Boston sewage by comparatively "cheap and simple" devices before it is "cast into the harbor," namely by running it continuously and rapidly through trickling or percolating filters consisting essentially of heaps of small stones, and afterwards disinfecting the stream flowing away from these filters by the addition of a solution of bleaching powder. While trickling or percolating through such heaps of small and loose stones, organic matters in the sewage capable of quick decay are converted into fixed or stable bodies which do not readily rot. By the addition of a solution of bleaching powder any disease germs present are completely destroyed. Careful estimates have been made of the area of trickling filters required to purify the present discharge at Moon Island, and it appears that an area of fifty acres would suffice,—which area might conveniently be secured by taking a portion of Thompson's Island for the purpose. The cost involved in filtration and disinfection would be for the sewage of Boston proper about $250,000 annually, and when we remember that the city of Baltimore is about to embark upon a plan of sewage disposal of this same general character and at a relatively similar expense, it is clear that these estimates, although only provisional, are probably not very wide of the mark.

Professor Charles-Edward A. Winslow, Biologist in Charge, and Professor Earle B. Phelps, Research Chemist and Bacteriologist, have continued as heretofore in direct and active con-

trol of the work of the Station. Upon the former has fallen a large part of the laborious duty of planning the details of our researches as well as that of collating and digesting researches made elsewhere, together with the formal preparation of some of our reports. Professor Winslow devoted his whole time during the summer vacation to work at the Station, and, although much of his attention and energy is necessarily given throughout the rest of the year to his classes in the Institute, he has maintained with ability and devotion his connection with the Station. In addition to bacteriological investigations upon sewage he has made, at the instigation and cost of the National Association of Master Plumbers, a new series of tests upon sewer air as a carrier of bacteria.

Special mention deserves to be made of our experiments on the disinfection of imperfectly purified effluents, such as are frequently allowed to escape from sewage purification works. These experiments were begun at the Station by Professor Phelps more than a year ago, and were briefly referred to in my last report. The first results were brought together in a paper published by him in collaboration with Mr. W. T. Carpenter, Assistant at the Station, in the *Technology Quarterly* for December, 1906. The novelty and importance of the results attracted wide attention, especially because it had suddenly become desirable to secure in Baltimore and some other places a very high degree of sewage purification in order to comply with exacting legal requirements and to protect harbors from pollution. Our work in this direction has ever since been vigorously prosecuted and with increasingly interesting and promising results. We are now regularly disinfecting the effluents of trickling filters, and have also made experiments upon the disinfection of crude sewage. In the same line, and by means of his association with the State Sewerage Commission of New Jersey, Professor Phelps was fortunate enough to be able to carry on during the last summer a special experiment on disinfection, on a large scale, at Red Bank, N.J. Here well planned tests were successfully conducted under his direction

by Mr. Francis E. Daniels, recently a graduate student of Biology and now Assistant at the Albany Street laboratories. For a period of ten weeks an average discharge of about 260,000 gallons a day from the septic sewage tanks of Red Bank was regularly and systematically disinfected. This experiment is probably the most important, as to both duration and magnitude, hitherto made anywhere. Further work along the same line is now contemplated in Baltimore, an arrangement having been made under which Professor Phelps is to co-operate in certain special experiments at the Walbrook Testing Station of the Sewerage Commission of the City of Baltimore.

Professor Phelps's connection with the U. S. Geological Survey has been continued and has resulted in a careful study of the disposal of the waste liquors of a sulphite pulp (paper) mill. This work is nearly completed and results of practical value have been reached. His connection with the State Sewerage Commission of New Jersey has already been referred to above. In addition, he has made for that Commission an extensive inspection of the various sewage disposal works of New Jersey, upon which he has submitted a report, besides recommendations as to new or improved methods required in several places. Following his advice, a plant is now being installed at Cluckamin, N.J., for experiments to be conducted under his direction upon the purification of woollen mill wastes. He has also made an investigation of a typhoid fever outbreak in the State Hospital for the Insane, tracing it to a polluted water supply. From all this work in other states there flows back to our own work a fund of experience, of criticism and of information of the highest value.

Beyond the direct results of the work coming from the Sanitary Research Laboratory and Sewage Experiment Station, indirect consequences hardly less important are constantly appearing. Around the principal sewage problems as a center arise from time to time problems of interest and importance to our Institute students of sanitation and public health. The study of these associated questions is a stimulus and encourage-

ment to our young men who, by witnessing the more advanced work of their teachers, and by themselves participating in the simpler problems, enjoy an apprenticeship no less stimulating than profitable. And while it is true that the Albany Street laboratories are at no great distance from most of the other work of the Institute, it is nevertheless certain that a closer association with the Biological, Chemical and Sanitary Engineering Departments would be in many ways of material advantage. Much of the work done on Albany Street might as easily and more serviceably be done under the same roof with other Institute work; and this fact makes it all the more desirable that a building devoted exclusively to General Biology and to be known as the Biology Building—reference to which has been made above in my report upon the Biological Department—should include all possible facilities for continued experimentation upon the purification of sewage, the purification of water, the purification of milk, and upon similar subjects bearing upon Sanitary Science and the Public Health. Such a building should in fact be designed quite as much for the subjects of Sanitary Science and Public Health as for the underlying subdivisions of Biology.

I desire again to place on record the appreciation and gratitude of all who have to do with the Sanitary Research Laboratory and Sewage Experiment Station to the donor for its continued support; and I would respectfully suggest that steps be taken by the Corporation to recognize this so large and long-continued generosity by supporting and reinforcing the work in every possible way, especially by grants of money from the Institute chest. It is also greatly to be desired that all persons interested in the work of the Station shall come forward and aid in its support. If in any way larger sums of money are supplied, much more work can be done both in wider and more far-reaching experimentation and research in Sanitary Science and in the direction of publication and other forms of education in Hygiene and Sanitation.

W. T. SEDGWICK,
Director.

DEPARTMENT OF PHYSICS.

So far as concerns the immediate wants of the Department, there is nothing new to be said. A larger lecture-room and more recitation-rooms are sorely needed. Serious difficulty has been felt both last year and this from the fact that our largest physical lecture-room has not sufficient seating capacity for the class attending the lectures in Heat given in the third year. Should there be much further increase in the number of students, which seems not unlikely to be the case, judging from the size of the present second-year class in Physics, a repetition of the lectures may be forced upon us, in the absence of any room which will accommodate as many as three hundred persons. Such a repetition of the second-year lectures has been necessary for several years past.

It would be of great advantage if the various instructors in the Department of all grades had more time for study and research than is possible with our present force.

For two years past an elementary knowledge of the principles of Physics, together with some laboratory practice, has been required as a condition for entrance to the Institute, so that in the lectures given to the second-year class of last year it was possible for the first time to take advantage of this. In view of such preliminary study of the subject as the entrance requirement implies, the lectures in General Physics have undergone a very considerable revision, which is still in progress. It is found that certain topics may safely be omitted, leaving room for a more thorough treatment of others, and, what is of more importance, it is often possible to adopt more satisfactory methods of treatment than has previously been the case. A year hence, as a result of the novel and radical changes in the course in mathematics just introduced in the first year, we shall be able to some extent to make use of the methods of the Calculus, which will be of material advantage.

While this report in strictness relates only to the work of the

school year 1906–07, nevertheless reference ought here to be made to important changes in instruction which have come into effect with the beginning of the present year.

Early last spring Mr. Clifford M. Swan, Instructor in Physics, was granted leave of absence for a year in order to pursue an advanced course of study in Harvard University.

In May last the Department sustained a serious loss through the death by accident of Mr. Guy W. Eastman, a highly valued instructor who had before him every hope of a useful and successful career in his chosen profession.

Furthermore, just at the close of the last term, after many years of devoted and successful service to the Institute in all grades of instruction from Assistant to Associate Professor, Dr. George V. Wendell resigned his position, in order to accept an appointment as Professor of Physics and Head of that Department in the Stevens Institute of Technology, an institution which from its beginning has laid the same great stress upon the necessity of a thorough and complete training in Physics as an essential factor in the instruction of an engineer that has been insisted upon at this Institute. Greatly as the loss of Professor Wendell is to be regretted, it should still be a source of congratulation that a graduate from our own Course in Physics, and one who has been thus closely identified with the work of the Department, has been chosen to fill so influential and important a position.

These changes, of which only the first-mentioned could have been foreseen, necessitated an unexpected rearrangement of the work for the coming school year, now just begun. We were fortunate in being able to secure the partial services as Instructor in Physics of Dr. Herbert T. Kalmus, a graduate in Physics from the Institute and subsequently from the University of Zürich, likewise Research Associate in Physical Chemistry at this Institute; and the whole time of Dr. Raymond Haskell, who holds the degrees of S.M. and Ph.D. from this Institute. Drs. Kalmus and Haskell together with Mr. Newell C. Page and Dr. Daniel F. Comstock, also Instructors in the

Department, divide among them the recitation-sections of second-year Physics. Assistant Professor Drisko has been given general charge of this work, which is proceeding in a very satisfactory manner. For the time being I have personally assumed the duplicate course of lectures which during the preceding four years was given by Dr. Wendell.

Much important and valuable apparatus has been procured during the year for both lecture-room and laboratory use. Additions have been made to our large collection of vacuum tubes, including a Perrin-Thomson tube showing the negative charge of the cathode rays. The apparatus for illustrating the lectures upon works, energy, and power has been largely increased in the direction of mechanical and electrical machinery.

Following the established policy of maintaining an equipment of the highest grade suitable for general laboratory instruction, the three photometer rooms of the Laboratory of General Physics have been completely re-equipped at considerable expense with the most approved form of Hartmann & Braun photometer bars, Lummer-Brodhun and Bunsen photometers, amyl-acetate and candle standards with delicate double candle balances and other accessories. Every student taking the general course is now taught the principles of modern photometric practice, as applied particularly to Gas Photometry, with the most approved form of apparatus. A modern high-grade compound microscope with complete accessories has also been added, in order to provide those engineering students who do not obtain special instruction in Microscopy with facilities for obtaining skill in this class of micrometric measurements.

It has been found practicable by some duplication of apparatus to extend the arrangement tried last year with such success, of giving the third-year laboratory course in Heat simultaneously with the lectures on that subject, so that now students in all Courses prepared to combine this work do so at the beginning of the third year. A much keener interest in the

work has resulted from this closer relation between lecture and laboratory instruction. The laboratory work in Mechanics and Optics and the related course in Precision of Measurements have been put back into the second year for the Courses in Mechanical Engineering and Naval Architecture, a change long desired by this Department, so that at present the instruction in Physical Laboratory begins in the second term of the second year and continues in close touch with the work of the class-room for all Courses except those in Mining and Chemical Engineering.

The Optical Laboratory has been supplied with a new König spectrophotometer of the horizontal type, which is especially adapted to the investigation of the absorption spectra of liquids, and is in use in connection with a research in progress under the direction of Professor Goodwin on the absorption spectra of liquid ammonia solutions of the alkali metals. A rotating-sector spectrophotometer is much needed to complete our equipment in this line. Another important addition to this laboratory is the apparatus by Zeiss for the study of microscopic objects by ultra-violet light, from the gift of the late Mrs. Katharine Bigelow Lowell, the income of which is devoted to the purchase of physical apparatus. The ultra-violet microscope will be devoted to study and research work in charge of Professor Derr. The new Lumière autochrome plates, only now procurable, will enable us to make further additions to our valuable collection of photographs in natural colors.

For the Electrical Laboratory there has been puchased, among other apparatus, a Duddell Thermo-galvanometer for the study and measurement of very minute currents, telephonic and other.

In the Laboratory of Heat Measurements a great amount of time has been devoted by Professor Norton and his assistants to the development of the calorimetric apparatus used in testing fuels for thermal efficiency. The procedure urged by United States engineers and rapidly coming into use, which proposes the specification of fuel not by name or grade, but by its calo-

rific efficiency, has emphasized more than ever the necessity for accurate and easily operated apparatus for the determination of the heat of combustion of fuel; and the energies of the laboratory have been directed toward the increase of accuracy and efficiency in such combustion apparatus. Co-operating with Professor Norton, Mr. Emerson, Instructor in Heat Measurements, has devoted a large part of the summer to reconstructing certain details of the apparatus and accumulating data, which, it is hoped, will permit of a much closer determination than has heretofore been possible by giving an accurate value of the troublesome "cooling correction." Electric furnaces, which have been developed after a series of discouraging trials, can now be used and controlled over very wide ranges of temperature and give very satisfactory results in such work as the standardizing or comparison of high temperature pyrometers. One of the recording pyrometers, ordered some time since, has been received and is in use with classes for measuring and recording the melting and critical points of steel.

Much thesis work, taken chiefly by students of Departments other than Physics, has been arranged as usual. A determination of the loss by radiation from gas engine cylinders has been begun and carried successfully through its preliminary stages. Further work in the same line is expected this year. Thesis work upon fire-proofing, a subject not developed in detail at the Institute, has been undertaken in this laboratory by a candidate for an advanced degree in Architecture; and a candidate for an advanced degree in Metallurgy has also made use of our facilities. These facts will illustrate the kind of work which the Laboratory of Heat Measurements with its equipment for the maintenance and management of high temperatures is able to carry out.

The development of a new material for use in the art of fire-proofing, a material which is a substitute for wood, and which it is hoped may have an economic value as a means of diminishing loss of life and property by fire has been ac-

complished by Professor Norton under conditions which could hardly have been realized except for the existence of the Laboratory of Heat Measurements with its complete equipment and close relations with the other laboratories of the Physical and allied Departments.

CHARLES R. CROSS.

DEPARTMENT OF GEOLOGY.

Changes of personnel in the teaching staff of the Department of Geology have been numerous in 1907. After over thirty years of successful teaching, Professor W. O. Crosby was the first professor of the Institute to accept retirement under the Carnegie Foundation. He now is enabled to give all of his time to independent research, while retaining his office in the Department. Assistant Professor Douglas W. Johnson resigned his position, owing to the demands of his work at Harvard University. Dr. Reginald A. Daly has been appointed to a newly established Professorship of Physical Geology. Professor James F. Kemp of Columbia University has accepted the position of Lecturer in Economic Geology for 1907–08, and will direct the advanced courses formerly given by Professor Crosby. Mr. de Steiguer, assistant, was obliged to go west in March, and he was succeeded for the spring months by Mr. William G. Ball (M. I. T. '05), and for 1907–08 by Mr. Charles H. Clapp of the same class.

Two students took the degree of Bachelor of Science in Course XII. in 1907. The number of enrolments in subjects given by the Department for 1906–07 was 847, an increase of 24 over 1905–06. New graduate courses of research, partly for the Master of Science degree, have been established in "Geology of the Igneous Rocks," "Advanced Field Geology," "Advanced Economic Geology," "Chemical Geology and Mineralogy" and "Advanced Paleontology."

Through the kindness of the trustees of the Caroline A. R. Whitney estate, the Department will receive a sum of money

for the purchase of a modern seismograph, wherewith to register the vibrations of earthquakes. The instrument has been ordered, and will be mounted in a suitable locality near Boston. It is hoped that this gift may mark the foundation of a Research Laboratory of Physical Geology. In the spring of 1907 thirteen thousand dollars was raised by subscription from twenty-eight individuals and corporations, to equip an expedition for the exploration of the Aleutian Islands, under the auspices of the Department. This expedition was led by Professor Jaggar, and investigations were carried on for four months. Travel was by sailing-schooner, starting from Seattle May 20th, 1907, and returning to the same port on September 11th. The economic resources, minerals, rocks, insects, plants, and physical features of the islands were studied, and collections were brought back for investigation by specialists. This expedition marks a further advance toward the foundation of a research laboratory, one of the functions of which should be exploration of volcanic and seismic lands. A fund of five thousand dollars per year for five or ten years is needed to start the work of this laboratory, and to maintain research assistants. It is hoped that eventually money will be provided to build a geophysical observatory.

On October 1st, 1907, Professor Daly assumed his duties at the Institute, having resigned his position as geologist for Canada on the International Boundary Commission. The change was made on the understanding that the completion of his report for the commision should hold first place among projects for his research work in the laboratories of this Department. This final report will summarize the results of field and laboratory work of seven consecutive years which have been spent on the geology of the western Cordillera where it is crossed by the 49th parallel of latitude. The work is being carried on for the Canadian government. To facilitate the preparation of the report, Dr. W. F. King, the Canadian Commissioner, has generously permitted the entire rock-collection made during the boundary survey to be deposited in the

Institute laboratory. The collection consists of about two thousand specimens, representing practically all the formations occurring on the 49th parallel between the Pacific and the Great Plains. Dr. King has also loaned from his government department a number of valuable instruments which will be used in the study of the rock-collection; among these is a large model Fuess petrographic microscope, provided with an unusually complete amount of accessory apparatus. As at present planned, the report will consist of a volume of text and an atlas of about thirty large plates. It is expected that its completion will occupy another year of more or less consecutive work.

During the past summer, the mineralogical and petrographical collections received many specimens, collected in part by members of the instructing staff, and in part gifts from graduates and friends of the Institute. A fine suite of specimens, illustrating the minerals and ores of Cobalt, Ontario, and Butte, Montana, is perhaps the most important of these additions. Over two tons of specimens have been received. Such gifts are encouraging to the Department, for they indicate a real interest on the part of graduates and friends and not only make unnecessary the purchase of material from dealers at an exorbitant figure, but furnish specimens better adapted for use in the practical instruction of mining students. It is to be hoped that in future the graduates and friends of the Institute will contribute even more generously than in the past. To the equipment of the mineralogical and petrographical laboratory has been added a large polarizing microscope. This instrument is especially designed for refined work in mineralogical and petrographical research and is a distinct addition to the research equipment of the Department. Eventually several special attachments will be added to this microscope.

During the vacation, Assistant Professor Warren made two collecting trips to points of interest in New York State and Nova Scotia. He was also engaged in various pieces of professional work. Two papers were completed by him during the sum-

mer: one a "Study of the Mineralogy and Petrography of Iron Mine Hill, Cumberland, R.I.," which is to appear in the January number of the *American Journal of Science;* the other a shorter paper on "Occurrence of the Rare Mineral Species, Hortonblite, at Cumberland, R.I.," to appear in the January number of the *Zeitschrift für Krystallographie und Mineralogie;* a third paper is practically completed on the "Metamorphism of the Cumberland Gabbro"; this will, however, not be published until later. The class in Mineralogy of the present year numbers approximately seventy-five men. The sections of this class for entirely successful work in a subject like Mineralogy are too large, unless two instructors are present. At the present time, the assistant can devote only a small portion of his time to Mineralogy, and it is recommended that an additional assistant or possibly an instructor be appointed in the future to co-operate in the instruction in Mineralogy. The same man would be available and very serviceable in the petrographical laboratory. Professor Warren considers it desirable to increase the available funds of the Department to such an extent as to permit of the giving of a summer school in Geology, Mineralogy, and Lithology. It is also to be hoped that some way may be found to provide a permanent fund, the income of which might be used for defraying the expenses of such students as are unable from lack of funds to attend. The advantages of summer school work of this kind cannot be too strongly emphasized. It is a matter of great importance to the economy of time during the winter semesters that such subjects as Geology, Surveying and Mining become required summer studies. If this were done in the Institute, much of the overcrowding of courses in the third and fourth year would be avoided.

Among the gifts of fossil collections received by the Department during the past year, Dr. Shimer wishes to acknowledge especially the large collection of tertiary shells from Plum Point, Maryland, given by Mr. Fred L. Franks, a former student of the Institute. Another gift by the Philadelphia Acad-

emy of Sciences consists largely of lower tertiary forms. These collections fill a gap in the index fossil series and also give material for research to graduate or fifth-year students. The book cataloguing of the fossils of the Department is almost complete and will soon be transferred to a card system for greater convenience in use. This will be an important aid to both instructors and students. A portion of the past summer Dr. Shimer spent in giving two courses in the Yale University summer school.

Dr. Loughlin has assumed charge of the courses in third-year Field-work and Building Stones and will co-operate with Professor Kemp in the advanced courses in Economic Geology. He is, this year, giving a course in General Geology at Tufts College in place of Professor J. S. Kingsley, who is on a year's leave of absence. Owing to increase of duties, he has resigned his position as compiler of foreign bibliography for Economic Geology to Mr. Charles H. Clapp.

Mr. Charles H. Clapp, assistant for the year 1907–08, comes from North Dakota, where he has been since graduation holding the positions of Assistant State Geologist and Instructor of Mining and Geology in the State University.

The Department acknowledges gratefully a gift of money from Mrs. William Barton Rogers, whereby it has been possible to bind all the unbound serial volumes in the library.

THOMAS A. JAGGAR.

DEPARTMENT OF NAVAL ARCHITECTURE.

The most notable change in the Department of Naval Architecture during the year past was a change in the course of study by which only one year of Modern Language is required; this change is parallel to those made in two of the leading Engineering Courses. Of the time thereby released somewhat more than half has been used for strengthening the technical side of the course and the remainder is applied mainly for providing options in general culture courses

The time available for technical purposes has been devoted to Mathematics, to Applied Mechanics, and to more strictly professional subjects. One great advantage obtained is the advance of Applied Mechanics to the second year, so that this fundamental subject may be kept well in advance of its application in other professional branches. It has also become possible to take up the special professional work of the Course in the second year, an arrangement which is doubly advantageous in that students come earlier to take interest in their special profession and a better foundation is laid for future work. The Department partakes in the advantages that come from increase of time and better facilities in Steam Engineering and laboratory work, which have direct bearing on a side of their profession which sometimes fails of recognition, namely Marine Engineering, for it has always been held that the best design of a ship demands a knowledge of the construction of both hull and machinery. A feature that may receive mention is the addition of the design of marine turbines; this was taken up last year and will receive additional attention this year. It is largely to facilitate this work that the text-book in Thermodynamics was rewritten, and that a chapter was added on steam turbines. Also an entirely new and important table has been computed to give rapid and accurate solution of the problems involved.

The Department has from time to time made important tests on steamships at sea, to the ends that students may become familiar with the conditions of that service and that information may be obtained that shall be useful in our instruction and to the profession. A very complete test was made in April on the steamship *Governor Cobb*, belonging to the Eastern Steamship Company, the first seagoing turbine steamer to be placed in service in America. Determinations were made of the power, speed, and economy, including the influence of the auxiliary machinery. A part of the material from the test furnished basis for theses for students of the graduating class, and a report has been presented to the Society of Naval Archi-

tects, etc. For the purpose of measuring the power a set of Denny-Johnson torsion-meters was borrowed from the Navy Department, this being the first use of that instrument in this country. Through the generosity of friends of the Department it has been possible to place an order for a set of torsion-meters of that type for the Institute, which will be set up in the Department for class instruction, and arrangements have been made with the Company mentioned to give the students experience in their use at sea.

Besides the torsion-meters just mentioned, the equipment of the Department has been enlarged by the addition of a machine for profiling ships' models and a machine for drawing frame line on models. The first greatly facilitates the cutting of models by the students, and the second is useful in laying out the plating on models.

For several years the Department has offered facilities for taking the special work of the Course in one year to graduates of other Engineering Departments of the Institute or to graduates of other technical schools having adequate preparation. This year, for the first time, advantage has been taken of this opportunity by students who come from another school, and it is to be expected that this method of using the facilities of the Institute will become better recognized in the future.

Since the institution of the Course for Naval Constructors it has been expected that the normal size of classes would be two or four, but the Navy Department has found it necessary to send larger numbers, classes of six or eight being most frequent; this year the entrance class numbers six and there are sixteen officers in the Course at the present time. The Course for that Corps has become so well systematized that for several years, it has received changes only as the growth of the Institute has made them necessary or advisable.

The following changes have occurred in the instructing staff of the Department: Mr. Charles F. Willard and Mr. John A. Ross have resigned; Mr. Harold A. Everett has been appointed Instructor in Marine Engineering, and Mr. Herman

R. Hunt Instructor in Naval Architecture; Mr. Arthur H. Jansson and Mr. Harold S. Wonson have been appointed Assistants in Naval Architecture; Messrs. Hunt and Jansson are assigned work in connection with the Course for Naval Constructors.

C. H. PEABODY.

DEPARTMENT OF MATHEMATICS.

During the past year important progress has been made in the revision of the general mathematical courses. First-year work this fall is based on the new "Course in Mathematics for Students of Engineering and Applied Science," by Professors Woods and Bailey, Volume I. dealing with Algebraic Equations, Functions of one Variable, Analytic Geometry and the elements of the Differential Calculus. The work opens with a chapter on elimination and determinants, followed by one on graphical representation. The remainder of the first term is occupied with a discussion of polynomials and their derivatives. An equal amount of time in the first term is still devoted to Plane Trigonometry.

In the second term of the first year, with a double allowance of time, the course includes as its principal subjects selected algebraic functions and their graphs, curves and their equations, differentiation of algebraic functions, change of co-ordinate axes, the general equation of the second degree, elementary transcendental functions, the parametric representation of curves, polar co-ordinates and curvature. The course as a whole aims to deal with problems of gradually increasing difficulty by the most advantageous and economical methods, irrespective of the traditional, somewhat arbitrary separation of these methods into distinct groups. By this means the student is expected to gain better judgment in the selection of mathematical methods, and better comprehension of the fundamental principles of Analytic Geometry and Calculus by reason of the longer period during which he employs them.

Professors Woods and Bailey are now engaged in the preparation of Volume II., which will, as soon as practicable, form the basis for second-year mathematical instruction.

The Department has been materially strengthened for the present year by the accession of Associate Professor Edwin B. Wilson, from the Faculty of Yale University, and of Dr. Henry B. Phillips and Dr. Nels J. Lennes, from the Universities of Cincinnati and Chicago, respectively.

The collections of the Department have been increased by the purchase of books and lantern slides adapted for use in the course in History of Science.

H. W. TYLER.

DEPARTMENT OF DRAWING AND DESCRIPTIVE GEOMETRY.

During the past year there have been two changes in the instructing staff of the Department. Mr. Samuel E. Gideon, who last year divided his time between teaching in the Drawing Department and study in the Architectural Department, has been made a regular Instructor and will give full time to the teaching of Drawing and Descriptive Geometry. Mr. John Mills has been made Instructor, giving half time to the Department and half time to study in the Department of Electrical Engineering. Mr. Mills is a graduate of the University of Chicago, Class of 1901, and was a Fellow in Physics at the same institution the following year; he was a Fellow in Physics at the University of Nebraska for the year of 1902–03, receiving the degree of A.M. from that University in 1904; since 1904 he has been Instructor in Physics at Western Reserve University, where he also developed a course in Mechanical Drawing and Descriptive Geometry.

During the summer of 1907 Professor Adams issued a second and enlarged edition of Part I. of his Descriptive Geometry; this book now covers the work taken by the first-year class. Professor Adams has in preparation Part II. of

his Descriptive Geometry, which is intended to cover the work of the second-year class in this subject.

On account of the larger number of college men entering the Institute in October, 1907, it was found necessary to divide the special class in Descriptive Geometry for college men into two sections. Mr. Bradley was asked to co-operate with Mr. Kenison in giving this instruction.

The use of good text-books facilitates the work of the teacher, but is likely to make his instruction more formal and stereotyped. To counteract such a tendency it is the intention of the Department so to arrange the course that new problems and new applications of the geometrical principles will be introduced each year. Frequent meetings of the instructors have been arranged for the coming year with a view to interesting all in the development of the course and to give opportunity for free criticism and suggestion. The personnel of the Department is now admirably adapted for such conferences, four of the instructors having had considerable experience in teaching at other colleges and schools.

ALFRED E. BURTON.

DEPARTMENT OF MECHANIC ARTS.

The total number of students receiving instruction in the Mechanical Laboratories is two hundred and eighty-six. Some attend in more than one class; the numbers attending in the several subjects are as follows:—

Carpentry and Wood Turning, II.	63
Joinery and Pattern Work, VI.	32
Forging, II., XIII.	71
Metal Turning, VI., VIII., X.	62
Chipping and Filing, II., XIII.	80
Machine-Tool Work, II., XIII.	66
Total, all classes	374
Students taking work in two or more classes and counted more than once	88
Total number of students	286

The total number of students attending last year was two hundred and forty-six. Many students have been excused from attending the Carpentry, Wood Turning and Forging classes, and a few from Pattern Work. The number of excuses granted in these earlier subjects is still on the increase, but is not yet sufficiently large to warrant giving courses in Advanced Wood Work. Such advanced work will, however, be desirable in the near future.

The attendance in the Summer School was sixty-six, an increase of ten over that of last year. The numbers attending in the several classes were:

Wood Work	15
Forging	16
Chipping and Filing	8
Machine-Tool Work	27
Total	66

The proportionally large attendance in Machine-Tool Work continues, due to the desire on the part of many students to anticipate the Mechanic Arts of the senior year, thus obtaining additional time for thesis or other departmental work.

The following new machines and apparatus have been added to the equipment of the Machine-Tool Laboratory:—

A Wright and Henry two-spindle, high-speed, upright drill; an American oil tempering furnace; a Bowser two-compartment oil cabinet. In addition the following new machines have replaced older machines of the same make: a Brown and Sharpe No. 2 universal grinding machine, a 14-inch Pratt and Whitney engine lathe and a Becker-Brainard universal milling machine. A new 14-inch engine lathe with a geared headstock has been ordered to replace one of the old 14-inch engine lathes and a new high-speed planer has been promised the Department. Some new small tools have been added to the equipment of the Wood Working Laboratory.

To maintain the required high standard in Machine-Tool Work, thirteen engine lathes, five speed lathes and a planer purchased in 1876 should be replaced at once with modern ma-

chine tools, some of which should be large and powerful enough to illustrate the use of high-speed tool steels. A small radial drill and an additional universal milling machine are needed to carry on the class work successfully.

The installation of an automatic screw machine would enable instruction in and operations of automatic machines to be given, which would be a valuable addition to our course.

Since the improvements in the Machine-Tool Laboratory were made mainly through donations and exchange of new for old machines at very liberal prices, it is hoped that funds may soon be forthcoming for modernizing the remaining old equipment.

The fixed equipment in the Forging Laboratory is now nearly worn out and can be kept in proper working condition but a few years longer. Unless its location is soon to be changed, a modern equipment should replace the present one. Six new anvils and thirty-two new tool benches are much needed.

Foundry Work is now required in Course II. and in one of the options in Course III.; the regular work of Course II. will not, however, begin until the school year 1909–10, when an entirely new laboratory should be ready. The foundry benches made in 1883 are now badly rotted, and the cupola furnace, purchased in 1876, is nearly worn out and is so small that it is exceedingly difficult to obtain good working results. The stack is so badly corroded that it cannot last more than one year longer. For these reasons it is earnestly recommended that new benches and a new melting plant be installed during the coming summer.

The Mechanical Laboratory building is, both externally and internally, in better condition than formerly; new floors in the Machine-Tool and Wood Turning Laboratories are needed, the present ones 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, which was installed in haste in 1884, should be replaced by a modern electric-lighting system.

Two assistants have resigned: Marshall G. Merriam, Assistant in Chipping and Filing, has taken the position of Director of Evening School Work of the Providence Young Men's Christian Association; Oscar W. Northrup, Assistant in Machine-Tool Work, has taken the position of Assistant Superintendent of the Chandler Planer Co.; Ernest Curley, a former student in Drawing and Mechanic Arts, has been appointed Assistant in Machine-Tool Work; and Alfred R. Hunter, a former special student in Mechanical Engineering with considerable practical experience, has been appointed Assistant in Chipping and Filing.

PETER SCHWAMB.

DEPARTMENT OF ENGLISH.

The English Department has during the past year put into operation a new plan of grading the students in first-year work. In the tabular view the sections are divided into three large groups, and in each of these groups the sections have been graded according to the proficiency shown in their entrance examination papers and in the first written exercises of the term. This affords opportunity for adjusting the work of any given class to what are practically the needs and capacity of all the students. Much effort is likely to be wasted in any college first-year class on account of the widely varied training of boys who come from schools of unequal efficiency. It is not possible entirely to overcome this difficulty by any grading founded upon entrance marks, yet that test is sufficiently accurate to give results better than those possible under old methods. The system becomes much more valuable, moreover, when it is applied to the second term. Here the grading of classes is guided by the results of the first term. Sections able to advance rapidly are taken forward, while in those which must go slowly this method makes possible that slow and gradual progression which is not practical when the class has an upper half or third impatient to advance. As the

system is used and developed, it seems likely to be of much value in the line of economy and efficiency.

The Department has in foreign students a problem which becomes each year more complicated. While theoretically every student admitted to the Institute understands and speaks English, it has more than once happened that an instructor has found it necessary to make explanations to especial students in French, Spanish, or German. The Department does not include a master of Oriental tongues, and since to the Institute come every year a number of students born to a variety of languages of the East, the matter is one which sometimes requires no little care.

The new system of entrance examinations has thus far worked excellently. The results of the freer and less mechanical literary training in the secondary schools made possible by the change in the Institute requirements are already beginning to show; and it is to be hoped that in the future this will become more and more marked.

To the staff has been added as Assistant Mr. Allen French, of the class of 1892, Course IX., the first Institute graduate to come into the Department. Mr. French is known as the author of a number of books, and has practical knowledge of the subjects which he teaches. This addition to the force is in part made necessary by the steady increase in consultation and conference work which distinguishes the English work in all its branches.

ARLO BATES.

DEPARTMENT OF HISTORY AND POLITICAL SCIENCE.

For several years a considerable amount of written work has been required in first-year United States History, with two objects in view: first, to ensure regular and due apportionment, week by week, of the time allowed for preparation; and, secondly, to give students needed practice in English composition. In both of these respects the plan has produced good results.

In second-year European History an increased allowance of time for preparation has already been made in the Courses in Civil and Mechanical Engineering and Naval Architecture, to which the Course in Electrical Engineering will be added next year. Accordingly, beginning next year, the same scheme of written work will be introduced in European History for students in these Courses, and subsequently for other students in case additional time for preparation is provided for in their respective Courses.

The courses in the History of European Civilization and Art have profited during the past year by a large increase in illustrative material. In addition to the extensive collections of the Department of Architecture, the series of photographs and of lantern slides of sculpture, paintings, maps, etc. which is being specially formed with reference to the needs of these courses has been much enlarged and now numbers upwards of six thousand. The increase in the collection of lantern slides is particularly welcome, since the efficiency of lectures dealing with matters of art is necessarily dependent upon adequate illustration. The photographs are at present being arranged and catalogued. Their usefulness is somewhat hampered by insufficient storage space, but it is hoped that additional cabinets may soon be provided.

Besides the two longer courses in this subject, planned with special reference to the needs of students in the Department of Architecture, an elective course on "European Civilization

and Art in its most famous Epochs" was given last year for the first time. In this course, which is intended for students other than those in the Architectural Department, the aim is to describe in outline the conditions and dominant forces of civilization in a few of its more brilliant periods, and to show characteristic examples of their art. Particular attention is given to making clear the elements of the great architectural styles.

CHARLES F. A. CURRIER.

DEPARTMENT OF ECONOMICS.

The Department of Economics has been called upon to co-operate this year in the establishment of a new and promising experiment in practical sociology. Professor Carroll W. Doten, in addition to his regular duties at the Institute, is acting as head of the Research Department recently established at the School for Social Workers in this city. Under his supervision three subjects are being studied, namely: (1) co-operation in its various forms; (2) seasonal and irregular employments; and (3) inebriety. This last subject is being approached from two points of view, or rather is the point of departure for two separate lines of investigation, namely: the study of individual cases and the methods of treatment in hospitals, penal institutions, and under the probation system; and a careful inquiry into the effects of license and no-license in several Massachusetts cities under our local option law.

D. R. DEWEY.

DEPARTMENT OF MODERN LANGUAGES.

Since I rendered my last annual report, the requirements in Modern Languages have been diminished for undergraduates in the Courses in Electrical Engineering and Naval Architecture. In five of the thirteen Courses but one language (above elementary grade) is now required for graduation, and

this language is left to the choice of the student. As the language requirements diminish, the average grade of the Courses tends to rise. In the Course in Electrical Engineering a year of French II. with a term of French III. has been substituted for a year of French II. and a year of German II. A similar change is to be expected in one or more other Courses. For the present year the Department is giving instruction in German I. to two sections, numbering together 39 pupils.

The work of the Department and its distribution among the Subjects is shown in the following table:—

Subject.	Sections.	Students.
Italian	1	3
French II.	10	243
French III.	2	8
French Colloquium	1	23
German I.	2	39
German II.	14	167
German III.	1	23
German Colloquium	2	26
Spanish I	2	56
Spanish II.	2	7
Spanish Option	1	15
Totals	38	610

Size of Average Section	16.2
Number of Students taking French	274
Number of Students taking German	255
Number of Students taking Spanish	78
Number of Students taking Italian	3

Last year the average section in Modern Languages numbered 18 students. This year it comes within two of that number. There are still four sections that number more than 25. Fifteen is considered a proper maximum.

As the time allowed to Modern Language study is diminished, the instruction should, if possible, be correspondingly increased in effectiveness. The present comparative smallness of the sections, allowing a closer contact between the students and the instructors, together with the attendant rise in the grade of the courses, points to a stronger personal influence, and

suggests a higher grade of work, on the part of the instructors; and may warrant or call for an increase in the salaries paid or allowed them. To provide for such an increase without augmenting the budget of the Department, it may be well to take advantage of the next vacancy in the instructing staff to make a permanent reduction of its force.

The experiment of having summer reading in foreign languages, as well as in English, was repeated last year with the results indicated in the following table:—

Year.	No. of Reports Received.	No. of Foreign Books Read.	No. to Every 10 Students.	
			1906.	1907.
First	246	30	1.17	1.22
Second	149	20	1.29	1.34
First and second . .	395	50	1.23	1.27

JOHN BIGELOW, JR.

The Society of Arts.

To the President of the Massachusetts Institute of Technology:

Sir,—From time to time it is well to pause to consider the objects of our endeavor and how far we are attaining them. In the "Objects and Plan of an Institute of Technology" (Edition 2, 1861), President Rogers points out the connection between industrial progress and an enlarged acquaintance with the objects and phenomena of nature and with physical laws, and he speaks of the benefit which the most enlightened communities of Europe have obtained from this practical co-operation of education and the arts by the establishment of museums, societies, and colleges of technology. He says: "With the view of securing the great industrial and educational benefits above alluded to, it is proposed to establish, on a comprehensive plan, an institution devoted to the practical arts and sciences, to be called the Massachusetts Institute of Technology, having the triple organization of a society of arts, a museum or conservatory of arts, and a school of industrial science and arts."

It will be seen that in the plan the Society of Arts was placed first, and in regard to it President Rogers says that "under the first of these characters" the Institute would form itself into a department of investigation and publication intended to promote research in connection with industrial science by the exhibition at the meetings of the society of new mechanical inventions, products, and processes, by written and oral communications and discussions, as well as by more elaborate treatises on special subjects of inquiry. Another line of activ-

ity proposed was the publication of a series of reports exhibiting the conditions of the departments of industry, with the progress of practical discovery in each and the discussion of the scientific questions involved. In order to carry out these plans for publication, it was proposed to found a journal, which, it was hoped, would be a powerful means for advancing the interests of the industrial arts and practical education.

With these plans the Society of Arts was founded, and it is with these objects in view that we have continued our activities until the present day. Advance in complexity and specialization of the various arts and sciences have resulted, however, in the formation of many special societies and in the publication of journals devoted to narrow lines of science and industry. There still remains, however, in every community the need of bringing to the attention of those who are not specialists the advances in arts and sciences which may have an influence upon the life of the people. This function may very well be filled for Boston by the Society of Arts. That we are accomplishing this object to some extent is shown by the gratifyingly large attendance in our meetings.

We have in the *Technology Quarterly* a journal which aims to fulfil the objects of the founder in regard to publication. This is done in two ways: first, by printing the proceedings of the Society of Arts, and so far as possible publishing in full the communications that have been presented to the Society; second, by publishing original papers, giving the results of investigations carried on in the laboratories of the Institute. In fulfilling the second function the *Technology Quarterly* is hampered by two circumstances, the most serious of these being that the investigators generally desire to publish their results in journals devoted especially to the sciences or arts to which they appertain. In order that the *Technology Quarterly* might be more truly representative of the work done in the Institute, a special committee of the Faculty and the Board of Publication, sitting as a joint committee, recommended the following resolution:—

That in future every member of the instructing staff be requested to send to the Editor of the *Technology Quarterly* a full and exact title of every volume or paper published by himself as soon as this appears. With such title he shall also be requested to send a concise and comprehensive abstract or description of the volume or paper, and if possible a copy of the same as printed. Some papers might, perhaps, be reprinted in the *Quarterly*, but in general only the title and abstract will be given.

This resolution was adopted by the Faculty, and in co-operation with the Editor the Faculty Committee on Publications have sent out circulars in pursuance of the above resolution, and this department of titles and abstracts appeared for the first time in the *Technology Quarterly* for June, 1907.

The second difficulty is that lack of sufficient funds makes it impossible to print in full the results of many investigations, which consequently appear elsewhere.

During the past year the Editor has been fortunate in securing an unusually large number of papers read before the Society for publication in the *Quarterly*, and also a number of papers presented to classes of students by distinguished visitors. Besides these, several of the departments have made valuable contributions, and the book reviews continue to be an interesting feature.

During the year there have been thirteen lectures delivered before the Society, as follows:—

October 28, 1906. Dr. George W. Pierce, "The Wave Lengths in Wireless Telegraphy."

November 8, 1906. William Lyman Underwood, "The Work of the River Drivers in the Maine Woods."

November 22, 1906. Dr. George A. Soper, "The Air of the New York Subway."

December 13, 1906. A. E. Brown, "The Application of Hoisting Machinery to Shipbuilding."

December 27, 1906. Richard L. Humphrey, "The California Earthquake."

January 10, 1907. H. E. Warren, "The Governing of High Pressure Water Wheels."

January 24, 1907. Dr. Walter E. Winship, "Storage Battery Regulations."

February 14, 1907. F. L. DuBosque, "The Marine Interests of a Railroad."

February 28, 1907. Edward S. Cole, "Water Works Losses, and the Use of the Photo-Pitometer."

March 14, 1907. Professor A. H. Sabin, "Paint as a Preservative Coating."

March 28, 1907. Dr. L. A. Bauer, "Recent Results of Terrestrial Magnetic Observations."

April 11, 1907. Hon. Willard Howland, "The Cape Cod Canal."

April 25, 1907. Frank M. Gilley, "Preparatory Trade Instruction in Holland, and the Instrument Makers' School in the University of Leyden."

May 9, 1907. W. R. Warner, "The Panama Canal."

The meetings have been advertised, with two or three exceptions, in the *Saturday Evening Transcript* on the Saturday preceding the lecture, but it is questionable if the attendance has been largely increased in this manner.

The attendance at the meetings has been comparatively good, the smallest number about twenty-eight and the largest one hundred and forty. Sixty seems to be the average attendance.

The membership of the Society has been decreased during the past year by ten. One new member has been elected and one cannot be found, no address being known. At present there are on the books of the Secretary three hundred and six names. Of these, fifty-four are in arrears to the extent of two years of more, the sum total of the delinquent dues amounting to $774. Since September, $921 have been collected—$729 dues of the current year and $192 arrears, varying in sums from $6 to $24. A personal letter of appeal has been sent to each of the delinquents, and it is believed that persistent efforts will result in the collection of at least half of the amount still due.

For the Executive Committee,

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

Publications.

CIVIL ENGINEERING.

GEORGE F. SWAIN.—Report to the Massachusetts Railroad Commission on Steam Railroad and Street Railway Bridges in Massachusetts. In *Report of Railroad Commissioners for* 1907.

FRANK P. MCKIBBEN.—Tension Tests of Steel Angles with Various Types of End Connections. Presented to American Society for Testing Materials, June, 1907. *Engineering News*, 1907.

GEORGE E. RUSSELL.—Notes on Hydraulics. Prepared for the use of students at the Institute.

MECHANICAL ENGINEERING.

G. LANZA.—Some Tests of Full-size Locomotive Connecting Rods. *Proceedings American Society for Testing Materials*, 1907.

G. LANZA.—Report of Committee on Standard Methods of Tests. *Proceedings American Society for Testing Materials*, 1907.

G. LANZA.—Discussion of "A Plan to provide a Supply of Skilled Workmen" by M. W. Alexander. *Proceedings American Society of Mechanical Engineers*, 1906-07.

C. F. PARK.—Discussion of "College and Apprentice Training" by J. P. Jackson. *Proceedings American Society of Mechanical Engineers*, 1906-07.

CHEMISTRY AND CHEMICAL ENGINEERING.

H. P. TALBOT and A. A. BLANCHARD.—Electrolytic Dissociation Theory. Second Edition. New York, Macmillan Co., 1907.

H. P. TALBOT.—See A. G. Woodman.

A. A. NOYES.—Institute Graduates at German Universities. *Technology Review*, Vol. VIII., No. 2, pp. 197-205.

W. H. WALKER.—The Chemistry of Cellulose. *Journal Franklin Institute*, Vol. CLXIV., p. 131. *Textile Colorist*, Vol. XXIX., p. 242.

W. H. WALKER.—The Annealing of Sterling Silver. *Journal of the American Chemical Society*, Vol. XXIX., p. 1198.

W. H. WALKER (with ANNA M. CEDERHOLM and L. N. BENT).—The Corrosion of Iron and Steel. *Journal of the American Chemical Society*, Vol. XXIX., p. 1251.

W. H. WALKER and COLBY DILL.—The Effect of Stress upon the Electromotive Force of Iron. *Transactions of the American Electrochemical Society*, Vol. XI., p. 153.

W. H. WALKER (with COLBY DILL).—The Influence of Stress upon the Corrosion of Iron. *Proceedings of the American Society for Testing Materials*, Vol. VII., p. 150.

HENRY FAY.—Determination of Sulphur in Pyrite. *Technology Quarterly*, Vol. XX. (1907), p. 27.

HENRY FAY.—Tellurium-Tin Alloys. *Journal of the American Chemical Society*, Vol. XXIX. (1907), p. 1265.

A. H. GILL.—A Comparison of Apparatus for Testing the Liability of Oils to produce Spontaneous Combustion. *Journal of the Society of Chemical Industry*, Vol. XXVI., p. 185.

A. H. GILL (with P. C. MCILHINEY, A. C. LANGMUIR, MAXMILIAN TOCH, and MAX WALLERSTEIN).—Report of the Sub-committee on Shellac Analysis. *Journal of the American Chemical Society*, Vol. XXIX., p. 1221.

A. H. GILL (with CHARLES R. HAYNES).—The Probable Efficiency of Accidental Gas Explosions. *Journal of the American Chemical Society*, Vol. XXIX., p. 1482.

A. H. GILL.—Engine Room Chemistry. New York and London, Hill Publishing Company, 1907, 8vo, p. 187.

M. S. SHERRILL (with F. M. EATON, A. MERRILL, and D. E. RUSS).—Equilibrium Relations of Chromates in Solutions. *Journal of the American Chemical Society*, Vol., XXIX. (1907).

E. H. RICHARDS.—Air Supply Examination. *Papers and Reports of the American Public Health Association*, Vol. XXXII., Part II. Meeting of 1906, published in 1907.

E. H. RICHARDS.—Sanitation in Daily Life. Whitcomb & Barrows, November, 1907.

E. H. RICHARDS.—Chemistry of Cooking and Cleaning. New Edition. 1907.

E. H. RICHARDS.—Address, Association of Collegiate Alumnæ, Quarter Centennial Meeting. Desirable Tendencies in Professional and Technical Education. *Association of Collegiate Alumnæ Magazine*, Anniversary number, 1907.

A. G. WOODMAN and H. P. TALBOT.—The Fluorine Content of Malt

Liquors. *Journal of the American Chemical Society*, Vol. XXIX., p. 1362.

A. A. BLANCHARD.—Inorganic Preparations. A Laboratory Course in the Chemistry of the Metallic Elements. 8vo. p. 80. Printed for students' use, not yet published.

A. A. BLANCHARD.—See H. P. Talbot.

R. S. WILLIAMS.—Ueber die Legierungen des Antimons mit Mangan, Chrom, Silicium und Zinn; des Wismuts mit Chrom und Silicium und des Mangans mit Zinn und Blei. *Zeitschrift für anorganische Chemie*, Vol. LV. (1907), I.

E. B. SPEAR.—Die katalytische Zersetzung des H_2O_2 unter hohen Sauerstoffdrucken. Doctor-dissertation, Heidelberg University, 1907.

E. B. SPEAR.—The Catalytic Decomposition of Hydrogen Peroxide under High Pressure of Oxygen. *Journal of the American Chemical Society*, 1907.

RESEARCH LABORATORY OF PHYSICAL CHEMISTRY.

Serial Publications of the Research Laboratory.

No. 15.—The Specific Heat of Solids at Constant Volume, and the Law of Dulong and Petit. By G. N. Lewis. *Journal of the American Chemical Society*, Vol. XXIX., pp. 1165–1168, 1907.

No. 16.—On the Density, Electrical Conductivity, and Viscosity of Fused Salts and their Mixtures. By H. M. Goodwin and R. D. Mailey. *Physical Review*, December, 1907.

No. 17.—Outlines of a New System of Thermodynamic Chemistry. By G. N. Lewis. *Proceedings of the American Academy of Arts and Sciences*, Vol. XLIII., pp. 259–293, 1907.

No. 18.—Solutions of Metals in Non-metallic Solvents. I. General Properties of Solutions of Metals in Liquid Ammonia. By C. A. Kraus. *Journal of the American Chemical Society*, Vol. XXIX., pp. 1557–1570, 1907.

No. 19.—The Electrical Conductivity of Aqueous Solutions. *Publications of the Carnegie Institution of Washington*, No. 63, pp. 1–352, 1907. Part I., by A. A. Noyes; Part II., by A. A. Noyes and W. D. Coolidge; Part III., by W. D. Coolidge; Part IV., by A. A. Noyes and A. C. Melcher; Part V., by A. A. Noyes and H. C. Cooper; Part VI., by A. A. Noyes and Y. Kato; Part VII., by R. B. Sosman; Part VIII., by A. A. Noyes and G. W. Eastman; Part IX., by C. W. Kanolt; Part X., by W. Böttger; Part XI., by A. A. Noyes and Y. Kato; Part XII., by A. A. Noyes.

Other Publications of the Research Staff.

C. L. VON ENDE.—A translation of Abegg's "The Electrolytic Dissociation Theory." John Wiley & Sons, New York, 1907.

C. L. VON ENDE (with K. E. GUTHE).—Standard Cells. *Physical Review*, Vol. XXIV., pp. 214–221, 1907.

ELECTRICAL ENGINEERING DEPARTMENT.

DUGALD C. JACKSON.—College Graduates and Central Stations. *Electrical World and Engineer*, Vol. XLIX., pp. 220–221, February, 1907.

DUGALD C. JACKSON.—Methods of Electric Lighting for Railway Trains. Read before the Western Society of Engineers, May 15, 1907. (Illustrated.) *Journal of the Western Society of Engineers*, Vol. XII.

DUGALD C. JACKSON.—The Relations of the Engineering Schools to Polytechnic Industrial Education. Address of the President of the Society for the Promotion of Engineering Education, July 2, 1907. *Proceedings of the Society*, Vol. XV.; *Science*, Vol. XXVI., pp. 104–111.

DUGALD C. JACKSON.—Report on the Telephone Situation in the City of Chicago; in respect to Service, Rates, Regulation of Rates, etc. By a Special Commission, Dugald C. Jackson, Chairman, William H. Crumb, and George W. Wilder. Chicago, April 31, 1907.

H. E. CLIFFORD.—The Moore Tube System of Lighting. Read before the New England Section, Society of Illuminating Engineers, March 12, 1907. *Proceedings of the Society*, Vol. II.; *The Illuminating Engineer*, Vol. II., pp. 161–163.

GEORGE C. SHAAD.—Abstracting Engineering Papers. *Electric Journal*, Vol. IV., pp. 83–85, February, 1907.

GEORGE C. SHAAD.—Loading Stationary Induction Apparatus. (Illustrated.) *Electric Journal*, Vol. IV., pp. 346–357, June, 1907.

GEORGE C. SHAAD.—Section X., Central Stations (joint author). (Illustrated.) Standard Handbook for Electrical Engineers. New York, McGraw Publishing Company.

GEORGE C. SHAAD.—Notes on Power Transmission. For use of Course VI. students, Massachusetts Institute of Technology.

HARRISON W. SMITH.—Notes on the Characteristic Curves of the Direct-current Machine. (Illustrated.) *Technology Quarterly*, Vol. XX., pp. 119–132, March, 1907.

CHARLES H. PORTER.—Notation for Polyphase Circuits. (Illustrated.) *Electric Journal*, Vol. IV., pp. 497–505, September, 1907.

BIOLOGY, AND SANITARY RESEARCH LABORATORY AND SEWAGE EXPERIMENT STATION.

W. T. SEDGWICK.—On the Protection of Public Water Supplies from Pollution during Construction, Maintenance, and Operation of Railroads; with Special Reference to the Water Supply of Seattle, Washington; and Criticisms of the Present Methods of Water Supply and Sewerage of Railway Trains. *Journal of the New England Water Works Association*, Vol. XX., No. 4, December, 1906.

W. T. SEDGWICK.—Address of Welcome as President New England Water Works Association to the President and Members of the American Water Works Association, in Huntington Hall, July 10, 1906. *Proceedings of the Twenty-sixth Annual Convention of the American Water Works Association for* 1906, pp. 557–562.

W. T. SEDGWICK.—The Expansion of Physiology. Address of the Vice-President and Chairman of Section K, Physiology and Experimental Medicine, New York Meeting A. A. A. S., 1906. *Proceedings A. A. A. S. for* 1906; *Science*, N. S., Vol. XXV., No. 635, pp. 332–337, March 1, 1907.

S. C. PRESCOTT.—Commercial Bacteriological Inspection of Milk and its Results. *Science*, Vol. XXV., No. 647, pp. 814–815.

S. C. PRESCOTT.—The Canning Industry. Wine and Cider Manufacture. Vinegar. The Alcoholic Fermentation: Ale and Beer. Articles in the *American Cyclopedia of Agriculture* (*in press*).

S. C. PRESCOTT.—Commercial Bacteriological Inspection of Milk. *Bulletin State Board of Health of Massachusetts*, July, 1907.

S. C. PRESCOTT.—Inspected Milk. (A Brochure for Physicians.) Boston, 1907.

C.-E. A. WINSLOW.—The Teaching of Biology and Sanitary Science in the Massachusetts Institute of Technology. *Technology Quarterly*, Vol. XIX., No. 4, pp. 416–425, December, 1906.

C.-E. A. WINSLOW.—Disposal of Sewage. *Bulletin No.* 1, *Vol. VIII., of the Vermont State Board of Health*, September 1, 1907.

C.-E. A. WINSLOW.—Review of Legislation as to Public Health and Safety. *Thirty-third* (*Legislation*) *Bulletin of the New York State Library for* 1906, p. 45, Albany, N.Y., 1907.

C.-E. A. WINSLOW (with E. B. PHELPS, C. F. STORY, and H. C. MCRAE). Studies of Sewage Distributors for Trickling Filters. *Technology Quarterly*, Vol. XX., pp. 325–374.

C.-E. A. WINSLOW.—See E. B. Phelps.

E. B. PHELPS (with W. T. CARPENTER).—The Sterilization of Sewage Filter Effluents. *Technology Quarterly*, Vol. XIX., pp. 382–403, December, 1906.

E. B. PHELPS (with C.-E. A. WINSLOW).—On the Use of Methylene Blue in Testing Sewage Effluents. *Journal of Infectious Diseases*, Supplement No. 3, pp. 1–13, May, 1907.

E. B. PHELPS.—The Prevention of Stream Pollution by Strawboard Waste. United States Geological Survey Water Supply Paper No. 189. *Technology Quarterly*, Vol. XX., p. 292.

E. B. PHELPS.—Report to the New Jersey State Sewerage Commission on an Outbreak of Typhoid Fever at the State Hospital for the Insane at Trenton. *Engineering News*, Vol. LVIII., No. 14, pp. 353, 354, Oct. 3, 1907.

E. B. PHELPS.—See C.-E. A. Winslow.

A. W. WEYSSE.—Eine anatomisch-physiologische Studie des Brust-Korbes vermittelst des Brust-Pantographen. Fr. Reinhardt. *Universitäts-Buchdruckerei*, Basel, July, 1907.

W. L. UNDERWOOD.—Some Personal Experiences with the Gypsy and the Brown-tail Moth. *American Journal of Public Hygiene* and *Journal Massachusetts Association of Boards of Health*, Vol. XVI., pp. 569–590.

C. F. STORY.—See C.-E. A. Winslow.

H. C. MCRAE.—See C.-E. A. Winslow.

F. A. WOODS.—The Non-inheritance of Sex in Man. *Biometrika*, Vol. V., Parts I. and II., pp. 73–78.

PHYSICS.

H. M. GOODWIN. See Publications of Research Laboratory of Physical Chemistry.

C. L. NORTON. Asbestos Wood. *Electrical World*, Vol. XLIX., 1907, p. 835.

C. L. NORTON.—Asbestos Wood. *Insurance Engineering*, Vol. XIII., March, 1907.

C. L. NORTON.—A New Fire Retardent. *Insurance Engineering*, Vol. XIII., April, 1907.

C. L. NORTON.—Asbestos Wood. *The Indian Electrical, Mechanical, and Textile News*, Bombay, India, October, 1907, Vol. V., No. 2, p. 45.

CHARLES J. EMERSON.—The Effect of Oil in the Cylinder of an Internal Combustion Motor. *The Horseless Age*, Vol. XIX., p. 554, 1907.

D. F. COMSTOCK.—Experimental Investigation of the Effect of Perma-

nent Magnetism in Iron on the Permeability for very Small Forces. Inaugural Dissertation, University of Basel, 1906.

A. E. GREENE and F. S. MACGREGOR.—The Electrothermic Reduction of Iron Ores. *Electrochemical and Metallurgical Industry*, Vol. V., 1907, p. 367.

GEOLOGY.

CHARLES H. CLAPP.—The Clays of North Dakota. Fourth Biennial Report. *Geological Survey of North Dakota*, 1907.

CHARLES H. CLAPP.—The Clays of North Dakota. *Economic Geology*, Vol. II., No. 6.

REGINALD A. DALY.—The Limeless Ocean of pre-Cambrian Time. *American Journal of Science*, February, 1907.

R. A. DALY.—Report on Field Operations in the Geology of the Mountains crossed by the International Boundary (49th Parallel). In Report of the Chief Astronomer, Department of the Interior, Ottawa, Canada, 1907.

HERVEY W. SHIMER (with A. W. GRABAU).—Index Fossils of North America, Part II. *School of Mines Quarterly*, New York, 1907.

HERVEY W. SHIMER.—A Lower-middle Cambrian Transition Fauna from Braintree, Mass. *American Journal Science*, Vol. XXIV., pp. 176–178, 1907.

HERVEY W. SHIMER.—Geology of Connecticut (book review). *Technology Quarterly*, Vol. XX., pp. 375–378, 1907.

HERVEY W. SHIMER.—The Broad Features of the Geologic History of North America in Diagram. *Technology Quarterly*, Vol. XX., pp. 287–291, 1907.

HERVEY W. SHIMER.—An Almost Complete Specimen of Strenuella Strenua (Billings). *American Journal Science*, Vol. XXIII., pp. 199–201, p. 319, 1907.

NAVAL ARCHITECTURE.

C. H. PEABODY.—Thermodynamics of the Steam Engine, etc. (rewritten). New York, John Wiley & Sons, 1907.

C. H. PEABODY.—Tables of the Properties of Steam and Temperature Entropy Table (partly recomputed and partly new). New York, John Wiley & Sons, 1907.

WILLIAM HOVGAARD.—Article on the Speed of Battleships. Read before the International Congress of Naval Architects in Bordeaux, France.

Proceedings of the Society of Naval Architects and Marine Engineering, 1907.

W. S. LELAND and H. A. EVERETT.—Test on the Steamship "Governor Cobb." Read before the Society of Naval Architects and Marine Engineering. *Proceedings of the Society of Naval Architects and Marine Engineering*, 1907.

MATHEMATICS.

FREDERICK S. WOODS and FREDERICK H. BAILEY.—A Course in Mathematics, Vol. I. Boston, Ginn & Co., 1907.

GEORGE A. OSBORNE.—Differential and Integral Calculus. Revised edition. Boston, D. C. Heath & Co., 1907.

CLARENCE L. E. MOORE.—Circles Orthogonal to a Given Sphere. *Annals of Mathematics*, January, 1907.

ECONOMICS.

DEWEY, D. R.—National Problems. In the *American Nation Series*. Harper & Brothers, New York, 1907.

DEWEY, D. R.—Financial History of the United States. Third edition and revised. Longmans, Green & Co., New York, 1907.

DEWEY, D. R.—Review of Burton's "John Sherman." *American Historical Review*, July, 1907, p. 905.

Massachusetts Institute of Technology

BOSTON

REPORT OF THE TREASURER

FOR THE YEAR ENDING SEPTEMBER 30, 1907

December, 1907

Report of the Treasurer.

The Treasurer submits the annual statement of the financial affairs of the Institute for the year ending September 30, 1907.

It may not be uninteresting at this time to compare the financial condition of the Institute sixteen years ago with that of to-day. The following table shows in concise form some of the principal items in 1891 and in 1907:—

	1891.	1907.
Total property both real and personal	$1,364,684.98	$3,957,129.88
Total students	937	1,410
Fees from students and Scholarship Funds	$182,088.00	$331,669.50
Salaries, including instruction, lectures, administration, and labor	$160,229.95	$383,481.28
Department Supplies	25,857.92	54,616.44
Repairs	6,948.66	5,816.55
General Expenses	9,180.83	17,315.03
Total Expenditure	238,676.91	510,069.50

From the above figures it will be seen that the number of students has increased over 50 per cent. Fees from Student and Scholarship funds, over 82 per cent. Salaries over 139 per cent., and total expenditure of all kinds more than 113 per cent. This increase in total expenses is not caused by any one class of expenditures, but is distributed throughout most of them. For instance, it will be noted that the amount for department supplies has more than doubled, and that the item "General Expenses" is nearly twice what it was.

In the matter of repairs, there was a large expenditure in the year 1906, and the cost this year may be considered abnormally low. In 1906 the amount for repairs was decidedly more than double that in 1891.

The increase in the total property of the Institute has been large, being nearly 190 per cent., but it must be borne in mind that of the total amount more than one half is in the form of real estate and scholarship funds, and another large portion

is represented by equipment and by special trust funds which do not contribute to meet the expenses of the Institute. The main reliance is therefore on the tuition fees, and in spite of the advance made some years since, raising the fee to $250 per annum, the increase in expenditure has far outstripped the increase in tuitions. This is easily explained by the higher educational requirements which now prevail; by the larger proportion of students in the upper classes; by the better facilities now offered and the increased cost of instruction and supplies. Expenditures have been rigidly scrutinized and many economies have been introduced, for which much credit should be given to our Bursar, Mr. F. H. Rand, but the fact remains that the requirements are much higher to-day than they were sixteen years ago. The generous aid of the alumni, amounting this year to $46,588.04, has made possible many much-needed expenditures which will be referred to hereafter, but this income, like much of that from the State, is pledged for only a few years. The need for endowment is most pressing, and should appeal to all who feel the importance to the community of the higher technical education.

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

Income Committee	$46,588.04
Legacy under the will of the late Charles Merriam	25,000.00
Legacy under the will of the late Alexander S. Wheeler	5,000.00
From an anonymous friend a further payment for the Sanitary Research Fund	5,000.00
From Dr. A. A. Noyes for Physico-Chemical Research	3,000.00
Additional Amount under the will of the late Thomas Gaffield	2,000.00
From Charles G. Weld, M.D., for the department of Naval Architecture	1,400.00
From the Saturday Club for the purchase of books	1,000.00
From the Caroline A. R. Whitney estate, for seismographic apparatus	750.00
From Mrs. William B. Rogers for the Department of Geology	500.00
And for the purchase of periodicals	225.00
From an anonymous friend for salaries	500.00
From the William E. Hale Research Fund, for Physico-Chemical Research	500.00
Additional payment under the will of the late Susan E. Dorr	440.40
From A. D. Little, Esq., for salaries in the Chemical Department	300.00
From Mrs. Henry Pickering, for the Department of History	100.00
Additional payment under the will of the late Macy S. Pope	28.81

In addition to these pecuniary gifts there have been made for the equipment of various Departments generous contributions, which should be brought to the attention of the Corporation.

The Institute has received from the American Bridge Company 27 pictures, mounted and framed; from Mr. Arthur Winslow a number of books and pamphlets; from Mr. H. M. Whitney fireproofing material for the Laboratory of Sugar Analysis; from Mr. Henry A. Morss a Sullivan universal shunt box; from the American Telephone & Telegraph Company various small pieces of apparatus; from the Western Electrical Company exhibit-specimens of telephone apparatus; from Mr. Charles A. Clarke a Wright & Henry two-spindle high-speed drilling machine; from the American Gas Furnace Company an oil tempering furnace; from the Brown & Sharpe Manufacturing Company a universal grinding machine; from the Becker-Brainard Milling Machine Company a universal milling machine; from the Pratt & Whitney Manufacturing Company a 13-inch engine lathe; from S. F. Bowser & Company a two-compartment glass-front oil cabinet; from the Starrett Company a mine pump; from the Westinghouse Machine Company and other friends a contribution for the acquirement of a steam-turbine of 500 kilo-watt capacity; from the American Superheater Company a contribution for a superheater; from the Baldwin Locomotive Works and the American Locomotive Company complete sets of blue prints of locomotives; from the Fitchburg Machine Tool Company, the B. F. Sturtevant Company, and the Napier Motor Company of America valuable apparatus for use in connection with work in the drawing-room; from members of the Instructing Staff and Alumni numerous mineralogical and petrographical specimens; from Mr. Fred L. Franks a large collection of tertiary shells; from the Philadelphia Academy of Science a collection of lower tertiary forms.

It is proper to make special reference to the great assistance furnished by the Income Fund Committee. Had the whole of the money contributed from this source been used for this

year's expenses, this report would have shown a surplus of several thousand dollars instead of a deficit, in the current expense account, but it has been felt that the wishes of the alumni would best be carried out by devoting their gifts so far as possible to special matters of development rather than to mere maintenance. Accordingly, besides paying during the past year for special apparatus for the Mechanical Engineering Department and for the Electrical Engineering Department, and besides salary payments to strengthen the instructing staff, there has been reserved the sum of $10,000 to be applied during the coming year to certain special purposes, such as the purchase of a steam turbine and the extension of the plan of personal conferences between first-year students and the instructors, in which matters various alumni have expressed a special interest.

The Walker Memorial contributions are technically held as a separate fund, and are not strictly to be included in the accounts of the Institute, but for the information of the alumni there is given in the present report a list of the securities held for that fund, and a statement of its total amount, which with accrued interest at the time of this report is $112,033.40.

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

Dr.

Cash balance, Sept. 29, 1906		$118,865.79
RECEIPTS FOR CURRENT EXPENSES.		
Income of funds for salaries	4,324.00	
" " " " Fellowships	1,800.00	
" " " " scholarships (students' fees)	10,125.00	
" " " " Joy "	62.50	
" " " " W. B. Rogers Scholarships	625.00	
" " " " Library	480.00	
" " " " general purposes	31,350.33	
" " Rogers Memorial Fund	10,850.50	
" " Charlotte B. Richardson Fund	1,495.15	
" " Rotch Prize Funds	400.00	
" " Rotch Architectural Fund	1,000.00	
" " Edward Austin Fund, Scholarships	7,750.00	
" " " " " Awards	3,935.00	
" " Teachers' Fund	2,350.00	
" " Ednah Dow Cheney Fund	570.00	
Students' fees	313,107.00	
State Scholarships	4,000.00	
United States Act of 1862	5,306.68	
United States Act of 1890	10,000.00	
Gift of State of Massachusetts	25,000.00	
Laboratory supplies and breakages	12,638.78	
Rents, per Table (page 12)	11,082.02	
Gifts	3,375.00	
Interest	4,659.68	
Sale Printed Lecture Notes	2,292.26	
Income Fund Committee $46,588.04		
Less Reserve shown below 10,000.00	36,588.04	505,166.94
GIFTS AND BEQUESTS FOR SPECIAL PURPOSES. (Page 14.)		6,611.26
GIFTS AND BEQUESTS FOR GENERAL PURPOSES. (Page 14.)		32,028.81
Income Fund Committee:		
Reserve for special uses next year		10,000.00
SECURITIES SOLD OR PAID.		
General Fund, page 14		44,740.00
SUNDRIES.		
Income credited to Bond Premium Acc't	3,851.50	
" " " Rogers Bond Premium Acc't	641.50	
Copley Society of Boston, on acc't	666.66	
Walker Memorial Fund	4,413.34	
Naval Architecture Fund	1,400.00	
Letter Box Fund	23.75	
Sanitary Research Laboratory Fund, additional	5,000.00	
Physico-Chem. Research Fund	3,500.00	
Notes Payable	19,034.75	38,531.50
		$755,944.30

MASSACHUSETTS INSTITUTE OF TECHNOLOGY.

FOR THE YEAR ENDING SEPT. 30, 1907.

Cr.

EXPENSES.

Salaries, per Table (page 12)	$383,481.28	
Edward Austin Fund, Awards	3,935.00	
Teachers' Fund "	2,350.00	
Prizes, Rotch Funds	400.00	
Fellowship paid from Savage Fund	500.00	
" " " Dalton Grad. Chem. Fund	500.00	
" " " Swett Fund	400.00	
" " " H. Saltonstall Fund	400.00	
Repairs to Buildings, per Table (page 13)	5,816.55	
General Expenses, per Table (page 13)	17,315.03	
Fire Insurance	3,146.04	
Fuel	16,832.38	
Water	3,010.30	
Gas	2,382.08	
Electricity	243.53	
Printing and Advertising	4,008.03	
" Lecture Notes	413.90	
" Annual Catalogues and Reports	5,740.79	
Physico-Chemical Research Fund	3,000.00	
Department Supplies and Repairs, per Table (page 12)	54,616.44	
Society of Arts	1,008.15	
Margaret Cheney Reading Room	570.00	$10,069.50

(Expenses more than Income, $4,902.56.)

SECURITIES BOUGHT OR RECEIVED AS LEGACIES.

General Fund, page 14	99,440.21

SUNDRIES.

Cabot Medal Fund	97.30	
Naval Architecture Fund	1,547.22	
Sanitary Research Laboratory Fund	5,244.68	
Physico-Chem. Research Fund	4,566.43	
Dormitory Fund	128.30	
New Gymnasium	20.64	
Roentgen-Ray Fund	25.00	
Notes Receivable	450.00	
Fees, in advance acc't	92,502.50	
Deposit, in advance acc't	7,049.44	
Accounts Payable, acc't	4,904.86	116,536.37
Cash balance, Sept. 30, 1907		29,898.22
		$755,944.30

E. and O. E.

GEORGE WIGGLESWORTH,
Treasurer.

The following account exhibits the property held by the Institute, as per Treasurer's books, Sept. 30, 1907:—

INVESTMENT OF THE W. B. ROGERS MEMORIAL FUND.

31,000.00	N.Y. Central & H. R. R.R. Deb. 4s,	1934	30,225.00	
6,000.00	Baltimore & Ohio R.R. 3½s . . .	1925	5,310.00	
27,000.00	Kansas City Belt R.R. 6s	1916	27,000.00	
3,200.00	Republican Valley R.R. 6s	1919	3,200.00	
4,000.00	Cin.,Ind.,St. Louis & Chicago R.R.6s,	1920	4,000.00	
4,000.00	Kansas City,Fort Scott & Gulf R.R.7s,	1908	4,000.00	
1,000.00	Lincoln & Northwestern R.R. 7s .	1910	1,000.00	
1,000.00	Atchison & Nebraska R.R. 7s . .	1908	1,000.00	
35,000.00	Fort Street Union Depot 4½s . . .	1941	34,825.00	
24,000.00	Rome, Watertown & Ogdensburg R.R. 5s	1922	24,000.00	
37,500.00	Detroit, G. Rapids & Western R.R.4s,	1946	37,500.00	
25,000.00	Atchison, Top. & St. Fé R.R. 4s .	1995	24,470.00	
7,000.00	Chesapeake & Ohio R.R. 5s . . .	1939	7,000.00	
40,000.00	Chi. Junc. & Union Stock Yards 5s,	1915	40,000.00	
1,000.00	Wabash Equipment 4½s	1916	961.00	
	Advances to Bond Premium acc't .		5,553.00	
				250,044.00

INVESTMENTS, GENERAL ACCOUNT.

5,000.00	Bur. & Mo. River (Neb.) R.R. 6s, non-ex.	1918	5,000.00	
2,000.00	Bur. & Mo. River (Neb.) R.R. 6s, exempt	1918	2,000.00	
4,000.00	Chicago,Burlington & Quincy R.R.4s,	1922	3,100.00	
3,000.00	Hannibal & St. Joseph R.R. 6s . .	1911	3,000.00	
26,000.00	Am. Dock & Improvement Co. 5s .	1921	26,000.00	
3,000.00	Illinois Central R.R. 4s	1951	3,000.00	
6,000.00	Chi. Junc. & Union S. Yards 5s .	1915	6,000.00	
1,000.00	New England Tel. & Tel. Co. 6s .	1908	1,000.00	
100,000.00	West End Street Ry. 4s	1917	100,000.00	
50,000.00	Utah & Northern R.R. 1st 7s . . .	1908	50,000.00	
120,000.00	Illinois Steel Co., non-conv. 5s . .	1913	119,586.25	
43,000.00	Chesapeake & Ohio R.R. 5s . . .	1939	43,000.00	
100,000.00	Long Island R.R. 4s	1949	96,137.50	
7,000.00	K. C., Clinton & Springfield R.R. 5s,	1925	6,289.21	
8,500.00	K. C., Mem. & Birmingham R.R. 4s,	1934	8,287.50	
50,000.00	Kansas City Stock Yards 5s . . .	1910	50,000.00	
25,000.00	Atchison, Top. & St. Fé R.R. 4s. .	1995	25,000.00	
50,000.00	Rio Grande & Western R.R. 4s . .	1939	49,180.00	
50,000.00	Oregon R.R. & Navigation Co. 4s,	1946	50,000.00	
50,000.00	Union Pacific R.R. 4s	1947	50,000.00	
100,000.00	Chi. & W. Michigan R.R. 5s . .	1921	100,000.00	
105,000.00	American Tel. & Tel. Co. 4s . . .	1929	104,700.00	
50,000.00	New England Tel. & Tel. Co. 4s .	1930	50,000.00	
50,000.00	Chi. Junc. & Union S. Yards 4s .	1940	49,250.00	
50,000.00	K. C., Fort Scott & Memphis R.R.6s,	1928	50,000.00	
25,000.00	Southern Ry., St. Louis Div. 4s . .	1951	24,875.00	
7,000.00	Ozark Equipment Co. 5s	1910	7,000.00	
50,000.00	Northern Pac. Gt. Northern Joint 4s,	1921	48,500.00	
34,000.00	Baltimore & Ohio R.R. 3½s . . .	1925	30,090.00	
30,000.00	Chi., Mil. & St. Paul R.R. 7s . . .	1910	30,000.00	
52,000.00	N.Y. Cent. & H. R. R.R.(L. S.) 3½s,	1998	46,046.65	
50,000.00	Oregon Short Line 4s	1929	48,500.00	
5,000.00	Terminal Asso. St. Louis 4s . . .	1953	5,000.00	
3,000.00	Lake Shore & Mich. Southern 4s .	1928	3,000.00	
	Advances to Bond Premium acc't .		24,467.00	
	Carried up		1,318,009.11	
	Amount carried up			$250,044.00

Amount brought up					$250,044.00

INVESTMENTS, GENERAL ACCOUNT,—*Continued.*

Brought up				1,318,009.11	
33,000.00	American Tel. & Tel. notes 5s . .		1910	31,968.75	
20,000.00	Louisville & Nashville 4s		1923	19,750.00	
25,000.00	Mass. Electric Co. notes 4½s . . .		1910	24,500.00	
75,000.00	Lake Shore & Mich. So. deb. 4s .		1931	75,000.00	
25,000.00	Wabash Equipment 4½s		1912	24,360.00	
19,000.00	Wabash Equipment 4½s		1916	18,259.00	
50,000.00	Interboro Rapid Transit 5s . . .		1910	48,625.00	1,560,471.86

STOCKS.

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

INVESTMENT OF THE JOY SCHOLARSHIP FUND.

	Massachusetts Hospital Life Insurance Co. . . .			5,000.00	
	Deposits in Savings Banks			5,933.77	10,933.77

INVESTMENT SWETT SCHOLARSHIP FUND.

	Massachusetts Hospital Life Insurance Co.				10,000.00

INVESTMENT OF RUSSEL FELLOWSHIP FUND.

2,000.00	Conveyancers Title Ins. Co. Mortgage 4s		1908		2,000.00

INVESTMENT WALKER MEMORIAL FUND.

30,000.00	American Tel. & Tel. Co. 4s . .		1929	30,300.00	
54,000.00	N.Y. Central & H. R. L. S. 3½s .		1998	47,986.35	
1,000.00	Chi., Bur. & Quincy R.R. 5s . .		1913	1,055.00	
14,000.00	Oregon Short Line 5s		1946	16,310.00	
5,000.00	St. Louis Iron Mountain 4s . . .		1933	4,812.50	
7,000.00	Wabash Equipment 4½s		1916	6,764.45	107,228.30
Amount carried up					$2,073,409.57

Amount brought up			$2,073,409.57

REAL ESTATE.

Rogers Building		200,000.00	
Walker "		150,000.00	
Land on Garrison Street	50,840.00		
Mechanic Arts Building	30,000.00	80,840.00	
Land on Trinity Place	76,315.69		
Engineering Bldg. A, Trinity Place	90,000.00	166,315.69	
Gymnasium Building		12,624.07	
Engineering Building, B		57,857.10	
Engineering Building, C		47,561.08	
Lot No. 2, Trinity Place		137,241.60	
Lot No. 3, " "		282,286.35	
Henry L. Pierce Building, Trinity Place		154,297.05	
Boiler and Power House, " "		26,916.74	
Clarendon St. Land and Building		142,762.94	
Real Estate, Massachusetts Ave., Cambridge		16,154.38	
Real Estate, Brookline, Mass.		112,964.32	
Aug. Lowell Lab. Elec. Eng. Bldg., 1902		121,790.93	1,709,612.25
Equipment, Engineering Building		16,555.24	
" Mechanical Laboratories		20,628.56	
" Elec. Eng. Building		87,282.24	124,466.04

SUNDRIES.

Notes Receivable		12,450.00	
Loans to Copley Society of Boston		5,666.66	
Students' Notes		570.50	
Physico-Chem. Research Fund		1,056.64	
Cash balance, Sept. 30, 1907		29,898.22	49,642.02
			$3,957,129.88

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

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

William Barton Rogers Memorial Fund	250,225.00	
Richard Perkins Fund	50,000.00	
George Bucknam Dorr Fund	49,573.47	
Martha Ann Edwards "	30,000.00	
Nathaniel C. Nash "	10,000.00	
Sidney Bartlett "	10,000.00	
Robert E. Rogers "	7,680.77	
Albion K. P. Welch "	5,000.00	
Stanton Blake "	5,000.00	
McGregor "	2,500.00	
Katharine B. Lowell "	5,000.00	
Samuel E Sawyer "	4,764.40	
John W. and Belinda L. Randall Fund	83,452.36	
James Fund	163,654.21	
George Robert Armstrong Fund	5,000.00	
Arthur T. Lyman Fund	5,000.00	
Charles Choate Fund	25,000.00	
Nathaniel Thayer Fund	25,000.00	
Alexander S. Wheeler Fund	5,000.00	741,850.21
Amount carried up		$741,850.21

Amount brought up		$741,850.21
The income of the following is used towards paying salaries:—		
Nathaniel Thayer, for Professorship of Physics .	25,000.00	
Jas. Hayward, for Professorship of Engineering,	18,800.00	
William P. Mason, " " Geology .	18,800.00	
Henry B. Rogers, for general salaries	25,000.00	
George A. Gardner, " "	20,000.00	
Sarah H. Forbes, salaries	500.00	108,100.00
SCHOLARSHIP TRUSTS.		
Richard Perkins Fund	53,434.07	
James Savage "	14,295.78	
Susan H. Swett "	10,582.95	
William Barton Rogers Fund	11,735.40	
Joy Fund	11,133.77	
Elisha Thatcher Loring Fund	5,433.45	
Charles Lewis Flint "	5,334.14	
Thomas Sherwin "	5,050.00	
Farnsworth "	5,000.00	
James H. Mirrlees "	2,899.42	
William F. Huntington "	5,274.13	
T. Sterry Hunt "	3,251.92	
Elisha Atkins "	5,000.00	
Nichols "	5,000.00	
Ann White Vose "	60,946.74	
Ann White Dickinson "	40,809.27	
Dalton Grad. Chemical "	5,499.39	
Willard B. Perkins "	7,483.89	
Billings Student "	50,000.00	
Henry Saltonstall "	10,000.00	
Isaac W. Danforth "	5,640.64	
Charles C. Nichols "	5,424.32	
Richard Lee Russel "	2,249.97	
Lucius Clapp "	5,299.84	336,779.09
OTHER TRUSTS.		
Charlotte Billings Richardson Ind. Chem. Fund,	37,378.78	
Susan Upham Fund	1,310.27	
Susan E. Dorr "	19,288.48	
William Hall Kerr Library Fund	2,000.00	
Charles Lewis Flint " "	5,000.00	
Rotch Architectural " "	5,000.00	
Rotch Architectural Fund	25,000.00	
Rotch Prize "	5,200.00	
Rotch "Special" Prize Fund	5,200.00	
Edward Austin "	379,601.72	
Teachers' "	110,520.00	
Saltonstall "	42,671.00	
Ednah Dow Cheney "	14,058.84	
Letter Box "	81.50	652,310.59
Walker Memorial Fund		112,033.40
Aug. Lowell Lab. Electrical Eng. Fund		68,000.00
George B. Upton Legacy, 1905		5,000.00
Macy S. Pope Legacy, 1906		25,028.81
Thomas Gaffield Legacy, 1906		2,043.18
Charles Merriam Legacy, 1907		25,000.00
M. I. T. Stock Account		1,816,023.15
Amount carried up		$3,892,168.43

Amount brought up		$3,892,168.43
MISCELLANEOUS.		
Cabot Medal Fund	100.92	
Reserve of Income Fund Committee	10,000.00	
Roentgen-Ray Experiment Fund	956.50	
Sanitary Research Laboratory Fund	1,341.05	
Dormitory Fund	1,868.96	
Naval Architecture Fund	189.08	
Students' Fees received in advance	19,685.00	
Deposits for Breakages and Supplies	1,317.81	
Deposits for Breakages and Supplies received in advance	1,070.00	
Accounts Payable	5,397.38	
State Fees received in advance	4,000.00	
Notes Payable	19,034.75	64,961.45
		$3,957,129.88

COMPARATIVE STATEMENT OF FUNDS, ETC.

	Sept. 29, 1906.	Sept. 30, 1907.
Trusts for general purposes	736,850.21	741,850.21
" " Salaries	108,100.00	108,100.00
" " Scholarships	335,390.68	336,779.09
Other Trusts, per page 9	647,063.99	652,310.59
M. I. T. Stock Account	1,821,924.71	1,816,023.15
Walker Memorial Fund		112,033.40
Aug. Lowell Lab. Electrical Eng. Fund	68,000.00	68,000.00
George B. Upton Legacy	5,000.00	5,000.00
Macy S. Pope Legacy	25,000.00	25,028.81
Thomas Gaffield Legacy	43.18	2,043.18
Charles Merriam Legacy, 1907		25,000.00
Miscellaneous, per page 10	141,427.55	64,961.45
	$3,888,800.32	3,957,129.88
Increase, Consisting of:		
Bequests for Special Purposes. (See page 14.)	6,611.26	
Gifts and Bequests for General Purposes. (See page 14.)	32,028.81	
	38,640.07	
Less Expenses more than Income	4,902.56	
Less Bond Prem. on Bonds sold 1906	999.00	$32,738.51
Walker Memorial Fund. (Securities on page 7.)		$112,033.40
Decrease in Miscellaneous		76,442.35

INCOME FROM GENERAL INVESTMENTS, AND APPLICATION THEREOF.

Applied to Salaries	4,324.00
" " Scholarships	10,750.00
" " Fellowships	1,400.00
" " Charlotte B. Richardson Fund	1,495.15
" " Teachers' Fund	4,000.00
" " Edward Austin Fund	14,400.00
" " Rotch Prize Funds	400.00
" " Rotch Architectural Fund	1,000.00
" " Cheney Fund	570.00
" " Library	480.00
" " General Purposes	31,350.33
" " Samuel Dorr Annuity	1,000.00
" " Increase of Funds	893.40
" " Advances to Bond Premiums	3,851.50
	$75,914.38

From Bonds	68,552.38
" Dividends, Railroad Stocks	2,065.00
" " Manufacturing Stocks	2,377.00
" Real Estate Stocks	2,920.00
	$75,914.38

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

Paid Massachusetts Institute of Technology	10,850.50
Credited to Advances Bond Premiums	641.50
	$11,492.00

Received Income from Railroad Bonds	11,492.00
	$11,492.00

DETAILS OF SOME ITEMS IN TREASURER'S CASH ACCOUNT.

Rents.

Huntington Hall, for Lowell Lectures	3,500.00	
Land and Building, Clarendon St., on account	8,500.00	
Use of Rooms and Gymnasium	136.00	$12,136.00
Less Cambridge Real Estate Expenses	71.79	
Less Edge Hill Road Estate Expenses	750.41	
Less Lunch Room Expenses	231.78	1,053.98
		$11,082.02

Department Supplies and Repairs.

Applied Mechanics	1,390.87	
Architecture	1,598.15	
Biology	1,229.75	
Chemistry	14,501.78	
Civil Engineering	1,984.42	
Drawing	913.39	
Economics	419.31	
Electrical Engineering	7,142.66	
English	199.96	
General Library	2,302.10	
Geology	1,308.73	
Heat Measurement	232.18	
History	749.88	
Mathematics	583.39	
Mechanic Arts	3,447.64	
Mechanical Engineering	4,717.06	
Military	612.63	
Mining	3,634.82	
Modern Languages	447.78	
Naval Architecture	830.84	
Physical Culture	1,007.34	
Physics	5,361.76	$54,616.44

Salaries.

Instruction	300,847.32	
Administration	38,218.62	
Labor	44,415.34	$383,481.28

General Expense.

Architectural Annual			$1,000.00
Alumni Association			1,000.00
Window Shades			68.20
Furniture			719.07
Stationery and Office Supplies			2,609.76
Postage			1,676.42
Sundries			3,067.57
Express			227.11
Janitor's Supplies			1,187.41
Examinations			470.00
Diplomas and Commissions			567.22
Washing			808.86
Telephone Service, Installing Stations, Rentals, Repairs, etc.			1,428.90
Engine Room Supplies:			
Oil	480.95		
Waste	203.51		
Sundries	105.14		789.60
Ice			400.60
Graduation Exercises			276.55
Removing Ashes			356.40
Glass			40.09
N. E. Trust Co. Deposit Vaults			75.00
State St. Trust Co. Deposit Vaults			75.00
Taxes, Brookline, etc.			471.27
			$17,315.03

Repairs to Buildings.

Rogers Building	1,815.41	
Walker "	705.25	
Engineering Buildings, A and B	554.67	
Pierce Building	346.55	
Engineering Building, C	129.23	
Lowell Building	1,002.82	
Gymnasium Building	69.06	
Mechanical Laboratories	255.17	
Boiler and Power House	811.55	
Sundries	126.84	
		$5,816.55

Securities Sold or Paid, General Fund.

$1,000	Chi., Bur. & Quincy 4s	1922	$1,000.00
1,000	New Eng. Tel. & Tel. 6s	1907	1,000.00
13,000	K. C., St. Jo. & Council Bluffs 7s	1907	13,000.00
2,000	Ozark Equipment 5s	1910	2,000.00
20,000	American Tel. & Tel. Notes 5s	1907	20,000.00
80	Rights Chi., Mil. & St. Paul		2,740.00
5,000	Wabash Equipment Notes 4½s	1907	5,000.00
			$44,740.00

Securities Bought or Received as Legacies, General Fund.

33,000	American Tel. & Tel. Notes 5s	1910	$31,968.75
19,000	Wabash Equipment 4½s	1916	18,259.00
50,000	Interboro Rapid Transit 5s	1910	48,625.00
	Interest on Savings Bank Joy Fund deposited		587.46
			$99,440.21

Gifts and Bequests for Special Purposes.

Sarah E. Dorr Fund, additional		$440.40
Income Scholarship Funds		1,805.86
"	Austin Fund	2,715.00
"	Teachers' Fund	1,650.00
		$6,611.26

Gifts and Bequests for General Purposes.

Alexander S. Wheeler Fund	$5,000.00
Charles Merriam Legacy	25,000.00
Thomas Gaffield Legacy, additional	2,000.00
Macy S. Pope Legacy, additional	28.81
	$32,028.81

BOSTON, Dec. 6, 1907.

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, 1907, 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,
WILLIAM L. PUTNAM,
} *Auditing Committee.*

BOSTON, Dec. 6, 1907.

To the Auditing Committee of the
Massachusetts Institute of Technology:

GENTLEMEN,—I have audited the accounts of Mr. George Wigglesworth, Treasurer, for the year ended September 30, 1907.

They are correct, payments duly vouched, and the receipts from students' fees and all other income duly accounted for. The cash at office and in banks, according to the deposit books, is correct, and the Students' Notes are on hand. The account of property held by the Institute and the funds, and balances, as shown in the Treasurer's report of September 30, 1907, is in accordance with the books.

Respectfully submitted,

EDWARD L. PARKER,
Public Accountant.