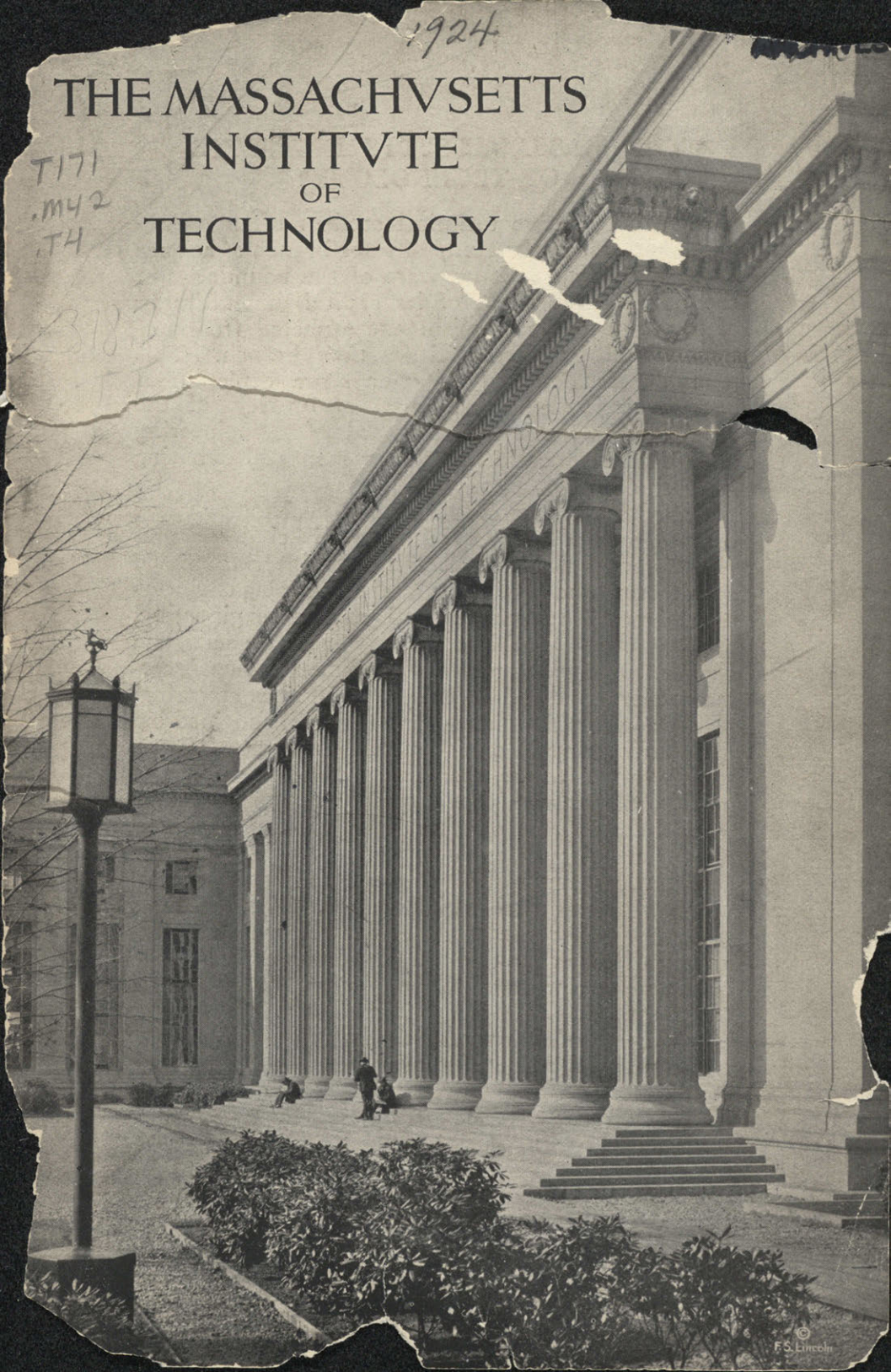


1924

# THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY

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## THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY\*

The prospective technical student often feels a vague interest in the study of some branch of science or engineering, but is unaware of the boundaries of the particular branch, of its capital difficulties or of the type of accomplishment expected from one who would be successful in that branch. This pamphlet is designed to offer some explanation, necessarily inadequate because of brevity, of the requirements, methods and rewards of an engineering or scientific education to young men still debating their choice of occupation.

The Massachusetts Institute of Technology offers courses, each of four years duration, in civil and municipal mechanical and electrical engineering, naval architecture and marine engineering, mining engineering and metallurgy, geology and geological engineering, architecture and architectural engineering, chemistry, chemical engineering and electrochemical engineering, biology and public health, sanitary engineering, physics, general science and general engineering and engineering administration. In each of these, sufficient options are offered to enable the student to make a selection which will qualify him to undertake work in new and special fields of technical and scientific endeavor, such as automotive engineering, aeronautical engineering, highway engineering, fuel engineering, industrial biology, etc. These options also provide for the study of the science and technology of paper making, of the refining of oils, and of the manufacture of rubber, leather, building and other materials. These courses lead to the degree of Bachelor of Science. In addition the Institute offers many facilities for graduate work and gives courses leading to the degrees of Master of Science,

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An airplane view showing the main educational group. The building at the right is the Walker Memorial, student club house. Between this and the main building may be seen the base ball diamonds and athletic field.

Master in Architecture, Doctor of Philosophy, Doctor of Science and Doctor of Public Health.

The Institute aims to give not only instruction in subjects essential for the future professional competence of its students, but also sufficient courses of a general cultural value to make its graduates men of a broad training who have specialized in some department of pure or applied science. To this end courses in English and history, political economy and some foreign language are required, as well as a certain number of "general studies" dealing with literature, music, or the fine arts.

For administrative purposes the Institute is divided into departments such as civil engineering, mechanical engineering, etc. Courses given in any department are open to students having the requisite preparation.

All engineering courses given at the Institute rest upon a fundamental basis of mathematics and physics and in some cases chemistry. It is therefore obvious that considerable time in the first two years must be devoted to laying a thorough foundation in these subjects before the more specialized profes-

sional work may be successfully undertaken. Since the different branches of engineering, when practiced in a professional career, require the application of a certain amount of physics and mathematics, an aptitude for these subjects is indispensable to the prospective students at Technology.

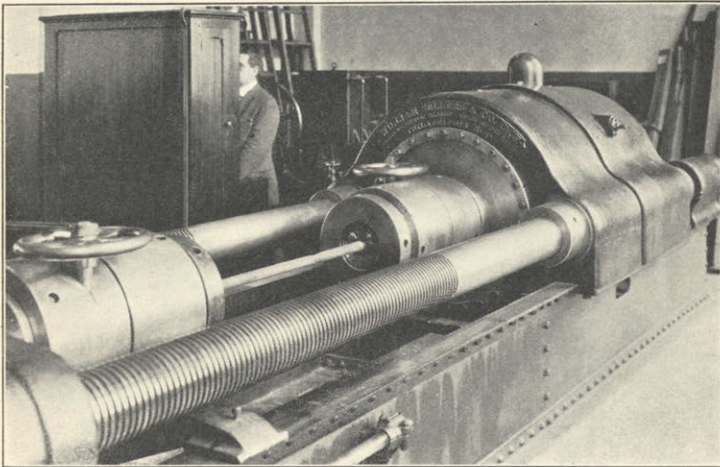
## **CIVIL ENGINEERING**

The oldest established branch of applied science is civil engineering. "Civil engineer" was at first a term applied, in opposition to that of military engineer, to designate a man who was engaged in engineering work of a civil or non-military character. Since the time when this classification was sufficient to indicate the activities of an applied scientist, the field of applied science has broadened and extended to such an extent that there have come into being the terms mechanical engineer, electrical engineer, etc., to describe men who have focused their attention upon some specific branch of engineering. Despite this increasing sub-division, civil engineering still covers a large and distinct field in the world of applied science. The activities of the civil engineer include such work as the design and construction of bridges and other similar structures of steel and concrete, the location and construction of railways and highways, the investigation of sources of water supplies for drinking and power purposes and the design and construction of the works necessary for their utilization, the design and construction of sewer systems, the improvement of harbors and rivers, and in general, all phases of engineering involving construction in the field. Since the concern of the civil engineer is more with stationary structures than moving machines it is obvious that the civil engineer is not concerned with the design of the railroad locomotives which run upon railroads which he constructs, nor of the dynamos which transform the power furnished by a hydro-electric development.

In addition to the general course in civil engineering known as option 1, two other options are given; transportation engineering and hydroelectric engineering. The option in transportation engineering is itself divided into either highway or railway transportation. In addition to the regular work at Cambridge, a summer course in surveying and railroad engineering is required of students in this department. This is given at a large and well-equipped camp owned by the Institute at East Machias, Maine.

### **SANITARY AND MUNICIPAL ENGINEERING**

The course in sanitary and municipal engineering has many subjects in common with the general option of the civil engineering course, but differs from it in placing special emphasis on the problems arising in the disposition of sewage, the treatment and purification of water supplies, and the construction and maintenance of city streets. Graduates of this course are in demand by private organizations dealing with



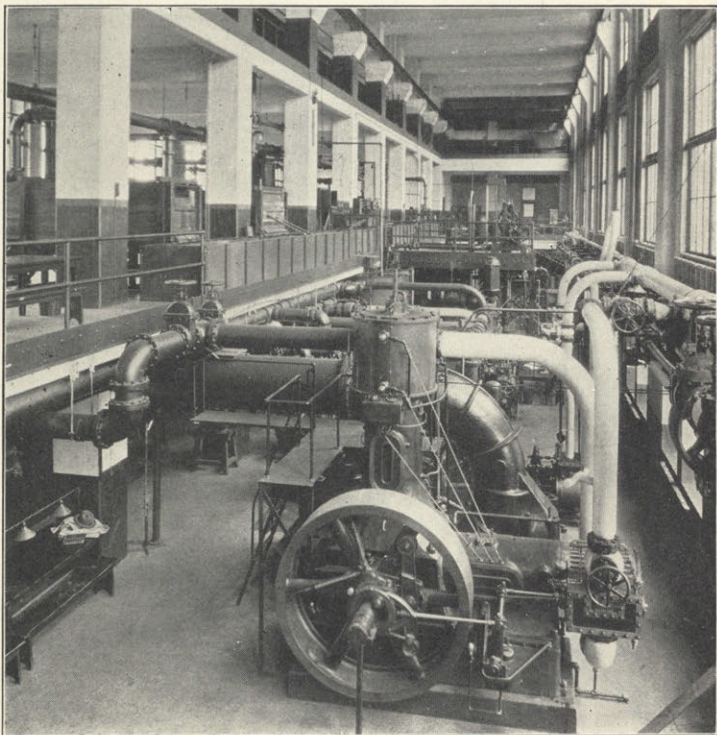
Determining the strength of materials. The materials testing laboratories are equipped with machines up to a million pounds capacity. The photograph shows a tension test on one with three hundred thousand pounds capacity.

sanitary problems, by Federal, State and Municipal Boards of Health and by Municipal Boards of Public Works.

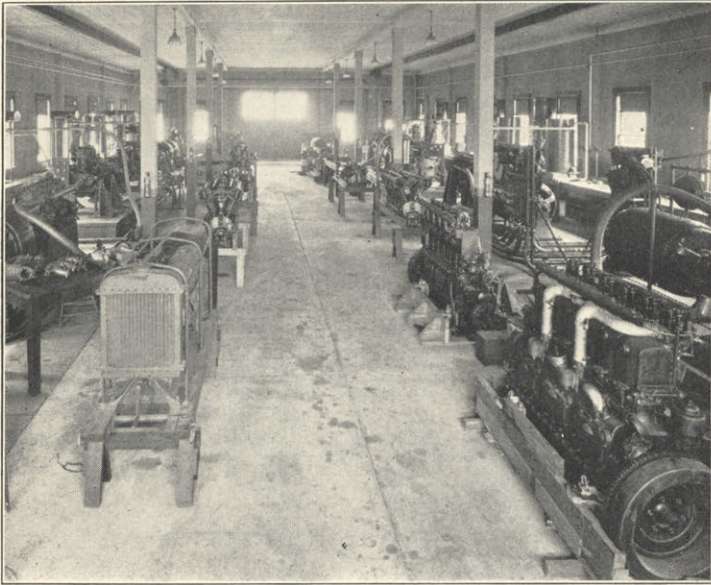
### **MECHANICAL ENGINEERING**

Mechanical engineering, which is perhaps the first division to be separated from civil engineering, is more concerned with machinery than with structures. The design and construction of a bridge is the concern of the civil engineer, but if it is a draw-bridge, the mechanical engineer would probably do the work of designing all suitable mechanisms for moving the draw-span.

In addition to the theoretical instruction in the



The Mechanical and Hydraulic Laboratory



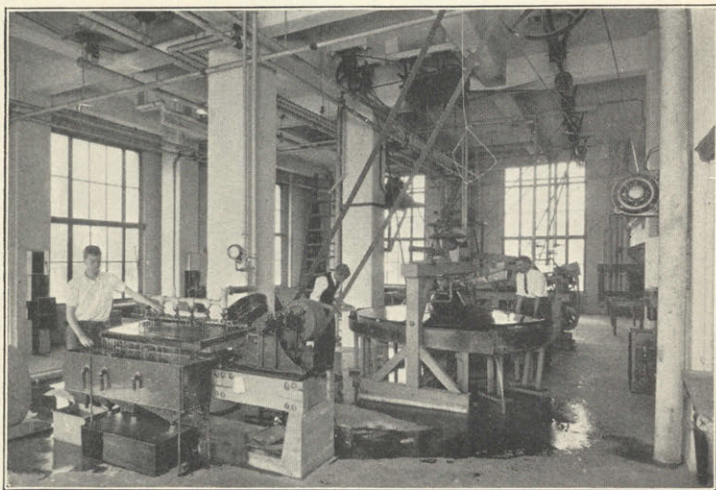
The Internal Combustion Engine Laboratory equipped with types of airplane and automobile motors

mechanical engineering courses given in classroom considerable stress is laid upon instruction by the laboratory method. The laboratories, which are among the largest and most fully equipped of any such laboratories in the world, occupy more than seventy thousand feet of floor space. In addition to the main mechanical engineering laboratories there are, likewise under the control of the department, laboratories for the testing of materials for heat treatment of metals, power measurement, textile machinery, and refrigeration. Also there is a laboratory for the testing of gas engines.

Four options are offered in the senior year to students taking the course in mechanical engineering, although a student may, in place of these options, take the so-called general course in the fourth year if he desires not to specialize so closely in some phase of mechanical engineering. If the student wishes to

take work in the options he may elect automotive engineering, which concerns a study of the principles of the construction and operation of automobiles and other self-propelled vehicles.

The second option is known as engine design, and deals in detail with the design and development of motors ranging from the fast types used in aeroplanes and dirigibles to the slow, sturdy and reliable engines required for the propulsion of boats. The third option is known as textile engineering and specializes in the study of the complicated automatic machinery which produces modern fabrics of all sorts from their raw materials. The automobile tire, the gas bag of the balloon and dirigible, the wing of the aeroplane, have all required fabrics hitherto unknown, and modern American textile engineering has had the inventiveness to produce them. The fourth option is for the Officers' Reserve Training Corps students in the Ordnance branch. In many respects it parallels the general course, but it includes also special courses in ordnance



The Ore Dressing Laboratory of the Mining Engineering Department



engineering given by a United States Army Officer detailed to Technology as a representative of the Ordnance Department.

### **MINING ENGINEERING**

The study of mining engineering covers a large field of technical endeavor and is consequently divided into options which permit the student to specialize in mining engineering alone or to study metallurgy at the same time. Naturally these courses are to a large degree dependent upon chemistry and the student therefore takes considerable work in this, in addition to the first-year instruction which is required for all courses. Work in mineralogy and geology likewise forms elements in the study of both options. The laboratories of assaying and ore dressing are equipped with much apparatus for special work in both options. Like the students in civil engineering, students in mining engineering are required to take the summer course in surveying, including additional work in underground surveying. This is given at the new Mining Summer Camp at Dover, New Jersey.

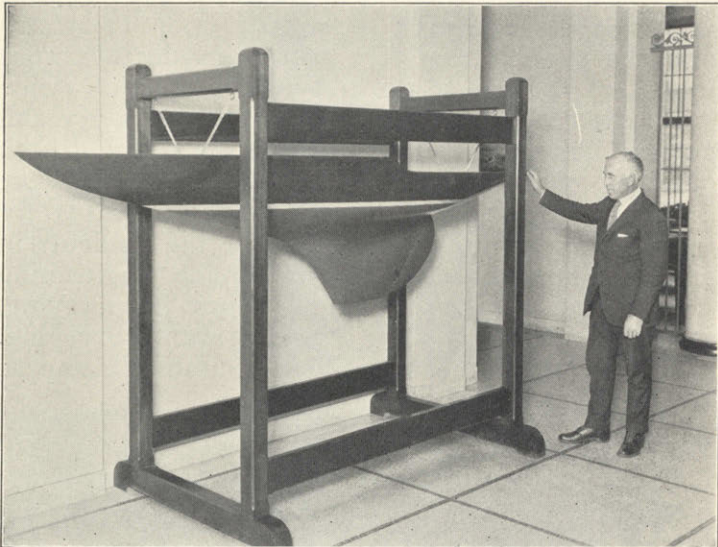
### **NAVAL ARCHITECTURE AND MARINE ENGINEERING**

The department of naval architecture and marine engineering deals with two classes of students. The first are civilian undergraduates who are studying naval architecture and the art of ship construction as an applied science. The second group is made up of naval constructors, officers of the United States Navy sent by the Government for advanced instruction at Technology.

Since a ship on a voyage is a complete community in itself, independent of outside assistance and supplies, she must have all the services of an ordinary town, such as water supply, commissary department, sanitary and fire departments. All consider-

ations which concern her taxation, her liabilities to shippers, underwriters and government departments must be carefully studied, and consequently the course is calculated to give the students an unusually broad training

Students are given practice in the special drawings and calculations appropriate to ships and their engines. They are also required in their senior year to make a model of a vessel to their own design.



A yacht model in the Naval Architectural Museum

## **ELECTRICAL ENGINEERING**

In the department of electrical engineering, besides the regular four-year course, four coöperative five-year options are offered which involve work alternating between the Institute and various large electrical manufacturing or public utility corporations. In all courses in electrical engineering, mathematics plays an extremely important part and students in electrical engineering receive more detailed instruction in this branch than students in

most other courses. The provision that engineering students should be creditable students in mathematics applies to an unusual degree in this course.

The different coöperative options offered begin in the second year. Students interested in the design and manufacture of electrical equipment upon a large scale are offered the opportunity of studying this with the General Electric Company in its Lynn works and elsewhere. Those interested in the generation and distribution of electric power study in the plants of the Edison Electric Illuminating Company of Boston. An option more recently established with the Boston Elevated Railway Company makes available a demonstration of problems relating to electric transportation. The most recent option is that operated in conjunction with Stone & Webster, Inc., which deals largely with the design, construction and operation of steam and hydro-electric generating stations.

In all these options the student enters the plants of the coöperating companies as an employee and is paid at a nominal rate for the work he does. This work is far from being of a haphazard nature. It follows close specifications made by the educational authorities of the Institute. The training is thorough and intensive. In the option given with the Boston Elevated Railway Company, the student is acquainted successively with the work of guard and motorman on street cars and on elevated and subway lines; he also studies such work as signalling in the operation department and in addition devotes attention to methods of office management of the company. The other options are similar in plan. All of them occupy one year more than the regular undergraduate course in electrical engineering, which is given entirely at the Institute. They lead to the degree of Master of Science.

Another option which has been offered by the electrical engineering department since 1922, is in

electrical communications. This is a four-year course leading to the degree of Bachelor of Science, and identical with the main electrical engineering course for the first two years, differentiating slightly therefrom in the third year, and very distinctly in the fourth or senior year. This option prepares the student for work in telephony and telegraphy both with and without wires. Important opportunities are offered for graduate work in this field.

The undergraduate course in electrical engineering prepares its students for work in the creative lines of electrical engineering. The plan of the curriculum is continuous through the four years, but is arranged so that college graduates from general courses who have made mathematics and physics a major branch of studies may enter at the opening of the third year.

In addition, the electrical engineering department offers a wealth of opportunity for advanced scientific study and research in the field of electrical engineering and graduate students may secure the degree of Master of Science or Doctor of Science.

## **CHEMISTRY**

The department of chemistry is completely equipped to offer courses in all branches of the science, besides the introductory work in inorganic chemistry taken by all first-year students. The instruction includes qualitative and quantitative analysis, organic chemistry and physical chemistry in all their ramifications. Some eighty courses are offered by this department. Because of the great amount of experimental phenomena which must be observed if the student is to acquire a proper grasp of his subject, considerable dependence is placed upon the laboratory method of instruction. All laboratories are fully equipped and are laid out in order to render swift and efficient work easily possible. The Research

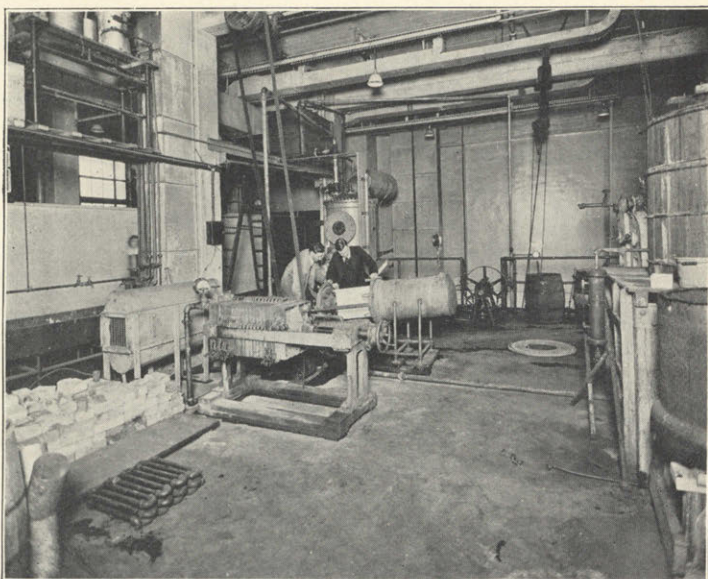
Laboratory of Physical Chemistry offers some remarkable opportunities and facilities for research.

The chemist of today is concerned with the methods by which many of the materials used in manufacturing and construction are obtained and particularly with development of new and better methods by which they may be more readily and economically manufactured. Among these materials are: paper, textiles, rubber, leather, lubricating oils, paints and varnishes, glass and many other industrial materials.

### **CHEMICAL ENGINEERING**

A chemical engineer may be defined as one who is concerned with the design, construction, operation and maintenance of plants and apparatus for carrying out the above processes on a commercial scale.

Although the boundaries of the profession are hard to define, the importance of chemical engineering work has become more and more appreciated within the past few years. In addition to the regular four-year undergraduate course, a course of one year's duration following the senior year is offered in the School of Chemical Engineering Practice, which leads to the degree of Master of Science. The Institute operates chemical engineering stations in the plants of the Revere Sugar Refining Company and the Merrimac Chemical Company near Boston, the Eastern Manufacturing Company in Bangor, Maine, and in the Bethlehem Steel Company's Lackawanna Plant. Students take work in these plants under the supervision of members of the Institute's Faculty, rotating from one station to another. This system of coöperative education is unique in that it does not in any way place the student upon the basis of an apprentice. The student is not an employee in any of these plants and consequently receives no pay. His status is that of an



Thesis work in one of the laboratories of the  
Department of Chemical Engineering

outside investigator of the scientific phenomena to be observed.

For students unable to spend an extra year in study, the opportunity is offered to take work in the School of Chemical Engineering Practice during the last two terms of the senior year, substituting work in the plants for these two terms of academic work and doing a certain amount of summer study between the junior and senior years to take the place of the academic work which would otherwise be omitted. Students studying in the school under this arrangement receive the degree of Bachelor of Science on the successful termination of their senior year.

Operated in close conjunction with the department of Chemical Engineering is the Research Laboratory of Applied Chemistry. Opportunities are open in this laboratory to young graduates of

exceptional capacity to train themselves for research positions in industry. Because such men must usually have some financial assistance they are given the status of members of the Institute staff and are paid a salary corresponding essentially to a liberal research fellowship.

### **METALLURGY**

Metallurgy, the art of economically extracting metals from their ores, is an option, which for administrative purposes is grouped in the same department with mining engineering. This option emphasizes the fundamental sciences and arts on which metallurgy depends. A short course in mining is included and the student may also elect lectures on geology and mineral deposits. Training in this metallurgical option fits men for positions of responsibility in the iron and steel industry and the vast industries for the production of copper, zinc, tungsten and other metals.

### **BIOLOGY AND PUBLIC HEALTH**

The courses in biology and public health are given in two options, the first of which deals primarily with public health and the second with the industrial or technical applications of biology, microbiology and organisms of fermentation. Graduates in the first option are eligible as candidates for the Certificates of Public Health (C. P. H.) after an additional year of study at the Institute. The Doctor of Public Health degree (Dr. P.H.) is offered to properly qualified candidates. Special programs of study in Health Education are offered by the department in coöperation with the State Department of Education and the Schools of Education located in Boston.

The undergraduate course in this department forms an excellent basis for the future study of medicine in any recognized school. Or, the student may utilize his training to become a health official,

a laboratorian, a teacher in the pure or applied aspects of biology, sanitary science or public health.

The preparation in industrial biology offered in Option 2 qualifies the graduate as an expert or technician in some line of food production and manufacture, or in the fermentation industries. Recently a special course of study has been developed in the field of fisheries technology leading to promising positions in the great fisheries industry. The degrees of Master of Science, Doctor of Science and Doctor of Philosophy are offered in both options.

### **PHYSICS**

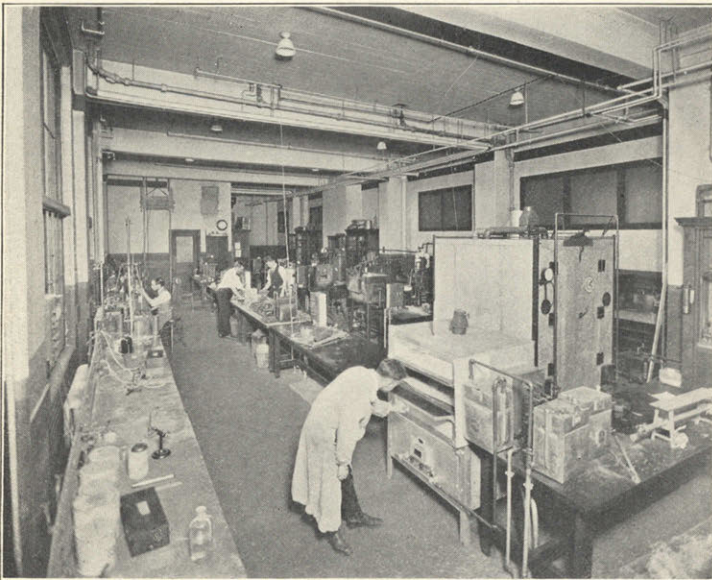
The course in physics at the Institute has in the past few years gradually changed in significance. A short time ago a specialist with a training in physics found little outlet for his knowledge save in teaching. Industry has come to realize, however, that the need for research physicists is just as pressing as the need for research chemists and that industrial physics and industrial chemistry are subjects of equal importance. The work of the physicist in industry is primarily development work and therefore it is concerned more frequently with new problems than with any routine of production or repeated analyses. The course in physics at the Institute is consequently designed to inculcate into students habits of scientific inventiveness. Work is given which covers a wide range of subjects. Graduates of the course may find themselves in charge of research laboratories of scientific institutions or working upon such specific problems as optics, the manufacture of glass and insulating materials, the development of vacuum tubes and radio apparatus, the development and manufacturing of X-Ray apparatus, upon the micro-structure and hardness of metals, refractories and other structural materials, upon the design of airplane structures and the study of airplane performance.



This latter subject, of such rapidly increasing proportions, is dealt with at the Institute by a separate division of aeronautical engineering.

## GEOLOGY

The undergraduate course in geology at the Institute does not aim to specialize, but does give a broad training in geological science which equips a man to enter after graduation upon work in the purely scientific or the more practical aspects of geology. Geology is the science of the earth, and, therefore, in an applied sense, deals with the earth from the viewpoint of its industrial development. Securing the economic resources of the earth, whatever they may be, is more than an engineering problem. Successful explorations for these resources depend upon geologic science. Today the larger



One of the extensive physical laboratories. This particular room is especially equipped with appliances for the study of illuminating gas in all its uses

mining companies, many railroads and most oil and coal companies place a heavy dependence upon their geological staffs, and in many other engineering projects geologic knowledge is of paramount importance. The field of government service is likewise one in which geologists find considerable opportunity.

The geological laboratories are equipped with many collections and much apparatus so that the students may have ample working material. Practically all the equipment of the department is actually used and handled.

The scientific basis of geology rests largely upon physics and chemistry, and a great part of the work of the first two years is spent upon these subjects. The work of the last two years takes on an increasingly professional tinge. Students in geology and geological engineering take a summer surveying course similar to that previously described for civil and mining engineers.

### **ELECTROCHEMICAL ENGINEERING**

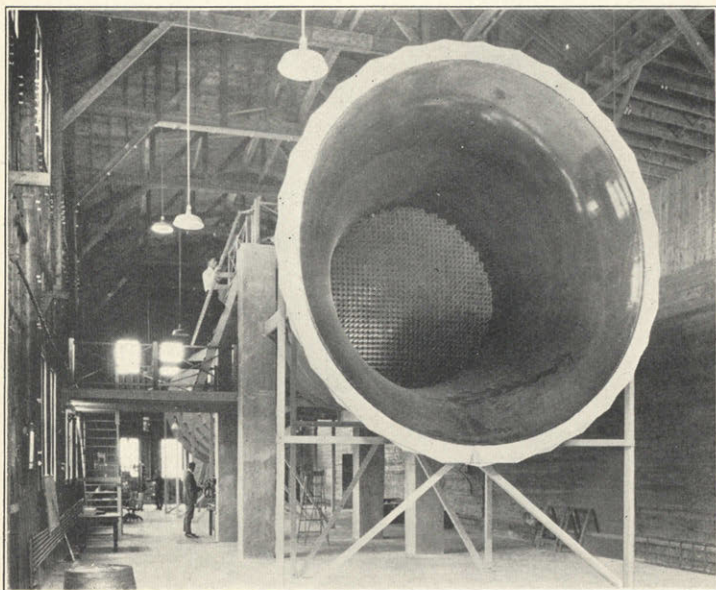
The course in electrochemical engineering is of necessity a composite course, inasmuch as it rests upon the broad fundamentals of physics, chemistry and electrical engineering. The course in electrochemical engineering was established to fill the increasing need for men who would not only understand the principles of physics, chemistry and electrical engineering, but who would also have a knowledge of their application to the problems embraced in the field of electrochemical engineering.

Instruction in electrochemistry extends throughout the third year. The third and early part of the fourth years are devoted to the consideration of the theoretical aspects of the science. Its application to the industries is taken up in the latter part of the course. A large amount of time is devoted to work in two laboratories which have been especially

equipped for carrying out all types of electro-chemical and electric furnace operations. Because of the limited capacity of these special laboratories the number of students who can be admitted to the course is necessarily restricted. In the senior year students are allowed considerable latitude in choice of studies and may select work in the departments of electrical engineering, chemical engineering, or metallurgy.

## ARCHITECTURE

The department of architecture offers two options, one which regards architecture itself as a fine art and the other which deals with architectural engineering. A certain amount of structural study is of course required in the first option, but stress is placed upon work in design more than upon the



The larger of the Institute's two wind tunnels in which aerodynamic tests are conducted on model airplanes, dirigibles and wing surfaces

practical element of construction. Architectural engineering is in no sense to be regarded merely as structural engineering. The student takes considerable work in architectural history and philosophy of architecture, but studies likewise such subjects as the materials of engineering, building construction, structures, surveying, foundations, and mechanical equipment of buildings.

### **ENGINEERING ADMINISTRATION**

Recognizing the value of a technical education as a foundation for a future administrative position in industry the Institute offers a course in engineering administration, which gives besides fundamental engineering subjects special studies along the lines of business economics.

The Institute's course in engineering administration is one, to quote from the report of the Committee which recommended the establishment in 1913, "whose aim shall be to furnish a broad foundation for ultimate administrative positions in commerce and industry by combining with the general engineering training instruction in business ethics, business economics and business law." The course in engineering administration consequently attracts men who are interested in the business methods by which an engineering or manufacturing plant is operated, as for example, the proper organization of a plant in its administration and management, the purchase of material, the care, storage and manufacture of supplies, the routing of orders, hiring and treatment of employees, efficiency methods, the analysis of accounts and statistical records and the advertising and selling of goods.

These subjects deal with human relationships rather than with chemical and physical principles. At the same time it is essential that graduates understand mathematics, physics and chemistry in order that they may properly apply them to economic

and commercial practice. The course consequently is a combination of engineering subjects and studies in business economics. About one quarter of the more advanced and specialized engineering work is omitted in order to make room for courses in accounting, cost accounting, banking, statistics, industrial organization and finance, securities and investment, business management, marketing and business law.

Three options are provided in this course, the first in civil engineering, the second in mechanical and electrical engineering and the third in chemical engineering. Opportunity is thus given the student to take a sufficient amount of work in the fundamental engineering subjects of these respective options to understand some of the scientific problems involved in business practice.

#### **GENERAL SCIENCE AND GENERAL ENGINEERING**

With the realization that other courses at the Institute may not be sufficiently flexible for the interests of many students who do not wish to specialize, courses are offered both in general science and general engineering. These courses supply the want which many students feel for the elective system in force in many universities. All other courses at the Institute have prescribed curricula of varying degrees of rigidity, but in these courses the student may elect work in any department of the Institute which interests him, allotting any proportion of his time which he desires to the studies he wishes to take, subject only to the approval of the head of the general courses. Under the same administration as these general courses, a course in pure mathematics has recently been established.

#### **GRADUATE STUDY AND RESEARCH**

The scope of this pamphlet does not permit more than brief mention of the opportunities for graduate study and research. The equipment of the Institute

laboratories and its close coöperative relation with many of the prominent industries of the country bring to its doors for solution a great number of technical and scientific problems. Graduate students and fellows of the Institute are thus brought in direct contact with the practical needs of the day and their training here eminently fits them upon the completion of their studies for high research positions in industrial organizations. These practical problems are unequalled as a means of training men to fill such positions and it is for this reason that the Institute has built up its industrial contacts over a period of many years.

### **UNDERGRADUATE ACTIVITIES**

Student life at Technology centers around the Walker Memorial, a four-story modern building facing the Charles River, built and presented by the Alumni to the student body as a recreational and social center. It contains a large gymnasium, a bowling alley and billiard room, three dining halls, a fiction library of some three thousand volumes, numerous lounges, and offices for the various student activities. The athletic field, baseball diamonds, tennis courts and the dormitories group themselves about this building to form a student center set apart from the Main Educational Buildings.

The principle of student government applies at the Institute. The governing body is known as the Institute Committee, an organization composed of the chosen representatives of each undergraduate class, and of the major student activities, whose duty it is to consider and act upon all affairs concerning the extra-curricular interests and activities of the students.

The so-called "student activities" at the Institute embrace the publication of a tri-weekly newspaper, a monthly humorous magazine, a monthly technical journal, and a year book; the complete production, every year of a musical comedy written, composed,

staged, acted and managed by undergraduates; the operation of glee, banjo and mandolin clubs, and so on.

Although the Institute maintains no varsity teams in football or baseball, it is well represented by extra-mural teams in the following sports: basketball, boxing, crew, cross-country, fencing, golf, gym, hockey, rifle shooting, soccer, swimming, tennis, track and wrestling.

From these paragraphs it may be seen that while the curriculum of the Institute allows no time for idleness, there is no reason why a mentally alert student cannot, to good advantage, enjoy the broadening influences of activities exterior to the class room.

### **SUMMER SESSION**

Many of the subjects of the Institute's curriculum are given by regular members of the staff during the summer. These are described in detail in the special bulletin entitled "Summer Session." Entrance subjects are also given during the summer and special courses for teachers in secondary schools on methods of teaching mathematics and physics are likewise offered.

### **FURTHER INFORMATION**

A more detailed description of these undergraduate and graduate courses, the Institute laboratories and equipment, is given in other publications, particularly the departmental circulars. A detailed list of these is given on the outside back cover of this pamphlet. Information as to living conditions in Cambridge and vicinity, the dormitories, expenses, etc., are covered in the booklet entitled "General Information and Requirements for Admission." Specific details not covered in any of these can be obtained by addressing the Registrar, Massachusetts Institute of Technology, Cambridge A, Mass.

Organized Technology alumni clubs exist in most of the large cities of the country, and their

officers and members (as well as individual alumni, in places where no such clubs exist) may be consulted for information about the Institute. Information as to the nearest available club or alumnus can also be obtained by addressing the Registrar.

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## Publications of the Massachusetts Institute of Technology

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### BULLETINS

#### MASSACHUSETTS INSTITUTE OF TECHNOLOGY

<i>Title</i>	<i>Vol.</i>	<i>No.</i>	<i>Date of Publication</i>
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Military Science and Tactics. R. O. T. C. . . . .	59	11	August, 1923
General Engineering . . . . .	59	12	April, 1924
(Course IX-B Circular)			
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Biology and Public Health Department Cir- cular . . . . .	58	8	September, 1922
The Research Laboratory of Physical Chem- istry . . . . .	58	9	March, 1923
Engineering Administration. (Course XV Circular) . . . . .	58	10	May, 1923