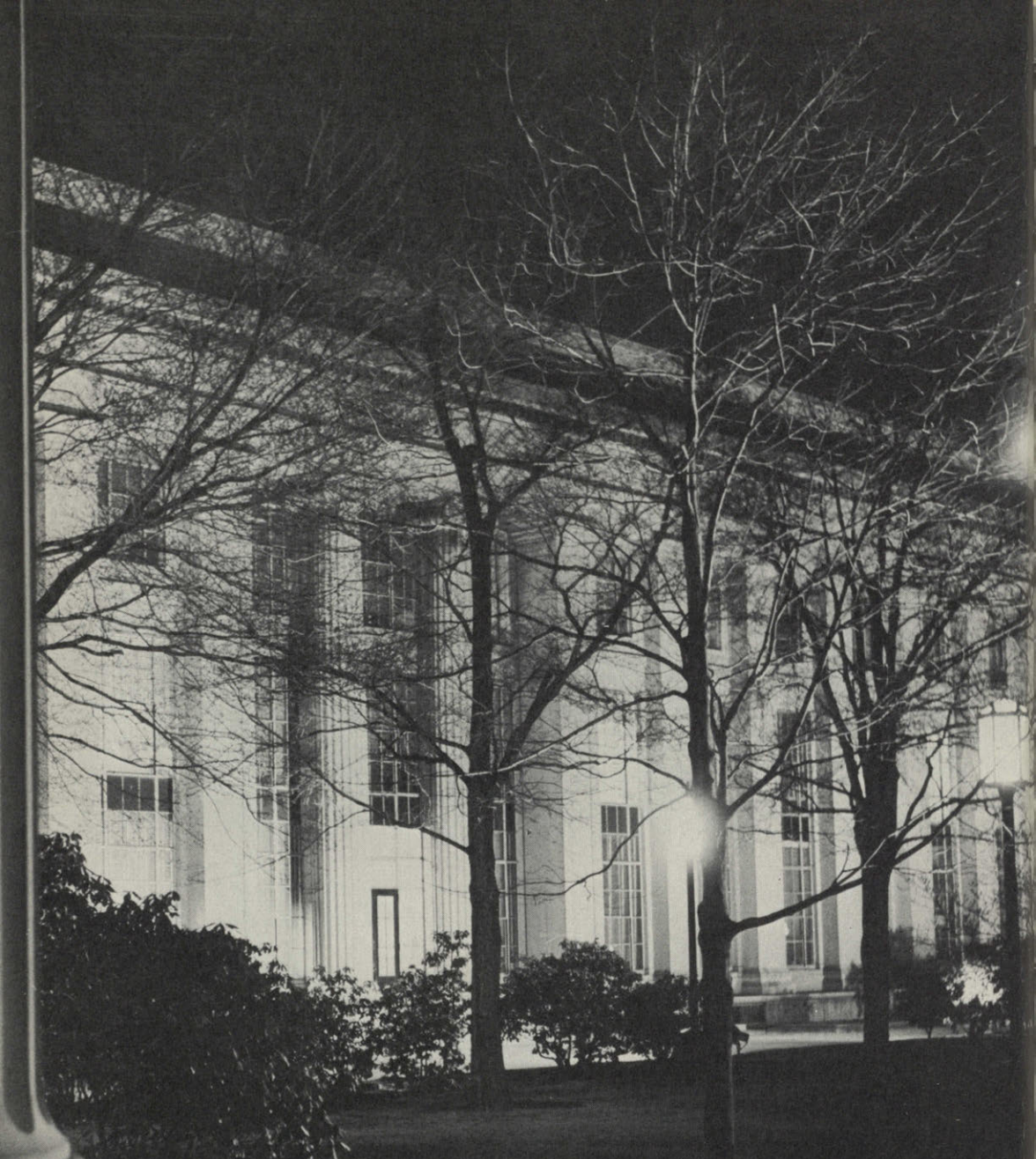
This Is M.I.T.

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

BULLETIN

THE UNDERGRADUATE CATALOGUE ISSUE 1958-1959 VOL. 92, NO. 5, MAY 1957



MASSACHUSETTS INSTITUTE OF TECHNOLOGY BULLETIN

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Issues of the Bulletin include the reports of the Treasurer and of the President, the Summer Session Catalogue, the Undergraduate Catalogue, and the General Catalogue.

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This Is M. I. T.

THE UNDERGRADUATE CATALOGUE FOR 1958-1959

MASSACHUSETTS INSTITUTE OF TECHNOLOGY, Cambridge 39

ACADEMIC CALENDAR

1957

September 19	FIRST TERM 1957 BEGINS FOR FRESHMEN
September 23	FIRST TERM BEGINS FOR UPPERCLASSMEN
October 12	COLUMBUS DAY (HOLIDAY)
November 2	FIELD DAY (HOLIDAY)
November 11	VETERANS' DAY (HOLIDAY)
November 28 *through December* 1	THANKSGIVING VACATION
December 21 *through January* 5	CHRISTMAS VACATION

1958

January 22	LAST EXERCISES, FIRST TERM
January 23-25	READING PERIOD
January 27-31	EXAMINATION PERIOD
February 10	SECOND TERM BEGINS
February 22	WASHINGTON'S BIRTHDAY (HOLIDAY)
March 31 *through April* 6	SPRING VACATION
April 19	PATRIOTS' DAY (HOLIDAY)
May 27	LAST EXERCISES, SECOND TERM
May 28-31	READING PERIOD
May 30	MEMORIAL DAY (HOLIDAY)
June 2-6	EXAMINATION PERIOD
June 13	COMMENCEMENT DAY
June 23	SUMMER SESSION 1958 BEGINS
September 17	FIRST TERM 1958 BEGINS FOR FRESHMEN
September 22	FIRST TERM BEGINS FOR UPPERCLASSMEN
October 12	COLUMBUS DAY (HOLIDAY)
	(Exercises omitted Monday, October 13)
November 1	FIELD DAY (HOLIDAY)
November 11	VETERANS' DAY (HOLIDAY)
November 27-30	THANKSGIVING VACATION
December 20 *through January* 4	CHRISTMAS VACATION

1959

January 21	LAST EXERCISES, FIRST TERM
January 22-24	READING PERIOD
January 26-30	EXAMINATION PERIOD
February 9	SECOND TERM BEGINS
February 22	WASHINGTON'S BIRTHDAY (HOLIDAY)
	(Exercises omitted Monday, Februray 23)
March 30 *through April* 5	SPRING VACATION
April 19	PATRIOTS' DAY (HOLIDAY)
	(Exercises omitted Monday, April 20)
May 26	LAST EXERCISES, SECOND TERM
May 27-29	READING PERIOD
May 30	MEMORIAL DAY (HOLIDAY)
June 1-5	EXAMINATION PERIOD
June 12	COMMENCEMENT DAY

TABLE OF CONTENTS

1 *This is M.I.T.*

The Massachusetts Institute of Technology is an independent, endowed educational institution which has concentrated its resources in certain broad areas: science, engineering, architecture and planning, industrial management, and the related humanities and social studies.

Through this principle of concentration M.I.T. brings to the areas of its major interests the services of a distinguished faculty, together with physical facilities of unparalleled variety and completeness. Indeed, Dr. James R. Killian, Jr., M.I.T.'s tenth president, today describes the Institute as a "new kind of university"—a school polarized about science where teaching and creative activities of highest professional stature are pursued in a limited range of fields now deeply relevant to the world's social, economic, and political opportunities. On the next pages Dr. Killian—himself a graduate of the Institute—restates as he sees them the philosophy and grand plan to which M.I.T. is now devoted.

An alumnus of M.I.T., after recently revisiting the Institute, has written: "The moment you are inside M.I.T., its calm exterior is forgotten. You are in a world of intense activity. Along five miles of corridors flows a constant tide of students, resolutely moving on urgent business. Through hundreds of doors you see shirt-sleeved professors and students working together at desks and benches. The air pulses with life."

"...We are preoccupied with a basic concern for the individual..."

Dr. James R. Killian, Jr., President of M.I.T., restates the Institute's long-term policies and objectives.

The Massachusetts Institute of Technology is a professional school in which professional standards of conduct, performance, and unselfish public service are controlling. Within the framework of these professional ideals, we at M.I.T. seek to educate men and women who have the competence of specialists plus a sense of the human values which extend far beyond specialized interests. We believe that this combination of professional and general education has exceptional relevance and power in preparing young people for careers of action and effective citizenship.

We carry on our work in the spirit of the university, including in close relationship post-doctoral, graduate, and undergraduate learning. The spirit of research and of other forms of creative scholarship infuses all our educational activities. As a "university bound in lesser volume," we embrace a few carefully selected objectives, concentrating our resources on fields involving science or which thrive in association with science. In fact, since its beginning M.I.T. has been evolving into a new type of educational institution, a modern university built around science and social technology rather than classical studies, but embracing the arts, the social sciences, and the humanities as essential partners in our corporate culture.

The Institute designs its educational program for a highly selected group of students, young people of intellectual promise and high personal qualifications. With a student body thus carefully chosen, we believe that our undergraduate program can be more advanced, its standards higher and its scope broader than in institutions where the student selection is not so great. So it is that we also believe in giving our students a maximum of choice consistent with the maintenance of professional standards, and in having them accept unusual responsibilities for their own intellectual progress and for the development of mature and responsible personal and community conduct.

We encourage original research in pure and applied science, since teaching of the highest type, especially in science and its applications, thrives best in intimate association with creative work which extends the boundaries of human knowledge. He who is still a student, who is still himself learning, can best guide those who are about to enter professional careers. The most striking features of research at M.I.T. are the spirit of co-operative effort in which it is conducted and the extent to which both undergraduate and graduate students participate in it as an integral part of their educational experience.

We seek always to provide exceptional facilities for study and research. This means more than well-equipped laboratories and class rooms, which are vital; it includes an environment which places learning in a setting of beauty and dignity which can lift the spirit.

We at M.I.T. do not accept the parochial view that breadth and humanism in education are the exclusive property of a particular kind of education. It is the outlook, the humanity, the wholeness of the teacher, the humane spirit of a community of scholars governed by ideal aims which are really important in achieving breadth and humanism in education. We are influenced by this conviction in selecting our Faculty, since we seek gifted teaching as well as distinguished scholarship. It is also our conviction that education which is truly humanistic must have social utility and relevance to the current needs of society. We seek this relevance and utility along with the generalizing benefits of perspective and theory. In the Faculty, in the student body, and throughout the Institute we are preoccupied with a basic concern for the individual, his responsibility, his growth, his freedom, and his dignity. We can thus exemplify the liberal arts as well as teach them.

CREATIVE EDUCATION: *". . . a feel for materials, an experimental attitude, theory tested by reality."*

THESE ARE THE CONCEPTS

The typical M.I.T. student enters his freshman year directly from high or preparatory school; he follows a four-year (or, in architecture and some co-operative Courses, a five-year) program of study in the undergraduate school. He finds an environment at once friendly and extraordinarily stimulating, one which will help him develop his interests and powers to the fullest extent. His educational experience results from five major concepts on which M.I.T.'s program is built:

1. ADVANCEMENT OF KNOWLEDGE

M.I.T. by charter and in spirit exists for the purpose of advancing knowledge. It fulfills this fundamental purpose by means of a two-fold program of education and research. The research activities of the Institute are evidenced in the notable additions to knowledge made by its staff. M.I.T.'s larger duty is, however, to provide young men and women with a sound and well ordered education to the end that they will be useful and productive members of society.

2. CREATIVE EDUCATION AND RESEARCH

The word *creative* best describes all the Institute's activities. Its original research is essentially creative. Its educational program is carried through in the spirit of creativeness. Students learn in an atmosphere where new fields of knowledge are being explored daily by the same men who are teaching them the established knowledge basic to thorough understanding and creative research. The undergraduate program brings students through the settled area of knowledge, shows them the present-day frontier, and points out to them the vast territories that have yet to be explored. Dr. George R. Harrison, Dean of the School of Science, believes this creative professional atmosphere to be "the quality that most distinguishes undergraduate education at M.I.T."

3. EDUCATION BASED ON FUNDAMENTALS

Not all M.I.T. students are going to be research scientists. The large majority will find creative satisfaction in applying established, useful knowledge to business and industry that form the backbone of present-day society. The difference between the pure scientist—whose chief concern is to evolve and explore new scientific theories—and the applied scientist—whose chief concern is the practical application of those theories to a particular industry—

is merely a matter of emphasis. The M.I.T. program is a good beginning for either. Students here become familiar with the whole scientific endeavor of which their specialized training is a part; as graduates they will have both competence in a specialized field and a wide understanding of scientific advances—prerequisites to the creative practice of technical professions.

4. LEARNING BY DOING

"Learning by doing" was an important concept in founding M.I.T., when experimental laboratories were uncommon in higher education. It is still a basic concept at M.I.T.; today "learning by doing" means learning by *thinking about* what one is doing. It is an expression of the interdependence of the theoretical and the practical, of the lecture room and the laboratory. The questions "Why does it work?" and "Why does it happen?" are discussed in the lecture room; the questions "How does it work?" and "How does it happen?" are answered in the laboratory, where students themselves construct the practical application of the theory and watch it work. The Geology Camp, practice schools, co-operative courses, and many opportunities for students of M.I.T. to visit industrial plants carry further this idea of learning by doing.

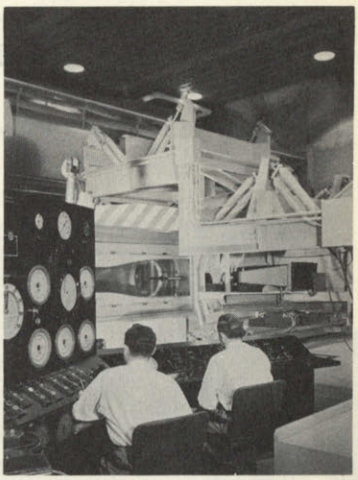
An alumnus has recently written that "the core of M.I.T.'s success is its power to vitalize its students' hidden reserve of energy and imagination. Constant contact with experiment gives them the habit of vigorous attack upon any problem—a habit that soaks into their bones and serves them for the rest of their lives."

5. THE IMPORTANCE OF USEFUL KNOWLEDGE

The man doing research in nuclear physics, the engineer in the field, the executive in industry, and the architect of the city are all holding responsible positions; their work affects the entire structure of society. No one needs much imagination to see these effects. Science has brought visible changes in towns and cities, and engineering has revolutionized the pattern of everyday living. Advances in transportation and communication have created a smaller world, which in turn has influenced political happenings and cultural views; the atomic age has influenced the world of ideas as well as the course of world events. These constant examples of the effects of scientific progress on society emphasize for those who teach and study at M.I.T. the importance and worth of their work.

6. DEVOTION TO THE HIGHEST STANDARDS

A basic characteristic of the Institute is its devotion to the highest standards. There is what Dr. Killian has described as a "traditional and established role of stressing excellence." M.I.T. students traditionally expect hard work; no one can achieve the highest standards without it. But this is an environment in which hard work is challenge—and in which it is combined with nonprofessional activities of great intensity and variety.



Operating the supersonic wind tunnel.

Student-faculty architecture conference.

7. EDUCATION FOR CITIZENSHIP

M.I.T. graduates are among the men who will create and administer scientific and technological progress in a world where science and technology have come to be sources of security to free nations and determinants of world affairs. Society looks to the scientist for a wider form of leadership than he has traditionally supplied, a form of leadership based on a thorough knowledge of the entire cultural environment of which his work is a part.

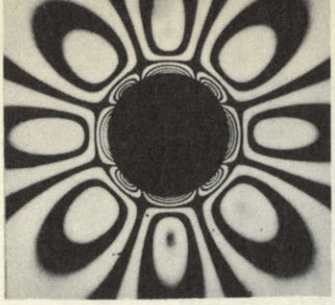
For this reason, the School of Humanities and Social Studies offers an integrated program to introduce M.I.T. students to the wider world of ideas, attitudes, and beliefs, historical and current, that determine the structure of present-day society. This program helps M.I.T. send out graduates who are men and women of broad perspective, qualified to take positions of leadership in scientific, industrial, national, and international affairs. An engineer, for instance, studies history, literature, and philosophy not as ornaments but rather because he can scarcely be a first-rate engineer without them.

This aim cannot be achieved solely by formal courses. Voluntary student activities contribute to the same end. Student government, athletics, and campus living are also educational in themselves. They offer every student the experience of practice in democracy on a campus-wide scale and provide all the members of this community with a chance to exercise responsibility and leadership.

Dean John T. Rule

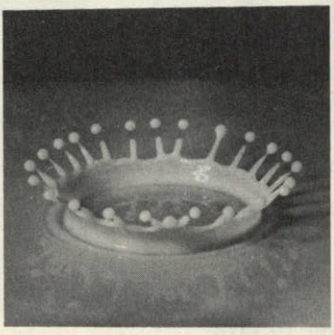
Professor John T. Rule, Dean of Students at M.I.T., believes "the best source of general education for all maturing students is other students who have developed successfully. We are certain that the atmosphere of student responsibility and freedom in the Institute's student government most effectively develops our students' judgments and understandings of the world of action within which they will always live."

Going to M.I.T. is thus a broad gauge undertaking. Students find a thorough basic knowledge of their professions; a concept of the effects of their work in its social context; and preparation for the non-professional demands of life to fulfill *more than adequately* the requirements of good citizenship.

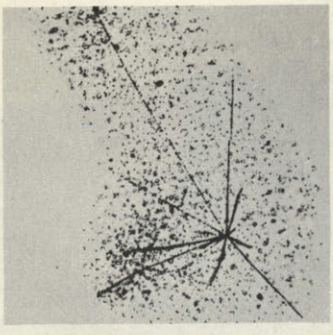


Stress analysis by photoelasticity.

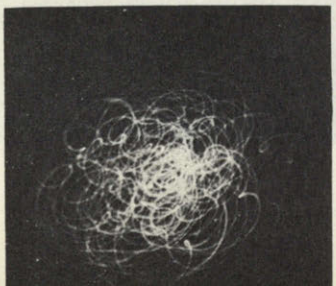
Crystals of a new nickel-chrome alloy.



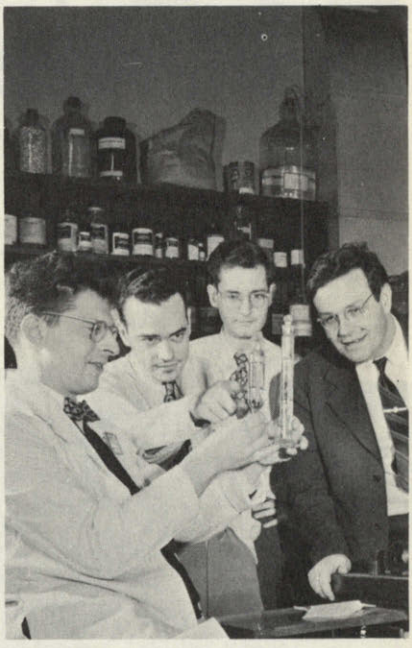
High-speed camera: sculptor of liquids.



A cosmic ray in a nuclear emulsion.



Sound pictured on an oscilloscope.



Music: a rehearsal of the M.I.T. Concert Band

"AS LONG AS YOU LIVE, KEEP LEARNING TO LIVE"

Sports: M.I.T. dinghies on the Charles River Basin

Philosophy: Visiting Professor Philipp Frank with a Humanities seminar.

Fellowship: student and teacher meet informally.

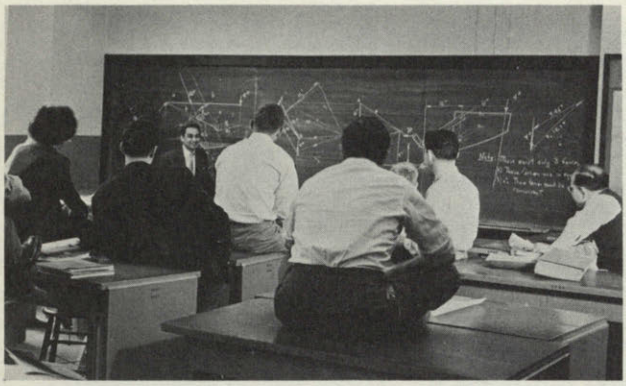
Parties: the annual Junior Prom.

Members of the Aeronautical Engineering Department's Visiting Committee watching a wind tunnel demonstration.

THESE ARE THE PEOPLE

In a legal sense, the Institute (which is not a state university) is a body of trustees known as the Corporation, chartered by the Commonwealth of Massachusetts in 1861. These men, distinguished leaders of science, industry, and education, are active in guiding and planning the Institute's program. Each department has its counselors, members of the Visiting Committees, who are leaders in their respective professions. Members of the M.I.T. Faculty, through their own activities and through their committees, share in this responsibility of charting M.I.T.'s course. Students, through their elected student government, administer their own affairs and take responsibility to an unusual degree in operating the total enterprise. Alumni are represented in the membership of the Corporation and of the Visiting Committees, and through the Alumni Association of the Massachusetts Institute of Technology fulfill other obligations in guiding the Institute. Through their membership in the Educational Council, many alumni are active in the important work of counseling high school students.

M.I.T.'s academic departments are grouped for administrative purposes into the five Schools which are shown in the chart in the second section of this book. Each School is headed by a Dean as administrator. The Dean of the Graduate School supervises graduate study, and the Dean of Students is directly concerned with student life and welfare.



". . . men who teach with zest, dedication, and art."

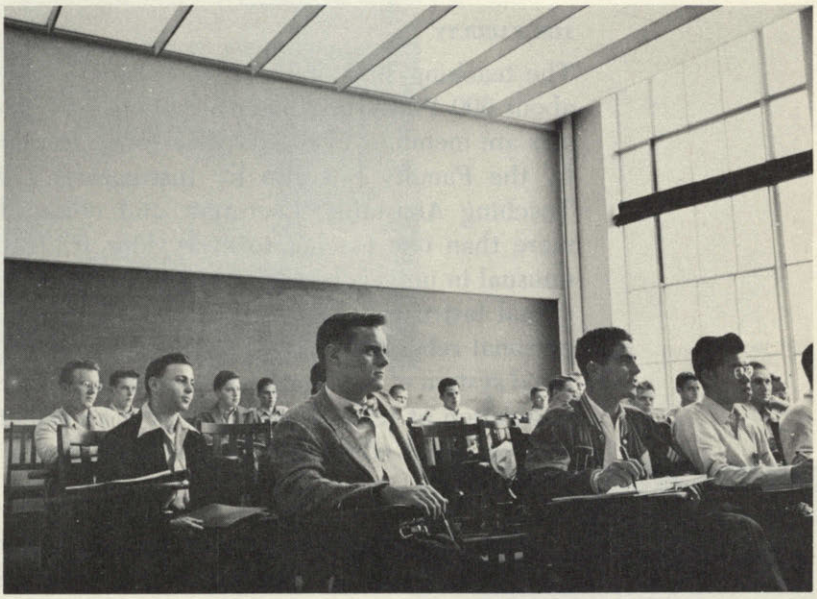
THE FACULTY

The teaching staff of the Institute totals about 1,800, of whom about 600 Professors, Associate Professors, and Assistant Professors are members of the Faculty. Since teaching is done not only by the Faculty but also by Instructors, Technical Instructors, Teaching Assistants, Lecturers, and others, there is in general more than one teacher to every four students. This proportion, unusual in university education, assures full opportunity for individual instruction and for personal discussion of problems. This personal relationship is encouraged, too, by a carefully administered system of registration officers and advisers to students. Close association of teacher and student is an essential part of M.I.T.'s philosophy of education. Beyond that, it is a source of pleasant friendship.

Teachers at M.I.T. are a varied and interesting group. Many are scholars of distinguished achievement. Some are scientists and engineers internationally known for applications of science and engineering knowledge in enterprises of great magnitude. Some are theorists who are working daily on the most remote frontiers of new knowledge. All bring into the classroom and lecture hall a wide range of firsthand professional experience which helps render their teaching immediate and compelling.

Indeed, a committee of M.I.T. Faculty members has recently reported that "effective teaching in all its aspects can flourish only when fed by continuous, active contact with research and with the realities of our industrial, economic, and social life. It is safe to assert that the Institute owes its educational position to a large extent to the possibility of such variegated activities."

A versatile group as well—with broad interests outside their professional lives—the M.I.T. instructing staff includes orchid growers, painters, writers, sculptors, boat builders, woodsmen, and all sorts of other hobbyists. There is a mathematics professor, for instance, who has pitched professional baseball and a mechanical engineering professor whose paintings have carried off prizes. There are scores of people who are interesting as people and who—more than that—are interested in people, responsive to friendship, and therefore ready to go more than half way in helping their students. M.I.T. is a friendly place.



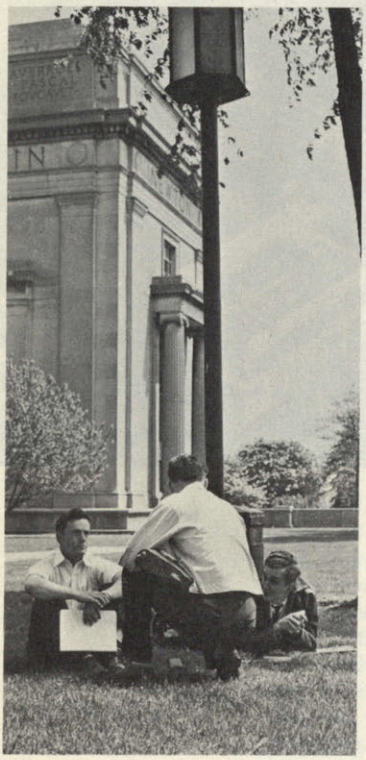
THE STUDENTS

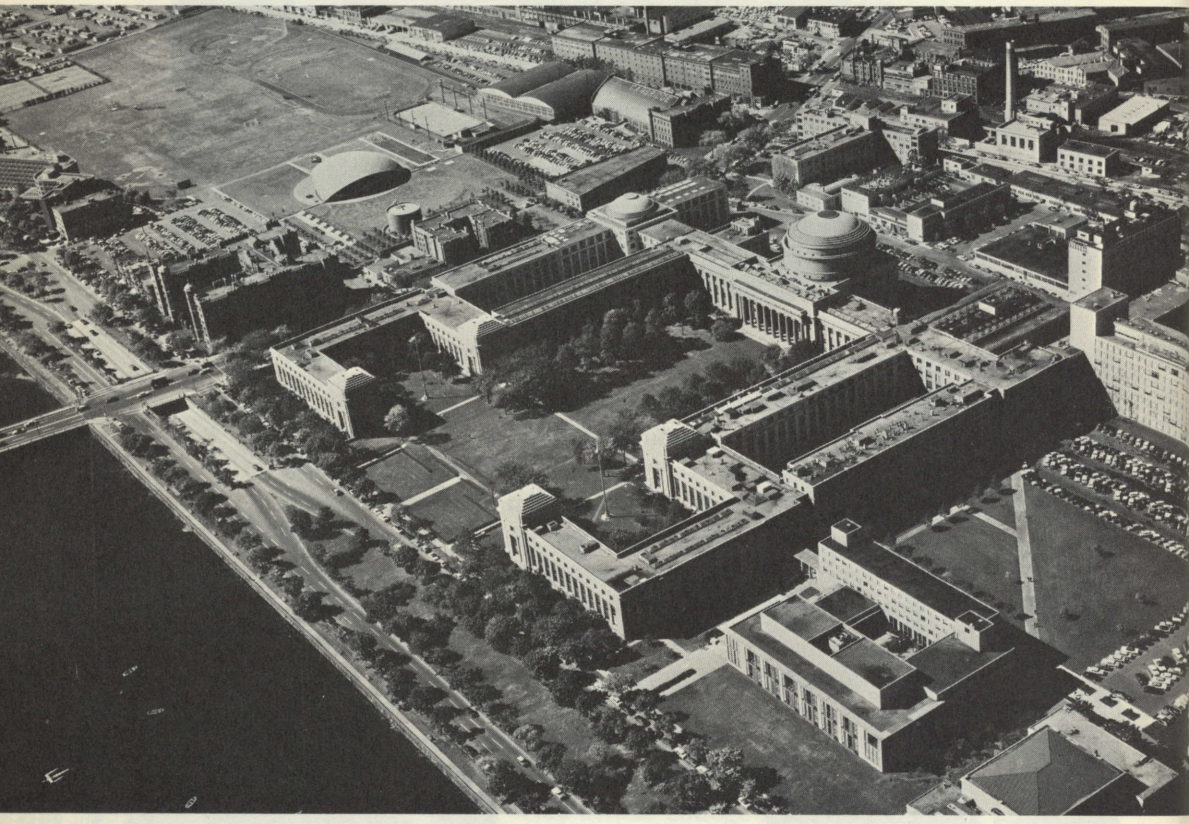
In selecting its students, the Institute seeks quality rather than numbers. Only a limited number of students can receive education of high calibre from a given number of professors, laboratories, libraries, and dormitories. Such a limitation on the number of students, coupled with the large number of applications for admission each year, makes it certain that those who attend M.I.T. may be young men and women outstanding as students and also as people.

If there were such a thing as an "average" undergraduate, he would have been 18 years old when he entered as a freshman and he would be a graduate of a public or independent secondary school. This typical M.I.T. student is not very different from any other top-ranking, wide-awake college student. He is not a bookworm or a genius; he has a good basic intelligence and a sincere and conscientious interest in his work, and he enjoys athletics and campus activities.

In all, there are about 4,000 undergraduate and 2,000 graduate students at M.I.T.

Students come here from every state and virtually every country of the world; indeed, the Institute's proportion of foreign students is the largest in any college in the nation.





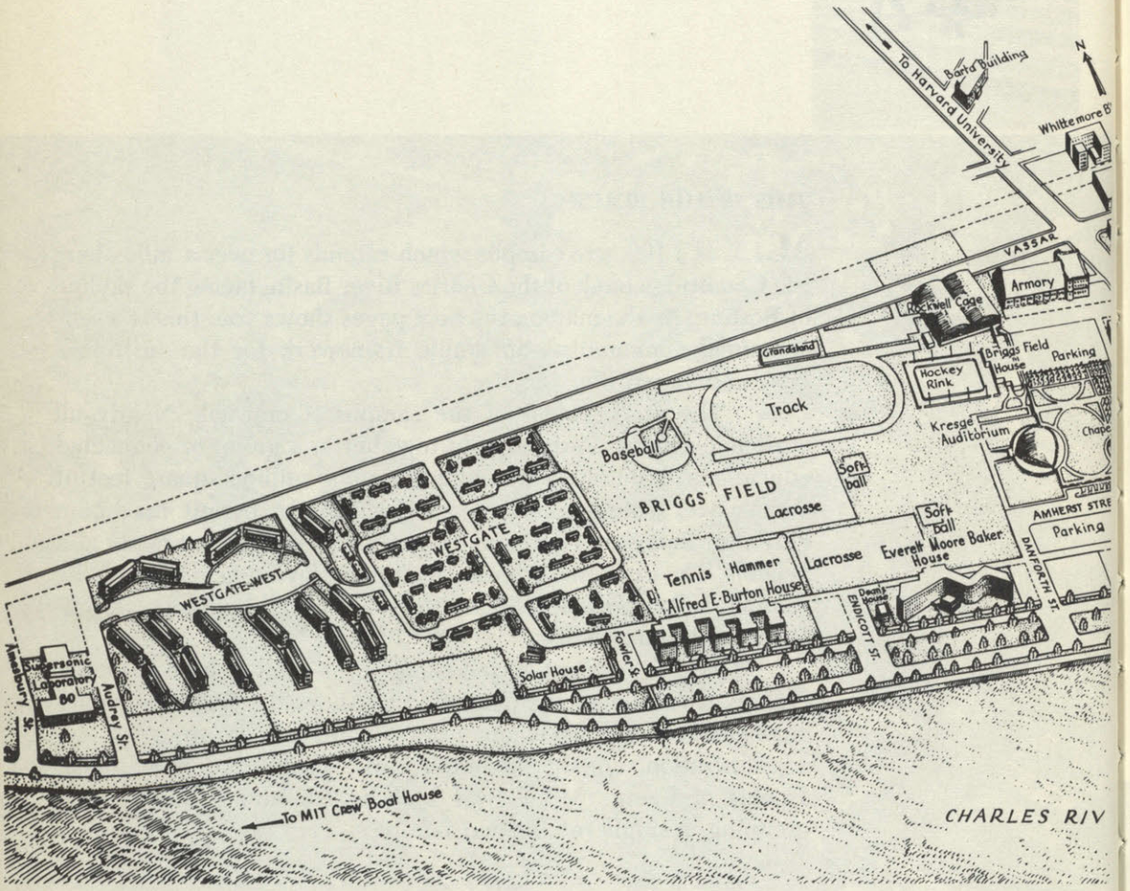
THIS IS THE PLACE

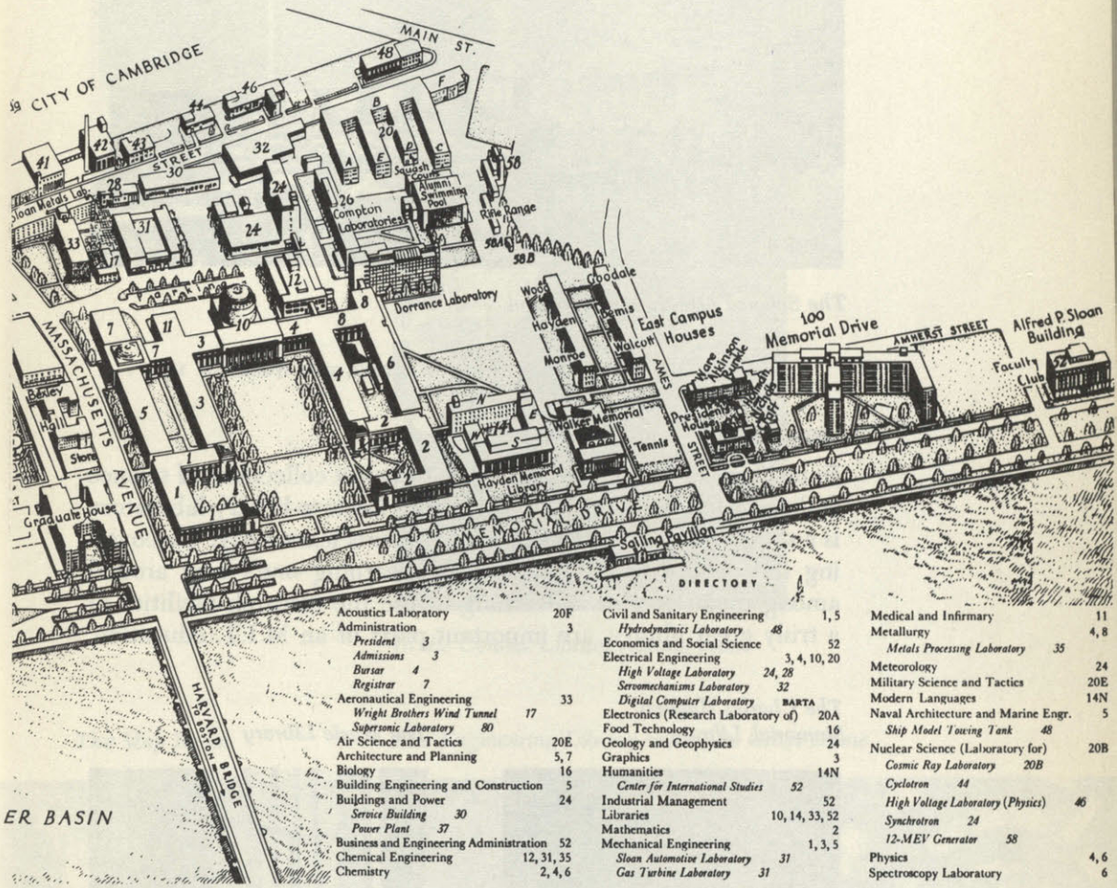
M.I.T. is a 100-acre campus which extends for over a mile along the Cambridge bank of the Charles River Basin, facing the skyline of Boston. As the map on the next pages shows you, this is a self-contained community—an ample framework for the Institute's busy and varied life.[1]

The arrangement of the campus is unusual. Nearly all academic activities are brought together in a group of connected educational buildings containing over one million square feet of floor space. These buildings are designed to permit maximum flexibility and easy communication among the Departments and Schools. The extensive athletic plant and playing fields are on the campus, fully accessible. So are the recreational buildings, dormitories, and dining halls.

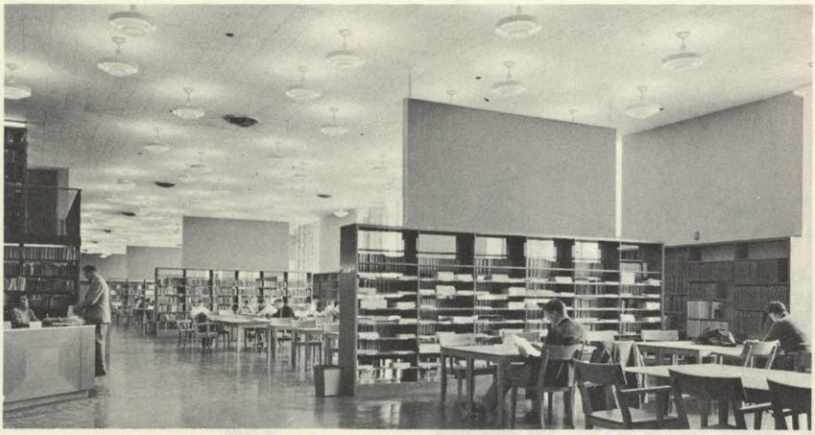
This convenient arrangement of the campus is no accident. It is an expression of the unity that pervades the Institute—unity among the sciences and humanities, among Faculty, students, and administration, among the intellectual, social, and recreational aspects of living. M.I.T. was built to contain, in harmonious grouping, a single intellectual family.

[1] Some of M.I.T.'s diversified technical activities spread beyond Cambridge. The School of Chemical Engineering Practice operates three field stations—in Buffalo, New York; Parlin, New Jersey; and Bangor, Maine. There is an Engineering Practice School at Oak Ridge, Tennessee, and the Department of Geology and Geophysics shares in the Nova Scotia Centre for Geological Sciences near Antigonish, Nova Scotia. Projects in meteorology and other fields are carried on at Round Hill near South Dartmouth, Massachusetts. The Institute operates the Lincoln Laboratory in Lexington, Massachusetts, and aircraft used in meteorology, instrumentation, and other studies are based in an M.I.T. hangar at Bedford Airport, near Lexington.





DIRECTORY



The Science Library reading room

". . . A PLEASURABLE VENTURE AMONG THE WORKS OF MAN . . ."

LIBRARIES

In its libraries M.I.T. has one of the foremost collections of science and engineering literature in the world. Lecture-library-laboratory is a sequence and relationship that students learn early. Discovering the delight of great books and learning one's way around among them, as well as learning to use the research facilities of a truly great library, are important parts of an M.I.T. education.

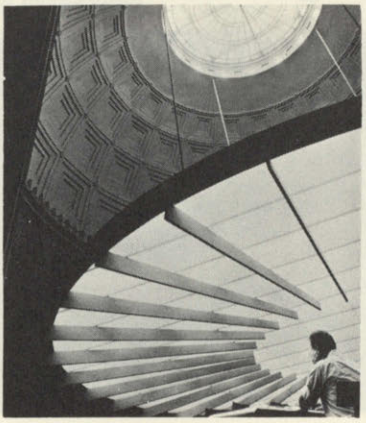
The Charles Hayden Memorial Library

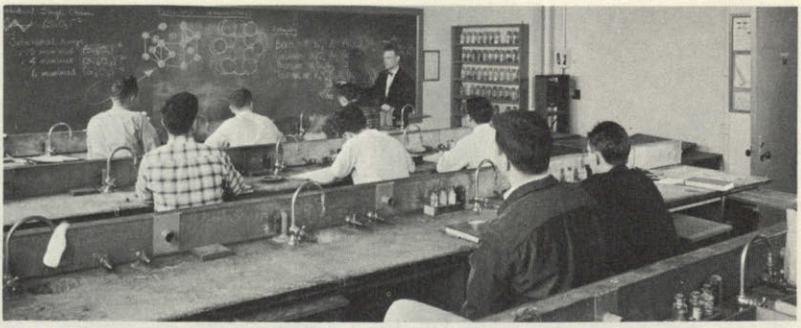
The Music Library

In the Central Library reading room

The Map Room

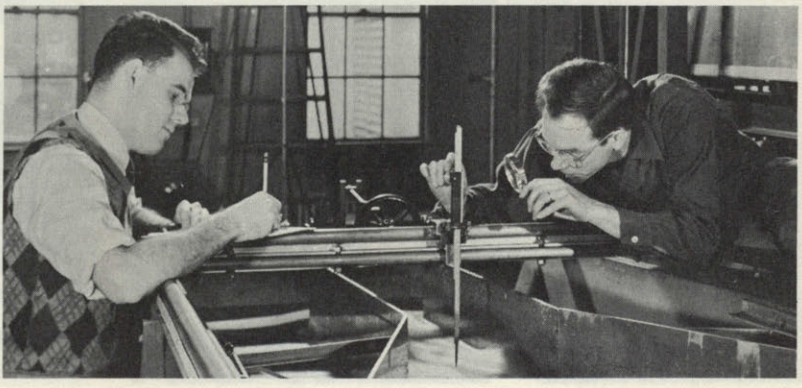
The Engineering Library under the Great Dome



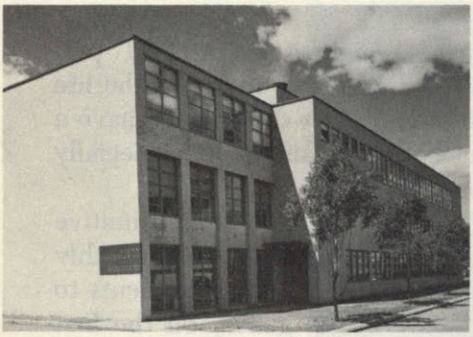


LABORATORIES

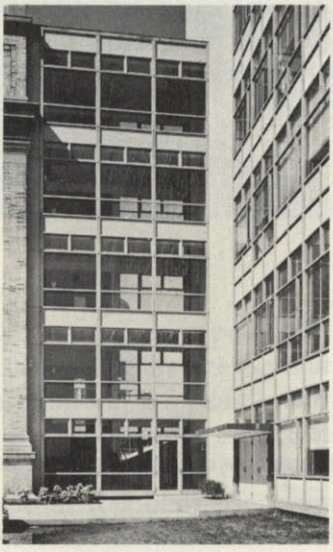
Most of the laboratories which have brought national fame to M.I.T. are devoted to teaching as well as research—and so are familiar to many M.I.T. students. There are more than 70 such special laboratories—among them the Laboratory for Nuclear Science, the Research Laboratory of Electronics, the Gas Turbine Laboratory, the Acoustics Laboratory, the Metals Processing Laboratory, the Samuel Cate Prescott Laboratories of Food Technology, the Spectroscopy Laboratory, the Guggenheim Aeronautical Laboratory, the Wright Brothers Memorial Wind Tunnel, the Supersonic Wind Tunnel, the Eastman Laboratories for chemistry and physics, the Sloan Automotive and Aircraft Engine Laboratory, the Nuclear Engineering Laboratory and nuclear reactor, the Computation Center, and the Laboratories of Steam and Compressed Air, Refrigeration, Testing Materials, Hydrodynamics, Ceramics, Servomechanisms, High Voltage, Physical Chemistry, Applied Physics, Insulation Research, Corrosion, and Geology and Mineralogy.



THEIR VARIED EXTERIORS BESPEAK THE DIVERSE ACTIVITIES OF M.I.T. LABORATORIES . . .



. . . for aircraft and automotive engines



. . . for biology and food technology

. . . for high-energy nuclear particles

. . . for aeronautical engineering

MUSEUMS

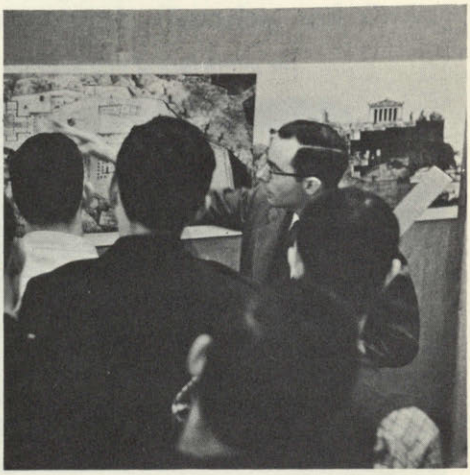
The museums, permanent exhibits, and exhibitions at M.I.T. present a wide variety of ideas, both old and new, to enrich the life of the entire Institute community. Many are designed to have a direct bearing on the studies in humanities and so are especially relevant to undergraduate purposes.

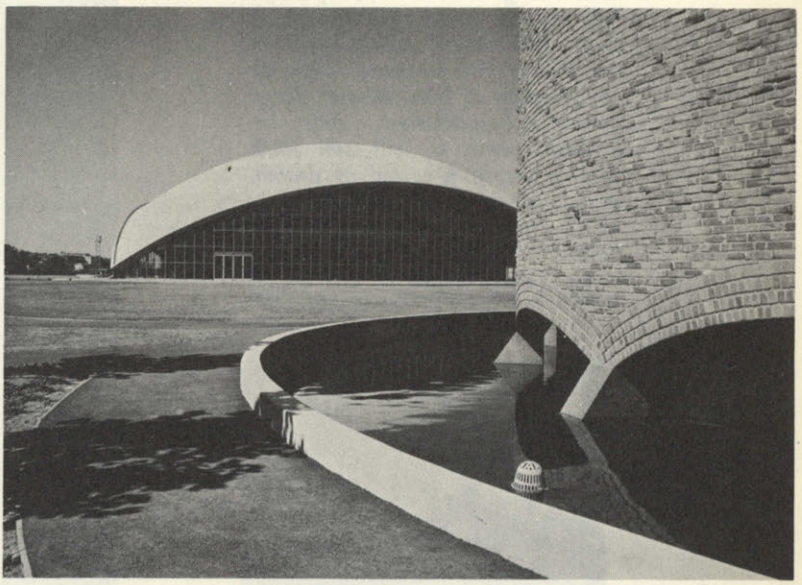
Anything from handcraft to machine craft, from primitive through contemporary art, may turn up in the Institute's monthly exhibitions, which often draw many Greater Boston residents to M.I.T. These exhibitions are usually in the gallery on the first floor of the Charles Hayden Memorial Library—a spacious, well-lighted room designed with a simplicity that enhances the appeal of its displays.

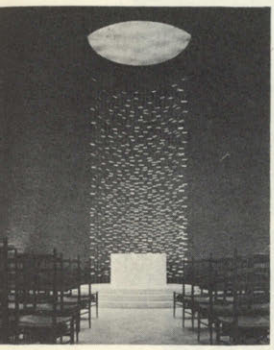
THE EXHIBITION GALLERY OF THE CHARLES HAYDEN MEMORIAL LIBRARY . . .

. . . for edification

. . . and as a teaching tool







AUDITORIUM AND CHAPEL

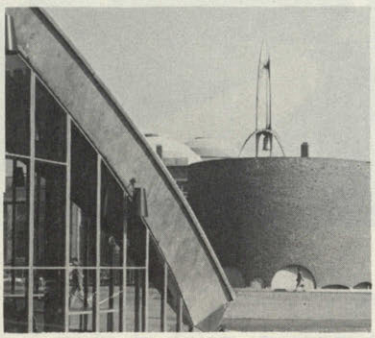
The Institute's contemporary point of view is nowhere better reflected than in the new Kresge Auditorium and its neighboring chapel. The Auditorium contains a large hall seating 1,200, an experimental theater for 200, and rehearsal rooms for musical and dramatic performances. It thus provides equipment and environment for the finest public performances of music and drama . . . as well as for lectures and many more informal events. A typical week's schedule for the Kresge Auditorium—including play readings, rehearsals, concerts, and movies, for example—would go far to suggest the vitality of this many-sided community.

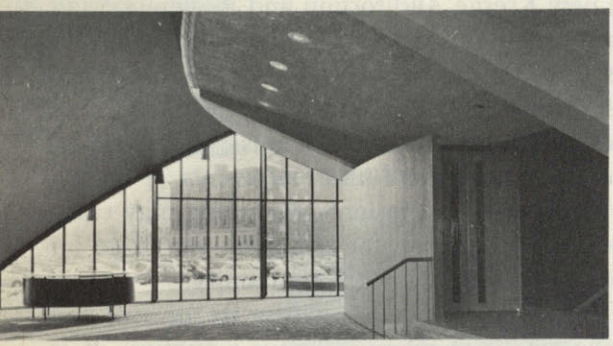
The M.I.T. Chapel, widely recognized for its unusual and effective design, is the center of many religious activities. It is open to—and used by—all religious groups for daily, weekly, or monthly services.

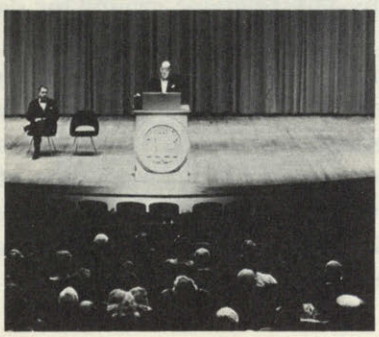
Dr. Killian has recently written of M.I.T.'s responsibility to maintain an atmosphere of religious freedom and, within this environment of freedom, to provide "adequate opportunity for its students to deepen their own understanding of their spiritual heritage and freely to pursue their own religious interests and to worship God in their own way." M.I.T.'s new chapel provides a focal point for these widening activities.

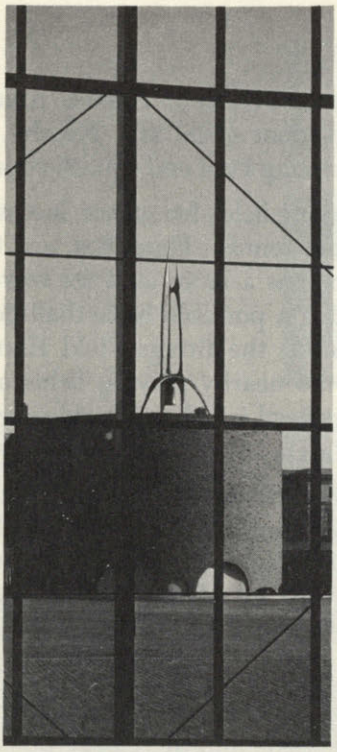
"The Kresge Auditorium, a festival hall on the banks of the Charles River, will have a lasting effect on the life of the Institute; with its combination of little theater, large concert-hall-auditorium, and rehearsal rooms, it will call forth such a yearly program of drama, music, speaking (and television) as M.I.T. has never participated in before."

EDWARD WEEKS, Editor of *The Atlantic Monthly*, in *Architectural Record*, July, 1955.



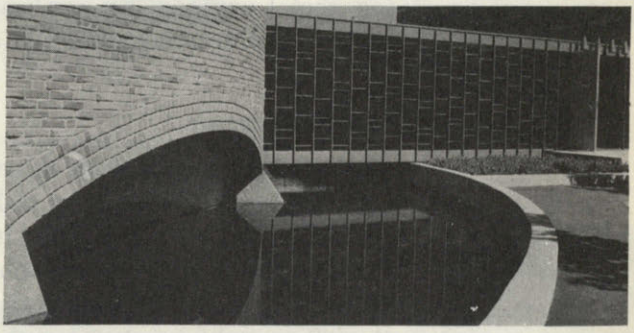






"The Kresge Auditorium and the M.I.T. Chapel are the fitting adornment of the campus of an institution devoted to advancing the boundaries of knowledge, creative, pioneering, respectful of acquisition, avid of improvement."

THE HONORABLE E. N. VAN KLEFFENS, Minister of State and Ambassador of the Netherlands, at the dedication of the Auditorium and Chapel, 1955.



RECREATIONAL FACILITIES

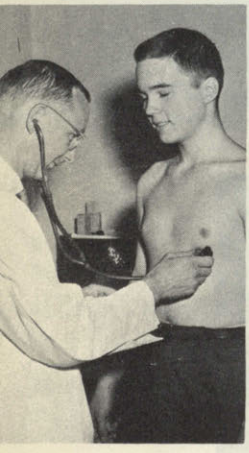
Walker Memorial, built in memory of President Francis Amasa Walker, has become the center of student social life. Nearby, as the map shows, are the Alumni Swimming Pool and squash courts.

On the West Campus are playing fields for soccer, lacrosse, baseball, softball, football, track, and tennis. Here, too, are the John Rockwell Athletic Cage, which has a large area for recreational and varsity athletics—including a portable basketball floor and stands—during the winter months; the Briggs Field House, with lockers and showers to serve the nearby playing fields and Rockwell Cage; and an outdoor artificial-ice skating rink which is used from November through March.

The Boathouse on the Charles River is supplied with indoor rowing machines as well as eight-oared shells, and any undergraduate may learn this sport under competent coaching. Any undergraduate, too, may learn to sail by joining the Nautical Association at the Sailing Pavilion on the Charles River in front of Walker Memorial.

A Hobby Shop provides students with tools for woodworking, metal working, gem polishing, bookbinding, radio, photography, electroplating, printing, and telescope making.

MEDICAL FACILITIES



The Medical Department is centrally located in the Homberg Memorial Infirmary, a wing of M.I.T.'s main buildings. The dispensary on the ground floor has treatment rooms and special facilities for minor surgery, ophthalmology, otolaryngology, dentistry, X-ray, and laboratory diagnosis. On the second floor are the offices and laboratories of the Occupational Medicine Service, which helps protect M.I.T. personnel from radiation, chemical, and sanitary hazards. An infirmary of 21 beds and an operating room is located on the third and second floors. (Facilities of the Boston and Cambridge hospitals are used in cases involving major operations or complicated medical procedures, after which students may return to the Infirmary for convalescence.)

The clinic is staffed by about 30 doctors, four of whom are on a full-time basis. Charges for medical services are described fully in section three of this book.

M.I.T.'s recreational assets include swimming pool, skating rink, sailing pavilion, and playing fields.

In addition to treatment services, the Department carries on an active educational program in group psychodynamics among the Faculty and students and cooperates with the Athletic Association in providing medical supervision for contact sports.

RESIDENTIAL PLAN

M.I.T. is essentially a residential college. In order that they may enjoy to the fullest the pleasures and benefits of campus living, freshmen are expected to live in the undergraduate houses (up to the limit of capacity) unless they live at home or in fraternities. Upperclassmen may make whatever living arrangements they choose; rooms on the campus are normally available to all who wish them.

On the basis of its living arrangements, M.I.T.'s student body divides into four major groups. The first group, consisting of about 2,000 men, is housed on the campus in the Institute houses: Baker House for 350 students, with dining service; Burton House for 353 and Conner Hall for 240, with dining service in the nearby Graduate House; the Graduate House for 450 graduate students, with dining service; and the East Campus Residence Houses for 620, with dining service adjacent in Walker Memorial. At the Women's Dormitory are comfortable rooms for 17 co-eds, and 33 upperclass and graduate women live in Bexley Hall.

Second, about 800 undergraduates live in the 27 fraternities, all of which serve meals for their members. Freshmen who elect, upon invitation, to join fraternities commonly do so early in their first year; they usually take up residence immediately in the chapter houses.

Third, some 270 married students live with their families in houses in Westgate or apartments in Westgate West, both of which are on the campus. First preference is given to veterans.

The fourth group consists of those students who live away from the campus, either at home, if that is within commuting distance, or, in a few instances, in lodgings or apartments in the Cambridge and Boston areas.

Though in the minority, women at M.I.T. share with men all of the Institute's academic life.

WOMEN AT M.I.T.

The importance of women in science, engineering, and management is clearly increasing. And, although the women at M.I.T. are far outnumbered by the men, they have an increasingly important part in Institute life. Co-eds at M.I.T. participate in every aspect of the academic program and in almost every student activity, and they use the facilities for tennis, swimming, and sailing.

In addition to the dormitory facilities for M.I.T.'s women students, there is a lounge in the main educational buildings where a large living room, kitchen, study, rest room, and locker room provide a pleasant place for teas and dinners and for business meetings of the Association of Women Students. Between classes the women students often stop here for a snack, a few hands of bridge, an hour of study, or just for conversation and relaxation.

Entering women freshmen are assigned to "big sisters" who introduce them to the Institute during Freshman Weekend.

THE ENVIRONS

Boston and its suburbs contribute richly to the facilities and experiences which await M.I.T. students.

There are still many reminders of colonial days: Faneuil Hall, the "Cradle of Liberty;" the narrow, winding streets of a more leisurely age; the Old North Church where Paul Revere's warning lanterns were hung; his home just around the corner; and Boston Common, first set aside in 1634 as a cow pasture and training field.

Nearby are many other places whose names have been household words for generations . . . Concord, Lexington, and Salem . . . The House of the Seven Gables, Plymouth Rock, Wayside Inn, Walden, John Alden's home, and Sleepy Hollow Cemetery. In the Boston area is a concentration of historical reminders unequalled in this country.

But Boston is not living in the past. Today there is here as wide a spread of cultural interest as can be found anywhere else in the United States outside New York. This means that every important musician and chamber group plays here yearly; that there is an active and varied theatrical season; and that the local organizations—the Museum of Fine Arts, the great Boston Symphony Orchestra, and the Boston Pops—have breadth and strength. Here, too, are educational institutions with a diversity perhaps unique in the United States. Going to college in Boston offers an unparalleled adventure outside the classroom.

M.I.T. students may draw in many ways on these resources of science and learning. Nearness to many large industries, too, gives them a chance to supplement academic work by visits to plants and discussions with business leaders. New England is one of America's famous vacationlands, and students here explore the attractions of mountains, beach, and rock-bound shore.

This remarkable aerial photograph shows M.I.T. (at the bottom), Boston, the islands of the harbor, the picturesque south shore, and—in the far distance—the hook of Cape Cod.

THESE ARE THE OUTCOMES

Few of the activities of mankind are so constantly changing as the fields of the scientist, the engineer, the architect, the economist, and the executive. Few are so secure from the monotony of repetitive routine, and few make so many stimulating new demands. Here is interesting and useful work for many temperaments and minds.

PLACEMENT

No one can suppose that our national and industrial progress will continue unless we continue to know more and more about science and its applications to human affairs as the years go by. Indeed, there has never been a time when more was expected of graduates in these fields and when such a wide range of important work awaited them. Thus a student in areas represented at M.I.T.—science, engineering, architecture, economics, psychology, and management—today has opportunities which were never before so great. Industry, education, and government call on M.I.T. for graduates to fill a variety of positions, and their representatives come here to interview seniors. An M.I.T. graduate normally may choose among several positions and thus find the job for which he is best suited. Nearly one-third of M.I.T.'s undergraduates go on to school, at the Institute or elsewhere, for advanced work.

M.I.T.'s Student Placement Bureau helps students plan for placement and brings them together with prospective employers and their representatives. Students who wish summer work will also find similar help here.

SELECTIVE SERVICE

M.I.T. students who may be subject to selective service will wish to know of the Institute's Military and Selective Service Office, which has been established to assist registered students in their dealings with their draft boards. Selective Service College Qualification Tests are given each year at M.I.T. and freshmen are advised to take these tests as soon as they are eligible. No other action is necessary by any student until he receives a classification

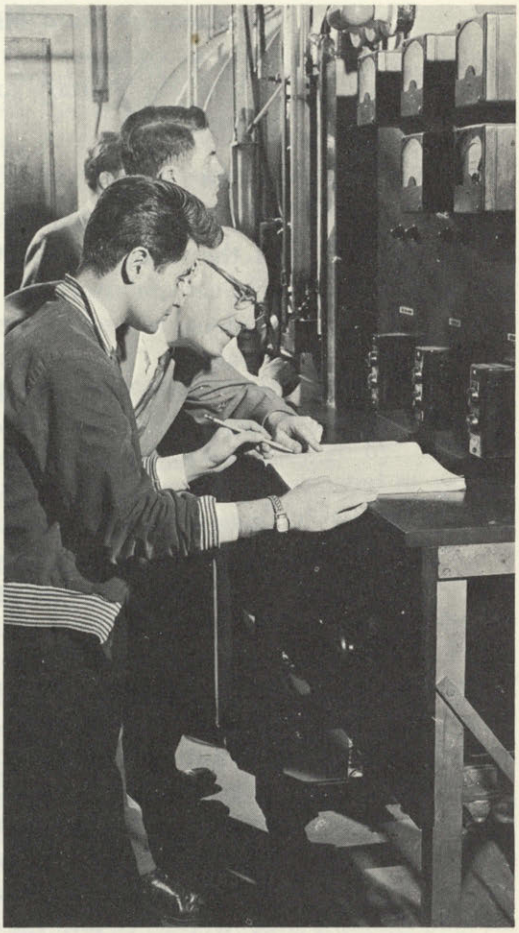
questionnaire from his local board; and M.I.T. can, of course, make no commitments to students. But the Institute's experience is that the Military and Selective Service Office may often be helpful.

ALUMNI

One way to appraise an M.I.T. education is to study the record of the Institute's 50,000 alumni. Most of them find their way into careers associated with science and engineering, and the professional records of these alumni are an important part of M.I.T.'s greatness. Two trends in this group have attracted recent attention: many M.I.T. graduates in science and engineering find themselves within a few years in executive positions; and many are doing technical work in fields other than those of their undergraduate courses. These facts serve to emphasize the importance of M.I.T.'s concept of a basic education without overspecialization and with the richness and breadth which only a great college community can provide.

In one recent year, M.I.T. alumni held the presidencies of the Society of Automotive Engineers, the American Society of Mechanical Engineers, the Illuminating Engineering Society, the Institute of Food Technologists, the American Electroplaters' Society, the American Association of Textile Chemists and Colorists, the Southern Association of Science and Industry, the Scientific Research Society of America, the New York Building Congress, the Manufacturing Chemists' Association, the American Institute of Architects, and the U.S. Chamber of Commerce.

Newcomers on the M.I.T. scene are invariably surprised at the wide range of activities which alumni represent. The roster includes such artists as Charles H. Woodbury, Daniel Chester French, and Samuel Chamberlain; bankers and economists such as Charles Hayden, Roger Babson, and Stuart Chase; public figures like Charles Edison; and Arthur Farwell and Frederick Field Bullard, composers. An M.I.T. graduate was awarded in 1952 a Lasker Award from the American Public Health Association, and still another has been Connecticut Commissioner of Health. Such diversity as this emphasizes that, though M.I.T. is a professional school, there is much of general education in its program.



Dr. Julius A. Stratton, Chancellor

2 *Education at M. I. T.*

Dr. Arnold J. Tustin, the distinguished British engineer and educator, said after spending one year as Visiting Professor at M.I.T., "I believe that the conception is taking shape that a 'university for the modern man' can and should be built around the teaching of applied science as its core, and that it is possible, and indeed likely, that M.I.T. may become the prototype of this new kind of university." Dr. Killian has said that "a great institute of technology must have first-rate science and first-rate general education if it is to have first-rate technology." Together these comments point toward the heart of the educational program which prevails at M.I.T.

Dr. Julius A. Stratton, Chancellor of M.I.T., who has special responsibility for academic affairs, describes in this way the concepts which guide M.I.T.'s education:

"I like to think of our undergraduate teaching at M.I.T. as a fabric interwoven of many strands. Its warp is mathematics, physics, and chemistry. These are basic ingredients of any modern liberal education; at M.I.T. we emphasize these subjects, too, because on their mastery depends the power to attack with confidence the most difficult technical problems of the engineering and scientific professions. We consider it necessary, of course, that an M.I.T. student master the calculus; but we believe it no less imperative that he learn to think in concrete terms, and that he sense the importance of quantity and measure.

"The professional subjects, which come in the second, third, and fourth years for most M.I.T. students, give unity and purposefulness to the whole. They deepen understanding of the basic sciences and mathematics by illustrating meaning in terms of application. They provide a motivating force because they use these principles in the field which each student has personally chosen.

"The roots of a profession go deep into our cultural soil; this of course is the meaning of our humanities program. We believe that 'Western Civilization' ought to be as truly a professional subject as a course in thermodynamics or structures. And we hold that a course in thermodynamics need be no less a contribution to general or 'liberal' education. If you thus view our M.I.T. curricula, you may be able to see with us how, without departing from the original idea of a school with a central focus on science and technology, we are indeed developing our undergraduate plan into a modern form of liberal education, indigenous to our country and relevant to our times."

THE PROFESSIONAL COURSES

There are 23 academic departments at M.I.T., each within one of the five schools. Of these, 17 departments give one or more undergraduate degrees—usually the Bachelor of Science (S.B.) degree—which require four (five years for Architecture) years of work at M.I.T. These undergraduate degrees are given on the basis of "Courses"—that is, major fields of study. Within these Courses some subjects are required, but much flexibility is provided by "options" and electives; the special interests of individual students are thus easily fulfilled.

Some of these "options" are so-called *co-operative courses,* in which, during his last two years, a student's time is divided between academic work at M.I.T. and practical experience at leading industrial plants. These options usually require a longer overall time—or permit fewer vacations—than the regular programs leading to S.B. degrees. But they represent "learning-by-doing" carried to its fullest development, and many students value highly this kind of on-the-job experience in close relationship to their academic studies.

Some Courses require work in one or more Summer Sessions, and—even when it is not required—some students choose to study during the summer in order to increase their experience and background. But this is not necessary and in most cases is not recommended.

All this may seem at first reading to be a complicated and difficult arrangement. The chart on the next page seeks to simplify

it by listing *all* the departments and *all* the undergraduate Courses; the chart should help to guide you through the more detailed descriptions of the fields at M.I.T. which appear in the section on "Educational Opportunities." Most departments give advanced degrees as well as the bachelor's degrees shown on the chart.

A brief account of the work of each undergraduate Course and the opportunities to which it leads appears in "Educational Opportunities" at the back of this book. Here, too, are shown typical curricula for each of the eight or more semesters normally required for the bachelor's degree; these give the best "bird's-eye-view" of what each of M.I.T.'s undergraduate Courses really covers.

In a special section are details of the first year of study at M.I.T.—including descriptions of the subjects from which first-year students normally make up their programs. Descriptions of the advanced subjects are in the General Catalogue, a copy of which each student normally receives soon after he arrives in Cambridge.

This great variety of subjects with which M.I.T. education may be concerned deeply influences the life of every undergraduate. In fraternity house and dormitory, at noon-time luncheon or evening bull session . . . everywhere, the naval architect and the biologist swap ideas, the thinking of the prospective metallurgist is stimulated by that of the future architect.

A technologist must, of course, be prepared to produce practical results: the bridges designed by a civil engineer must not fall down, and the wings must not break off airplanes designed by aeronautical engineers. In this sense engineers must be conservative. But the scientist, on the other hand, must first of all be radical in his concepts; he must enter new fields of thought seeking new truths. "It is good for scientists, once their imaginations have been stretched," says Dean of Science George R. Harrison, "to be made more practical by working with engineers and more responsible by working with humanists." This kind of opportunity for understanding the problems of fields other than one's own and for contributing one's special view to a general discussion with keen minds from other fields is a valuable part of education at the Institute.

DEPARTMENTS AND PROFESSIONAL COURSES

Department	*Courses*	*Degree*
SCHOOL OF ENGINEERING		
Aeronautical Engineering	Aeronautical Engineering	S.B.
	Co-operative Course°	S.B.
Chemical Engineering	Chemical Engineering	S.B.
	Chemical Engineering Practice°	S.B.
Civil and Sanitary Engineering	Civil Engineering	S.B.
Electrical Engineering	Electrical Engineering	S.B.
	Co-operative Course°	S.B., S.M.°°
	Electrical Science and Engineering	S.B., S.M.°°
Mechanical Engineering	Mechanical Engineering	S.B.
	Co-operative Course°	S.B.
Metallurgy	Metallurgy	S.B.
Naval Architecture and Marine Engineering	Naval Architecture and Marine Engineering	S.B.
	Shipping and Shipbuilding Management	S.B., S.M.°°
SCHOOL OF SCIENCE		
Biology	Quantitative Biology	S.B.
Chemistry	Chemistry	S.B.
Food Technology	Food Technology	S.B.
	Biochemical Engineering	S.B.
Geology and Geophysics	Geology and Geophysics	S.B.
	Geology and Geophysics	S.B., S.M.°°
Mathematics	Mathematics	S.B.
Meteorology		
Physics	Physics	S.B.

°Including several months of work and study with leading industries.
°°Requires five years, at the end of which both bachelor's and master's degrees are awarded.

Department	*Courses*	*Degree*
SCHOOL OF ARCHITECTURE AND PLANNING		
Architecture	Architecture	B.Arch.***
City and Regional Planning		
SCHOOL OF HUMANITIES AND SOCIAL STUDIES		
Economics and Social Science	Economics, Politics, and Engineering	S.B.
	Economics, Politics, and Science	S.B.
Humanities	Humanities and Engineering	S.B.
	Humanities and Science	S.B.
	Science and Mathematics Teaching****	S.B., M.A.T.
Modern Languages		
SCHOOL OF INDUSTRIAL MANAGEMENT		
Industrial Management	Business and Engineering Administration *based on* Physical Sciences	S.B.
	based on Chemical Sciences	S.B.
Air Science		
Military Science		
Naval Science		

***Requires five years of study.

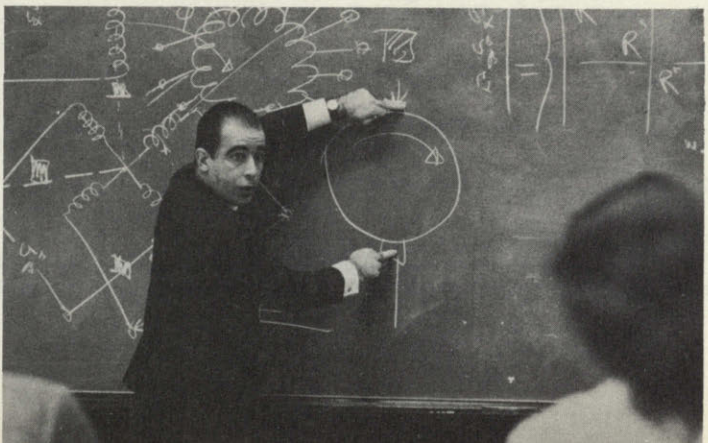
****In cooperation with the Graduate School of Education, Harvard University, which awards the Master of Arts in Teaching degree at the completion of the fifth year of study.

COMPETENCE AND VERSATILITY

This picture of M.I.T.'s education—each undergraduate Course apparently a separate, self-sufficient package—is misleading. Today's professional opportunities demand of *every* student great competence in basic science and versatility in its exploitation, to enable him to move easily across the familiar fields of specialization. In response to this need, the boundaries between M.I.T. Courses are softening. Their similarities are far more important (if less obvious) than their differences.

You will find everywhere in all M.I.T. Courses the basic instead of the specific, the broad instead of the narrow. There are no subjects in highly specialized industrial practices. Because scientists and engineers, like administrators and managers, work with their brains rather than with their hands, the emphasis in professional Courses is on the larger aspects of subjects—the theories which make a Diesel engine possible, and the optics which are behind a dish-shaped radar antenna.

Manual skill is near the bottom of the list of qualities a student should possess if he is to be successful in these fields. Dexterity in assembling a radio transmitter is a good thing, of course, but far more important than handiness with pliers and screw driver is the ability to master the theory of why the set works. More important still, and much rarer, is the quality of mind that can evolve new concepts out of which still other useful things can be developed, or that can administer large undertakings involving scientific processes and control. The number of M.I.T. graduates holding positions of major responsibility in industry and government evidences the soundness of the Institute's emphasis on breadth rather than on technical detail.



HUMANITIES AND ECONOMICS

This pattern is somewhat different in the case of M.I.T.'s new Courses in Humanities and Engineering or Science and in Economics, Politics, and Engineering or Science; these are distinctly less specialized than many of the professional Courses. In these cases students devote 60 per cent of their time to basic work in one of the fields of science or engineering and 40 per cent to the humanities and social sciences. Students in these Courses may, if they wish, use a fifth year to gain the Bachelor of Science degree in the science or engineering field of their earlier concentration.

These Courses are significant because, while they prepare a student to go on with work in the engineering or science of his choice, they also give him sufficient background for a career in law, public administration, writing, personnel work, economics, or other humanities and social science fields if he prefers to follow one of these directions.

THE FOUR-YEAR PATTERN

Although each entering student is asked to indicate his tentative choice of Course before he arrives here, this choice is not considered definite until the beginning of his sophomore year; and, even after this, a student who comes to the Institute with a sound preparation and an open mind will find that the curricula are arranged to permit him to change his choice in accordance with his own increasing knowledge of himself and of the things he is studying.[1]

So it is possible to write generalized descriptions which fairly describe each of the four years in M.I.T. Courses:

THE FIRST YEAR

All freshmen (except those enrolled in the Course in Architecture) follow programs of study containing in common: humanities (Foundations of Western Civilization), mathematics, physics, chemistry, and military, air, or naval science. The Course in Architecture replaces chemistry with graphics. An additional subject, generally elective, is also a required part of every freshman curriculum except for students in the Naval R.O.T.C. program. All these subjects are described in detail at the end of this book.

[1] Admission to certain Courses beyond the first year is limited when the demand exceeds the staff and facilities available.

"BASIC INGREDIENTS OF ANY MODERN LIBERAL EDUCATION . . ."

. . . mathematics

. . . chemistry

. . . physics

Because of its general nature, the first-year curriculum is easily adapted to the requirements of any Course. But this adaptability does not prevent the basic program from being a rigorous and thorough foundation for later work.

In mathematics first-year students build on their basic knowledge of algebra and trigonometry to master analytic geometry—linking symbolic logic with geometrical form—and the calculus—essentially a method of reasoning about rates of change. In these fields, so basic to all science and engineering, every student has the benefit of the give-and-take of discussion in small classes which meet three times a week.

In physics, freshmen hear two lectures a week, illustrated with experiments and demonstrations. To supplement these, each student has two meetings with an instructor in a small section where he has ample opportunity for questions and discussion. Once every three weeks he spends half a day in the physics laboratory, mastering the technique of scientific experiment.

In chemistry first-year students follow a similar pattern of two experimental lectures and two section meetings a week, with a weekly laboratory period in which assistance from an instructor is close at hand.

Three hours a week in military science are devoted to lectures and—occasionally—drill.

A first-year student's total study time is likely to average 20 hours per week. If he plans his time well and utilizes free hours during the day, he should not need to study late at night. There is no conventional "cut system" at M.I.T. Occasional absences are assumed to be for valid reasons, and a student who is making satisfactory progress is not held to account for them. Freshmen soon learn that they are out of the schoolboy atmosphere of rigid restrictions. They respond quickly to the challenge of a mature university system, where students must take responsibility for planning their own time.

THE SECOND YEAR

In the second year, all students begin their studies in the particular Course of their choice. This does not mean, however, that they have begun to narrow their activities to a high degree. All students continue to study the fundamental subjects in science, mathematics, and humanities.

THE THIRD YEAR

The basic subjects in engineering, science, or architecture are the chief concern of the third year in the Courses within each of these three major groups. In addition, professional subjects within each Course are introduced, and Course specialization begins to a limited extent.

THE FOURTH YEAR

In the fourth year, students in each Course concentrate upon the professional subjects within that Course, and in many cases each finds that by choosing from various electives he is able to follow his own special interests within the broad field.

All M.I.T. seniors, as a graduation requirement, have the opportunity to write a thesis—a report on a special project or an original investigation. The booklet of instructions to seniors about their theses says, simply, "The thesis gives you a chance to show what you can do on your own with a genuine man-sized problem in the field you have chosen; instead of learning and practicing the basic principles of your chosen profession, you will now use your education to do a piece of real professional work. You are judged as the practicing engineer or architect or surgeon is judged —by how well you can do one complete job."

Each senior has a member of the Faculty as a consultant for the thesis, and he picks his topic with the help of this adviser. But, say the instructions, "you should come to your adviser with a well formulated question or plan of action. The initiative is yours throughout this project. You are in charge of this job yourself."

FOR PRE-MEDICAL STUDENTS

Many students come to M.I.T. to prepare for medical schools, and almost any of the Institute's Courses is an excellent pre-medical program. The specific requirements for entrance into medical school may be satisfied—where they are not included in the regular curriculum—by elective subjects. This type of pre-medical program fully meets the specifications of the Association of American Medical Colleges.

The flexibility and diversity of the programs available to pre-medical students at M.I.T. make it desirable that each student have individual guidance. If you are interested in entering

medical school after graduating from M.I.T., you should consult Dr. James M. Faulkner, Medical Director, who is the official Adviser to Pre-medical Students.

HUMANITIES AT M.I.T.

As an undergraduate at M.I.T. you study the humanities, as do college students throughout the western world, primarily to explore such elusive topics as these: ethical, spiritual, and aesthetic values . . . the reconciliation in a free society between liberty and order . . . the temptations of complacency and conformity. The curriculum encourages you to respond as you will to the past experiences about which you learn; it requires that you think about those experiences and talk and write about them. Indeed, the program continually provides exercises in expression—exercises constructed to help you command and organize data, for the Faculty believes that clear thinking must precede clear writing and that clear writing is at once a sure mark of the educated and an indispensable tool of the successful. The introductory subjects have also a third purpose: to introduce you to the kinds of materials which you may elect to study further in upperclass subjects in the humanities and social studies.

The required first-year course, "Foundations of Western Civilization," combines materials from history, literature, philosophy, and the arts in four topics, each requiring seven weeks, which focus successively upon Athens in the Fifth Century B.C., Western Christendom in the Middle Ages, Sixteenth Century Crises, and Science and the Secular State in the Seventeenth Century. Most of the readings, selected both for their significance and their interest, are from the writings of such men as Sophocles, Thucydides, and Plato; St. Augustine and Dante; Machiavelli, Calvin, and Shakespeare; Newton, Hobbes, and Locke.[1]

Sophomores may elect one of two courses, either "Modern Western Ideas and Values," or "The United States: Ideas and Men." Then, familiar with the substance of the introductory courses and practiced in oral and written expression, M.I.T. upperclassmen are prepared to begin more specialized and advanced

(text continues on page 52)

[1] Students who come to M.I.T. with sufficient background in French may enter a special group which studies the first- and second-year humanities subjects in the French language, using French-language source materials. If you are interested in this group, you should write to Professor William N. Locke, head of M.I.T.'s Modern Languages Department.

"... The vastness of man's experience and his limited knowledge of himself ..."

Dean John E. Burchard of the School of Humanities and Social Studies explains M.I.T.'s concern for helping its specialists develop a sense of proportion.

Specialization is here to stay. It is essential to our complex contemporary life. And for the individual there is a deep satisfaction in really knowing about something, in being able to deal with an explicit problem with force and elegance. So specialists are likely to be among the happiest of educated men.

Yet to have specialized competence today requires a formidable amount of specialized knowledge.

Needing to know so much about so little, there is always a risk that those who choose to be specialists may end by knowing—and caring—very little about anything else. In the long run the specialist will have to develop most of his sensitivities and his sense of proportion about the whole of society from a long experience in living. He will have to develop his own interest in and knowledge of the forest beyond the trees which he has been taught so sharply to identify. His undergraduate education can at best provide only a start.

By no means all of this start will come from his non-specialized subjects. Indeed, one of the largest forces for developing a sense of dignity and integrity will build up from within the specialty. Moral and ethical attitudes, for example, are rather more likely to develop from the codes of fellow scholars in the specialty than from sermons delivered in general courses.

The program of liberal education at M.I.T. has been arranged on the premise that specialists will not be made into men of wide vision through exhortation. Even a very learned modern man cannot hope in a lifetime to acquire a universal familiarity with all the fields of humanities and social sciences. Any undergraduate curriculum which undertakes to provide a comprehensive introduction to such a hope is bound to be inordinately superficial. We go at it differently. We look, for instance, at a few brief moments of time under a microscope rather than trying to run the course of history from Asoka to Eisenhower.

Every undergraduate at M.I.T. will study an average of at least one subject in this School during every semester of his residence with us. He may study more. An important part of the plan is that he does this study in all his years and not just his early ones.

We require our freshmen and sophomores to participate in two years of common experience in humanistic study. This part of the program tries to provide each student with some sense of the vastness of man's experience and some appreciation of the limited knowledge man has acquired about himself. It may lead our students to recall from time to time that there have been great nations before ours, that there have been great problems, great successes, and great failures, and to find some of the possible reasons for these successes and failures. It may influence them not to ignore their past on the silly premise that nothing that has ever happened to anyone before can be of any value to us now.

After this common experience every upperclassman must elect a sequence of subjects in one or another field of concentration, a field of his choice. Here we are seeking to have him do a little "deep digging" in an area quite different from that of his specialty but one which has exerted some fascination on him. As the first part of the program tries to make him realize that there were great men before him, the second might show that there are great fields of current experience other than the one that he will follow, that there are great men in professions other than his own. This is more than a matter of creating an atmosphere of mutual tolerance and respect, although this is not a trivial objective. Once one can understand that there is a rigor in respectable study of history, though a different rigor from that of experimental physics, one is less likely to be taken in by shoddy history.

We must pay a great deal of attention, and do, to the quality of the works selected for study, to the nature of our library and our art exhibitions and our concerts. But we still could not succeed if we did not have a first-rate Faculty, scholars of talents equal to those of their colleagues in science and engineering. We would not have such scholars unless their opportunities were in every direction equal to those enjoyed by their colleagues in their own fields in other universities. That this has been achieved at M.I.T. is symbolized by the fact that this Faculty is assembled in a School. The existence of this effort as a School is unusual in engineering education and is of the utmost significance.

(text continued from page 49)
work in economics, psychology, political science, labor relations, history, literature, philosophy, music, or the visual arts. They are also equipped to understand something about the heritage and the shaping of their society, its present problems, and their future roles as decision-makers in it.

Upperclassmen in the professional Courses choose at least four one-semester subjects in the School of Humanities and Social Studies during their junior and senior years. Three of these must be in one general area of study and the fourth must be outside this area. The list on the next pages shows the upperclass humanities

Composer-pianist Professor Ernst Levy conducting a seminar.

subjects as they are divided into nine fields, and—in general—indicates the usual sequence of three subjects within each field. Subjects which are marked by an asterisk (*) may also be taken as the single, so-called distributional, subject which is required in a different field.

Students who are interested in additional work in humanities and social sciences in the context of modern technology will wish to consider registering in the Courses in Humanities and Engineering or Humanities and Science or in the Courses in Economics, Politics, and Engineering or Science.

OUTLINE OF HUMANITIES SUBJECTS

FIRST YEAR

First Term

H11 Foundations of Western Civilization

Second Term

H12 Foundations of Western Civilization

SECOND YEAR

First Term

H21 Humanities

Option A: The United States: Men and Issues

Option B: Modern Western Ideas and Values

Second Term

H22 Humanities

Option A: The United States: Men and Issues

Option B: Modern Western Ideas and Values

THIRD AND FOURTH YEARS

Any one of the following combinations of subjects may be taken without the approval of a Humanities Adviser. Other combinations are not prohibited but must be specifically approved by a Humanities Adviser.

Subjects indicated by a dagger (†) may be taken as a single subject to satisfy the distributional requirement.

1. HISTORY AND PHILOSOPHY

(Requirements: any three subjects, at least one of which must be in Group B.)

a.

†**H31** American Social and Intellectual History
†**H32** Political Process in Industrial America
†**H34** Religious Thought and American Society
†**H35** Europe: The Expansion of Europe
†**H36** Modern Europe: War, Society, and the State
†**H38** The Russian Revolution and the Soviet Union
†**H51** Growth of the American Industrial Economy
†**H52** Business Leadership in the American Economy
†**H54** History of American Technology
†**H55-6** History of Engineering
†**H57** The Labor Force in Industrial America
†**H58** Art and Industrial Civilization
†**H63** American Foreign Policy in Action
†**H71** Basic Ideas of Western Politics and Ethics, 500 B.C.–1500 A.D.
†**H73** Science and Philosophy from Antiquity to Copernicus
†**H75-6** Philosophic Problems and Systems

b.

H65 Problems in Economic Development
H72 Rise of Modern Political and Social Science, 1500–1914
H74 Science and Philosophy from Copernicus to the Present
H77 Classical Philosophy
H78 Symbolic Logic
H79 Problems in Contemporary Philosophy
H81 Contemporary Ideas on Political and Economic Development
H82 Nationalism and National Development
H83 Philosophy of Science
H84 Topics in the History of Science
H85 Philosophy of History
H91-2 Special Topics in History

2. LITERATURE

†**E31** Introduction to Literature
plus any two of the following:
E40 Epic Tradition in Literature
E41 American Folklore
E42 Non-Western Literature
E43 Comedy in the Theatre
E44 Nature of Poetry
E45 Shakespeare
E46 Tragedy and Modern Drama
E47 Nineteenth-Century American Literature
E48 Twentieth-Century American Literature
E49 Dostoevsky, Tolstoi and Modern Russian Literature
E50 The Bible
E51 Modern Novel
E52 The Comic Sensibility
E57-8 Special Readings
L75 Language and Society
L76 Linguistic Structure

(continued on the next page)

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3. MODERN LANGUAGES

a. German:

L14 Intermediate German *or*
†E31 Introduction to Literature
plus any two of the following:
†L15 German Literature 1919-1933
†L16 Literature of Postwar Germany
†L20 Great Books and Authors in German Literature

b. French:

L54 Intermediate French *or*
†E31 Introduction to Literature
plus any two of the following:
†L55 Contemporary French Literature
†L56 French Literature of the Third Republic
†L59 Great Books and Authors in French Literature

4. MUSIC

†Mu31 Introduction to Music
and
Mu32 Western Music from the Middle Ages to the Present

plus one of the following:
Mu42 Twentieth-Century Music
Mu43 The Opera
Mu44 Classic String Quartet
Mu51-2 Seminar in Music

5. ECONOMICS

†14.01 Economic Principles I
and
14.02 Economic Principles II
and
14.09 Economic Problems Seminar

6. POLITICAL SCIENCE

a.

†14.91 American Political System
and
†14.92 Comparative Political and Economic Systems
and
14.93 Issues in Contemporary American Politics

b.

†14.01 Economic Principles I *or*
†14.90 Psychology of Learning and Motivation
and
†14.91 American Political System *or*
†14.92 Comparative Political and Economic Systems
and
14.93 Seminar: Issues in Contemporary American Politics

c.

†14.01 Economic Principles I *or*
†14.71 Personality and Social Structure *or*
†14.91 American Political System *or*
†14.92 Comparative Political and Economic Systems *or*
†H32 Political Process in Industrial America
and
†14.95 Politics, Society, and Policy Making
and
†14.96 Influences on Policy Decisions

7. INTERNATIONAL RELATIONS

†14.51 International Relations
14.52 Principles and Problems of American Diplomacy
14.53 Seminar in International Politics

8. LABOR RELATIONS

†14.01 Economic Principles I *or*
†14.73 Organization and Communication in Groups *or*
†14.71 Personality and Social Structure
and
†14.63 Labor Relations
and
14.64 Labor Economics and Public Policy

9. PSYCHOLOGY

Any three of the following:
†14.70 Introductory Psychology
†14.73 Organization and Communication in Groups
14.77 Language and Communication
14.79 Learning

10. VISUAL ARTS

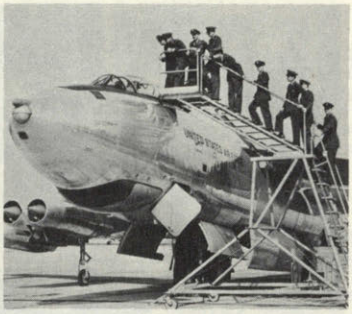
Any three of the following:
†4.031 Visual Design Problems
4.032 Visual Projects
†4.65 Introduction to Art and Architecture
†4.66 Modern Art and Architecture

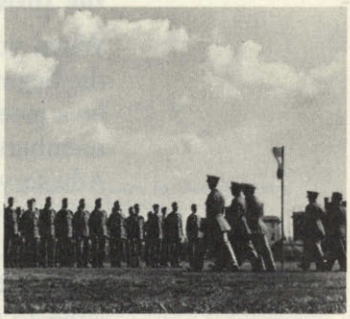
THE ADVISORY COUNCIL

When you come to M.I.T. for the Freshman Weekend preceding the beginning of classes, one of the first events of the program will be a meeting with your faculty adviser. He will be one of seventy members of the M.I.T. Faculty who comprise the Freshman Advisory Council, and his meeting with you will be the beginning of a mutually profitable and enjoyable association.

The principal reason for having a Freshman Advisory Program is the sincere desire of the Faculty to help in any way possible to make each student's career at M.I.T. interesting, enjoyable, and productive. The Faculty is aware that an entering freshman may very well feel bewildered and somewhat lonely upon first coming to this new environment, and thus its members are anxious to extend a personal hand of welcome, to point out that the essence of M.I.T. is not the classrooms and buildings but the students and teachers who people them. The Faculty wants to be on friendly terms with those with whom they associate and to establish this relationship as soon as possible. And—as do all members of this community—the Faculty has a clear interest in working together with freshmen to develop their full capabilities.

There will be some individual conferences with your adviser, since he will also act as your registration officer. He will be the one with whom you discuss your program of studies and who will approve any changes you may decide to make in your program. Your adviser will also undoubtedly try to see you under more informal circumstances, perhaps at his home, perhaps somewhere at M.I.T. Remember that half of the initiative for developing the relationship between student and adviser rests with each student; only when you contribute your share can a relationship of interesting substance develop.





AIR, MILITARY, AND NAVAL SCIENCE

All male students entering M.I.T. who meet certain qualifications are required to complete two years of study in a military science. The qualifications are: under 23 years at the time of entering, citizen of the United States, and physically qualified.

The basic courses in either Air Science or Military Science fulfill this two-year requirement. After you complete both years of either of these basic courses, you may—if you wish—apply for training in one of the advanced courses which lead to commissions as second lieutenants in the Air Force or Army reserves.

The Naval R.O.T.C. program consists of a four-year course in the naval sciences which, when you also complete a bachelor's degree in one of several engineering or science fields, qualifies you for a commission as Ensign in the Naval Reserve as a restricted (engineering duty) line officer. This program, which of course meets the basic military science requirement, is restricted to a limited number of students who qualify upon definite application for it. If you are interested in this opportunity, you must apply by

mail directly to the Professor of Naval Science at M.I.T. before September 1 of the year in which you will enter the Institute.

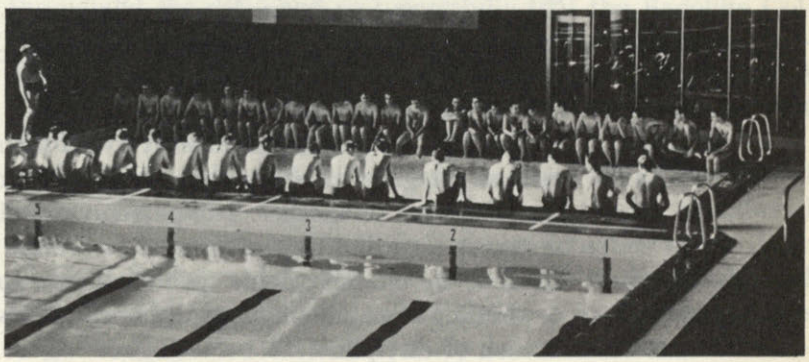
PHYSICAL EDUCATION REQUIREMENTS

The objective of M.I.T.'s physical education program is to develop good health through skill in physical activities which may be enjoyed both in college and in later life. The physical education requirements are based upon a point system, a flexible arrangement which leaves room for every student to satisfy his own personal preferences. Each male student must compile a minimum of eight points through some phase of the physical education program by the end of his second year. Points may be acquired by participating in any one of the eighteen freshman and varsity sports or in physical education classes. For example, members of intercollegiate teams acquire two points for fall or spring sports and four points for winter sports. Two points are awarded for each physical education class; there is a wide variety of such classes, including sailing, tennis, golf, basketball, badminton, squash, swimming, gymnastics, volleyball, skating, bowling, archery, and softball.

Upon entering M.I.T. each student must complete a medical examination, swimming test, and a physical fitness test. Those who do not meet certain minimum standards are recommended for swimming or development classes. If the medical examination indicates any disability which might limit physical activities, the requirements are modified accordingly.

Although there are no specific requirements for women students, they are encouraged to participate in the class and intercollegiate programs suited to their abilities and interests.

A swimming class in the Alumni Pool.



ACADEMIC REGULATIONS

M.I.T.'s general policy is to have as few rules and regulations as are consistent with its academic purposes. The day-to-day affairs of students are in general the responsibility of student government, and the following—which you should have in mind before you come to M.I.T.—are the only regulations which are of wide concern.

Irregular attendance, habitual tardiness to classes, or other conduct inconsistent with general good order may lead to probation or suspension.

Damage caused to any building, or to furniture, apparatus, or other property of the Institute, will be charged to the student or students known to be immediately concerned; but if the persons who cause the damage are unknown, the cost of repairing it may be assessed equally upon all students.

Final examinations are held at the end of each term. No member of the Faculty is empowered to grant excuse from a final examination, and absence is equivalent to complete failure except as a student may present a valid medical or other reason for not attending.

The Institute's grading system includes four passing grades, A, B, C, and D, representing work of descending degrees of quality. The last of these, although barely passing for an individual subject, is not regarded as of satisfactory average quality.

It is the aim of the Faculty to maintain the highest standards of integrity. The attempt of any student to present as his own the work of another or to pass any examination by improper means is regarded by the Faculty as a most serious offense and renders the offender liable to immediate expulsion. The aiding or abetting of a student in any dishonesty is also held to be a grave breach of discipline.

EDUCATION IS ALSO EXTRACURRICULAR

Basic to education at M.I.T. is the concept that learning need have no artificial boundaries of classroom walls; it must extend to living and working with one's fellows in an environment stimulating to intellectual and professional activities. There is a full program of such activities at the Institute, managed (and M.I.T. is very proud of this) with great independence by the students themselves.

MUSIC AT M.I.T.

Musical events are a case in point. M.I.T.'s Professor of Music, Klaus Liepmann, especially calls attention to the fact that students disciplined to concentration and conditioned to scientific thinking turn out to be ardent music lovers and active music makers.

The subjects in music are among the most popular of the Department of Humanities' offerings; "Introduction to Music" is intended for those with little or no knowledge of music; "Western Music—Middle Ages to the Present" brings a detailed analysis of musical masterpieces by old and new composers; and several music seminars for a limited number of students draw on previous experiences to make a detailed analysis in depth of Beethoven's string quartets, for example, or Twentieth Century music, or the history of opera.

But where do these classrooms end? On this campus, nearly 24 hours a day, there are unusual opportunities for those whose musical taste will respond to hearing or helping make fine music. The campus radio system, WTBS, carries music from the Music Library to all the dormitories and nearby fraternities throughout the day—and so successfully that the Radcliffe College radio has joined the network. Spontaneous barbershop singing and "jam sessions," hi-fi fans, serious music a best-seller at the campus record store . . . these are some of the evidences that M.I.T. is a musical community.

The Combined Musical Clubs include a Glee Club, Choral Society, Symphony Orchestra, Concert Band, and a Woodwind and Brass Ensemble—all out-of-classroom activities which draw a large following among the musicians in the student body. All of these organizations give public concerts in Boston and the neighboring communities—frequently in combination with musi-

cal groups of other colleges. The Choral Society joins with members of the Boston Symphony Orchestra for annual major concerts; the Glee Club appears with the Boston Pops Orchestra in Symphony Hall. In 1956 the Choral Society made a summer tour of Germany, singing with the International Youth Symphony Orchestra and the Orchestra of the Darmstadt Technische Hochschule.

Many of these are concerts of highest professional standards. Here is what newspaper reviewers have said about some recent ones:

The Choral Society in a concert of Hindemith and Brahms: *"The Requiem was completely and utterly beautiful throughout. . . . In a city of fine choruses, none now offers the public anything better than does the M.I.T. Choral Society."*—THE JEWISH ADVOCATE (1956).

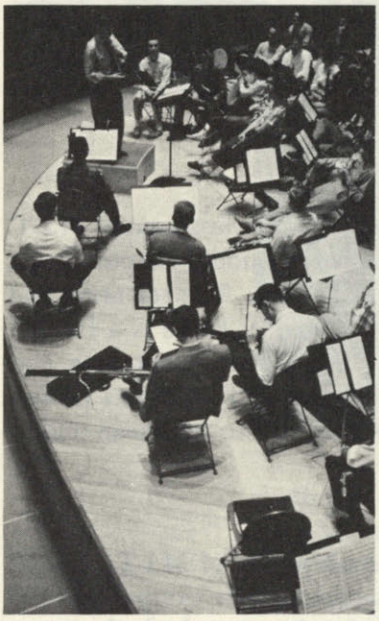
The M.I.T. Concert Band at Smith College: *"We were fortunate in having an organization of highest caliber; the M.I.T. group plays good music and plays it well."*—SMITH COLLEGE SOPHIAN (1953).

The Choral Society in a concert of Honneger and Stravinsky at the International Festival of Contemporary Music (Darmstadt, Germany): *"The chorus will finish once and for all many a European superiority complex! It is an amateur chorus vocally superbly balanced, with strict discipline, clear diction, absolutely sure of its entrances."*—DARMSTADT TAGBLATT (1956).

A series of chamber music concerts and a concert by the Boston Symphony Orchestra in the Humanities Series—and additional recitals in the Music Library—bring to M.I.T. a variety of outstanding instrumentalists and singers.

"You will never believe how much enthusiasm, talent, and skill exist among young Americans, especially among those whose mental curiosity and searching minds drive them to study science and engineering, until you have given them opportunities to make music in their free time."

PROFESSOR KLAUS LIEPMANN



President Killian speaks at a professional society seminar.

PROFESSIONAL SOCIETIES

Professional activities, too, extend outside the classroom at M.I.T. All the principal professional societies have student chapters here, and there are local professional clubs as well. The scientific and engineering honor societies are represented. (There is a full list in the chart on the following pages.) In lectures, plant trips, and general fellowship these groups bring to M.I.T. students professional experience of a vitality which is unusual to American undergraduates.

STUDENT GOVERNMENT

Little more can be said about this multiplicity of M.I.T. student interests without first introducing the democratic campus government by which students guide the activities in which they participate—including, indeed, those which have already been described.

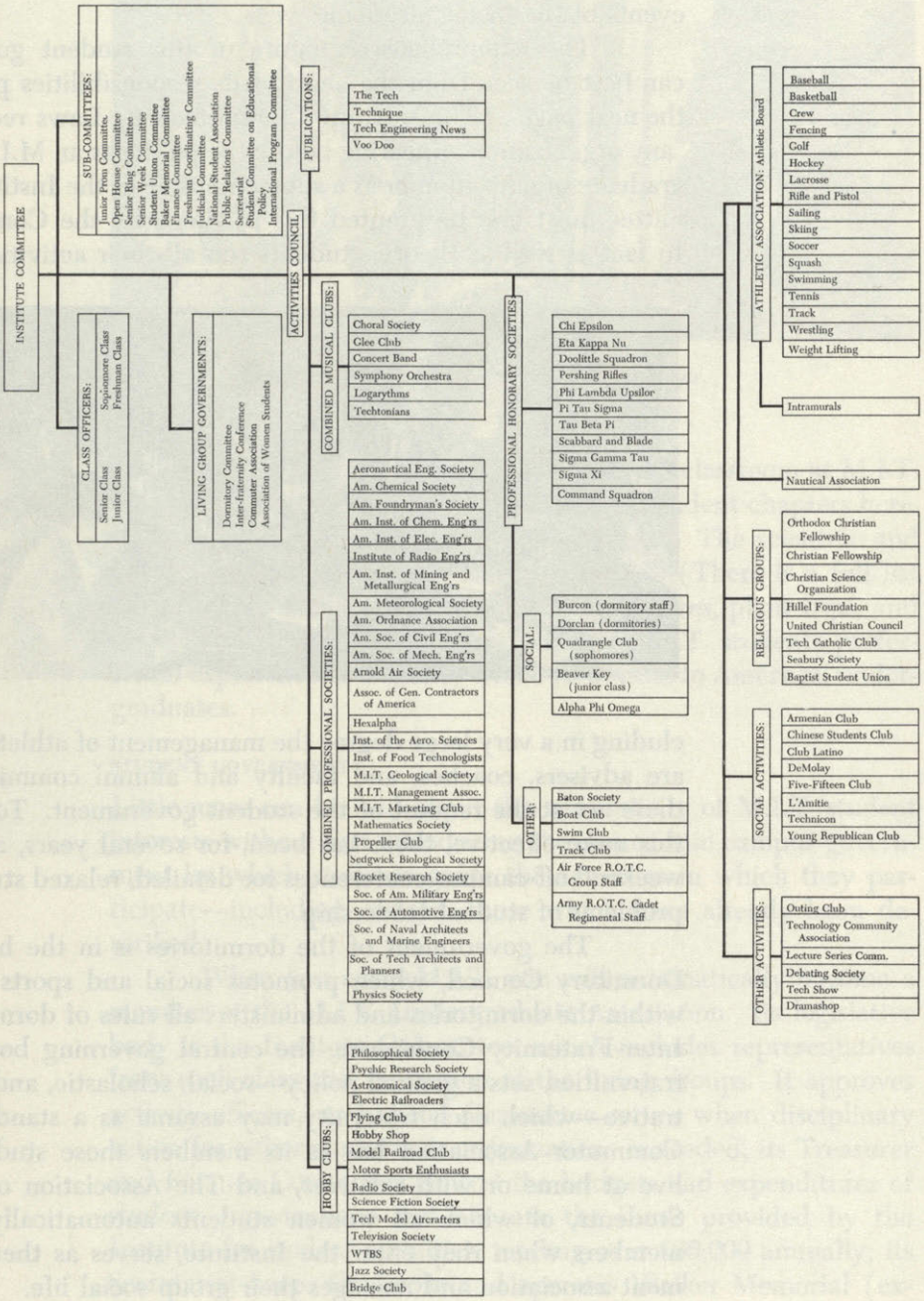
When you enter M.I.T. you will automatically become a member of the M.I.T. Undergraduate Association. Its legislative body is the Institute Committee, which includes representatives from each class and from each of the living groups. It approves activity officers; its Judicial Committee serves when disciplinary action for either students or organizations is needed; its Treasurer and Finance Committee control the budgets and expenditures of student organizations and allocate the funds provided by the Institute for student activities, totaling over $36,000 annually; its Secretariat keeps the books and operates Walker Memorial (ex-

cept the dining service) and other student non-athletic facilities; and its sub-committees are responsible for many of the leading events of the M.I.T. academic year.

The comprehensive nature of this student government can best be seen from the chart of its responsibilities printed on the next page. (The Institute Committee's By-Laws require that "any organization appearing before the public as an M.I.T. undergraduate organization or as a sub-committee of the Institute Committee must first be granted this privilege by the Committee.") In fact as well as theory, students run all their activities . . . in-

cluding in a very large degree the management of athletics. There are advisers, coaches, and faculty and alumni committees, but these act at the request of the student government. To make all this more effective, there has been, for several years, a series of weekend off-campus conferences for detailed, relaxed study of the problems of student leadership.

The government of the dormitories is in the hands of a Dormitory Council, which promotes social and sports activities within the dormitories and administers all rules of dormitory life. Inter-Fraternity Conference, the central governing body of the fraternities, sets a general policy—social, scholastic, and administrative—which each fraternity may assume as a standard. The Commuter Association has as its members those students who live at home or with relatives, and The Association of Women Students, of which all women students automatically become members when they enter the Institute, serves as their government association and manages their group social life.


INSTITUTE COMMITTEE
SUB-COMMITTEES:
Junior Prom Committee
Open House Committee
Senior Ring Committee
Senior Week Committee
Student Arts Committee
Baker Memorial Committee
Finance Committee
Freshman Coordinating Committee
Judicial Committee
National Student Association
Public Relations Committee
Secretariat
Student Committee on Educational Policy
International Program Committee
CLASS OFFICERS:
Senior Class
Junior Class
Sophomore Class
Freshman Class
LIVING GROUP GOVERNMENTS:
Dormitory Committee
Inter-fraternity Conference
Commuter Association
Association of Women Students
ACTIVITIES COUNCIL
PUBLICATIONS:
The Tech
Technique
Tech Engineering News
Voo Doo
COMBINED MUSICAL CLUBS:
Choral Society
Glee Club
Concert Band
Symphony Orchestra
Logarythms
Techtonians
COMBINED PROFESSIONAL SOCIETIES:
Aeronautical Eng. Society
Am. Chemical Society
Am. Foundryman's Society
Am. Inst. of Chem. Eng'rs
Am. Inst. of Elec. Eng'rs
Institute of Radio Eng'rs
Am. Inst. of Mining and Metallurgical Eng'rs
Am. Meteorological Society
Am. Ordnance Association
Am. Soc. of Civil Eng'rs
Am. Soc. of Mech. Eng'rs
Arnold Air Society
Assoc. of Gen. Contractors of America
Hexalpha
Inst. of the Aero. Sciences
Inst. of Food Technologists
M.I.T. Geological Society
M.I.T. Management Assoc.
M.I.T. Marketing Club
Mathematics Society
Propeller Club
Sedgwick Biological Society
Rocket Research Society
Soc. of Am. Military Eng'rs
Soc. of Automotive Eng'rs
Soc. of Naval Architects and Marine Engineers
Soc. of Tech Architects and Planners
Physics Society
HOBBY CLUBS:
Philosophical Society
Psychic Research Society
Astronomical Society
Electric Railroaders
Flying Club
Hobby Shop
Model Railroad Club
Motor Sports Enthusiasts
Radio Society
Science Fiction Society
Tech Model Aircrafters
Television Society
WTBS
Jazz Society
Bridge Club
PROFESSIONAL HONORARY SOCIETIES
Chi Epsilon
Eta Kappa Nu
Doolittle Squadron
Pershing Rifles
Phi Lambda Upsilon
Pi Tau Sigma
Tau Beta Pi
Scabbard and Blade
Sigma Gamma Tau
Sigma Xi
Command Squadron
SOCIAL:
Burton (dormitory staff)
Dorclan (dormitories)
Quadrangle Club (sophomores)
Beaver Key (junior class)
Alpha Phi Omega
OTHER:
Baton Society
Boat Club
Swim Club
Track Club
Air Force R.O.T.C. Group Staff
Army R.O.T.C. Cadet Regimental Staff
ATHLETIC ASSOCIATION: Athletic Board
Baseball
Basketball
Crew
Fencing
Golf
Hockey
Lacrosse
Rifle and Pistol
Sailing
Skiing
Soccer
Squash
Swimming
Tennis
Track
Wrestling
Weight Lifting
Intramurals
Nautical Association
RELIGIOUS GROUPS:
Orthodox Christian Fellowship
Christian Fellowship
Christian Science Organization
Hillel Foundation
United Christian Council
Tech Catholic Club
Seabury Society
Baptist Student Union
SOCIAL ACTIVITIES:
Armenian Club
Chinese Students Club
Club Latino
DeMolay
Five-Fifteen Club
L'Amitie
Technicon
Young Republican Club
OTHER ACTIVITIES:
Outing Club
Technology Community Association
Lecture Series Comm.
Debating Society
Tech Show
Dramashop

ATHLETICS AT M.I.T.

Athletics at M.I.T. are a demonstration of the principles of M.I.T. student activities: the responsibility of students in student affairs, the intimate relation of the academic and extracurricular, and the value which M.I.T. students place on the diversity of a full college experience.

Athletics at M.I.T. are not for the physically favored few. The program is based on the concept that athletic competition—competition to win—is good for everyone. You will never see a salaried athlete here, never hear of an athletic scholarship.

There is no room at M.I.T. for an athletic program that exists outside the broad boundary of recreation. This does not mean we do without intercollegiate competition. But it does mean that all these many activities—intercollegiate and intramural alike—serve the primary purpose of recreation. Winning the game is for this end only.

Last year some 1,500 students played in intercollegiate competition in 18 sports, and others joined intramural teams. And these figures do not include sailing, by far the most popular recreational activity. There are more than 1,300 members of the Nautical Association. Intercollegiate dinghy racing originated at M.I.T. in 1936, and about seventy colleges from coast to coast have now followed that lead.

Here are the details of M.I.T.'s varsity and freshman intercollegiate teams:

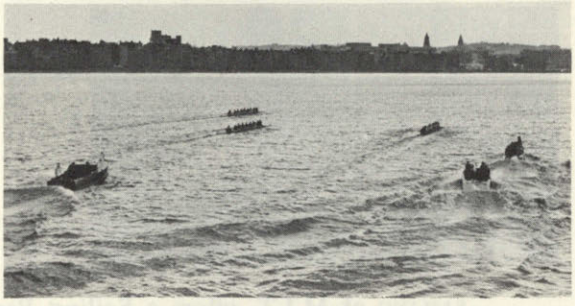
BASEBALL ranks high from the first crack of the bat early in March until the final out late in May. The diamond on Briggs Field provides the setting for the varsity and freshman home games. The varsity squad participates in the strong Greater Boston Intercollegiate Baseball League, and in addition the schedule includes such teams as Bowdoin, Wesleyan, Colby, and Harvard.

BASKETBALL has always enjoyed a place of prominence at M.I.T. With a portable floor in Rockwell Cage, the M.I.T. team has a superb practice facility and home site for the 15-game schedule. The varsity, junior varsity, and freshmen start practice early in November, finishing their season around the first of March.

CREW brings out more than 100 men to compete with all the major college crews in the country. Five separate teams—"heavy" crews for varsity, junior varsity, and freshman teams, and "light" (or 150 pound) crews for both varsity and freshman teams—give plenty of opportunity for every candidate to have intercollegiate experience.

FENCING teams at M.I.T. have commanded respect in eastern fencing circles for years. There are schedules for both varsity and freshman teams; because it is an individual sport, fencing attracts men who have limited time for athletic activity.

GOLF offers intercollegiate competition to many students desiring matches. A full varsity and freshman schedule is climaxed with the New England Collegiate Championships.

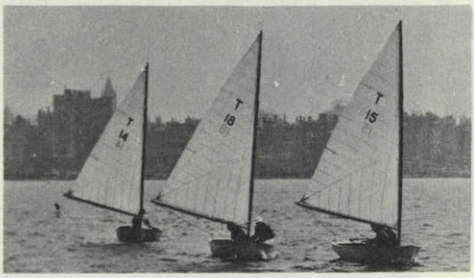


HOCKEY is appropriately important at the Institute, since Boston is the outstanding hockey city in the United States. M.I.T.'s membership in the New England Intercollegiate Hockey League assures both the varsity and freshman squads of ample competition each year, including many games on the Institute's outdoor rink.

LACROSSE, a sport only now growing into national popularity, has a long history at M.I.T. The game appeals to interested students desiring competition, as previous experience is not necessary. M.I.T. holds membership in the United States Intercollegiate Lacrosse Association. There is a spring schedule for varsity and freshmen, with the New England League and annual competition for the Briggs Cup highlighting the season.

RIFLE AND PISTOL teams from M.I.T. traditionally place individuals on the annual All-American Rifle and Pistol teams. A well-balanced schedule of shoulder-to-shoulder and pistol matches starts in December and extends to April, with separate varsity and freshman squads. Annual shoulder-to-shoulder competition is held with the three leading intercollegiate teams in the country—Army, Navy, and U.S. Coast Guard Academy.

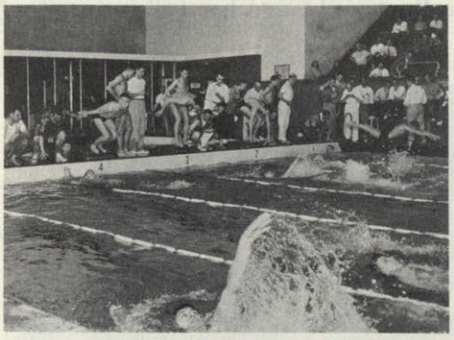
SAILING at M.I.T. offers a Sailing Pavilion fleet of Technology-designed dinghies, 110-class sloops, a snipe, and an olympic firefly. Sailing, under the direction of the Nautical Association, can be for recreation as well as competition; informal racing goes on all week, and formal races are held regularly every weekend during the season. There are regular courses of instruction for beginners; some of M.I.T.'s most successful skippers never sailed a boat before they came to Cambridge.



SKIING is represented at M.I.T. by an intercollegiate ski team through the co-operation of the Athletic Association and the Outing Club. Competition and competitive sites (including the Winter Carnivals of New England colleges) are close at hand, and the intercollegiate season extends from the middle of January to the beginning of April. This is one sport that truly provides recreation along with competition.

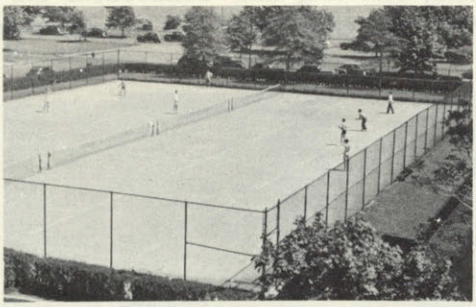
SOCCER has always been a favorite at M.I.T., and formidable teams are fielded by the Institute each year. The squad is a member of the New England Intercollegiate Soccer League and plays a full varsity and freshman schedule. Brown, Dartmouth, Springfield, Harvard, and Connecticut are among the annual competitors in a season extending through October and November.

SQUASH, a winter sport which requires no previous experience, provides excellent intercollegiate and intramural competition. The eight courts at M.I.T. rank with the best in the area.



SWIMMING is high in the intercollegiate sports program. A normal schedule consists of eight or ten meets for the varsity team and five or six for the freshman team between December and March, climaxed by the New England Intercollegiate Swimming Association Championships. M.I.T. has for years produced well-balanced teams, meeting some of the best competition in the East—Harvard, Williams, Amherst, Brown, Boston University, R.P.I., Wesleyan, Tufts, and others.

TENNIS is part of the M.I.T. athletic program as a competitive and recreational sport. Varsity and freshman intercollegiate schedules include top teams from New England: Williams, Wesleyan, Harvard, Boston University, and others.



TRACK at M.I.T. includes cross-country and indoor and outdoor track. Practice sessions and intra-squad, inter-class, and intramural meets are scheduled throughout the school year. More than 125 men are usually carried on the roster; they practice and compete in the leading meets of the East. Briggs Field has an excellent quarter-mile outdoor track and a new portable wooden track; the Rockwell Cage has full indoor facilities.

WRESTLING is increasing in popularity, both from the participant and spectator point of view. Varsity and freshman teams compete in dual-meet schedules with Brown, Harvard, the Coast Guard Academy, Williams, Tufts, Springfield, and others. The climax of the season is the New England Intercollegiate Wrestling Tournament.

INTRAMURAL ATHLETICS

But if you are not a member of any of these intercollegiate teams, you are still not out of the M.I.T. athletic picture. All the athletic facilities are available for recreational use, and observation proves that practically every M.I.T. student thus makes use of them.

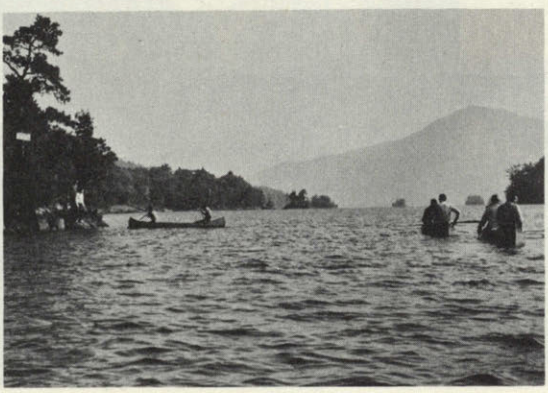
For many M.I.T. men intramurals make a fortunate combination of the competitive and recreational in sports. Intramurals at the Institute include touch football, basketball, volleyball, softball, swimming, squash, tennis, track, table tennis, bowling, sailing, badminton, and hockey. Students administer the program with a vice-president of the Athletic Association in charge. A manager of each different intramural activity is appointed by the Athletic Association. The manager selects his staff of assistants who receive numerals for satisfactory service.

About 400 teams, from groups such as fraternities, dormitories, and departments, compete in the 13-sport program. This means that about 1500 men are involved in at least 950 contests.

CLUBS AND ACTIVITIES

There is no need—and insufficient space—to describe here all the student clubs and activities which are shown on the chart. But a few need descriptions, which follow:

The weekend is rare when the OUTING CLUB is not conducting a rock-climbing or skiing expedition, a cycling trip to Walden in co-operation with Wellesley or Radcliffe, or an overnight camping trip to the White Mountains. The club is a member of the Intercollegiate Outing Club Association, which means that M.I.T. students are a part of many joint outings of New England colleges. Thanksgiving dinner on the slopes of Mount Katahdin, Maine's highest peak, is an M.I.T. Outing Club tradition; so is spring white-water canoeing, and so are the square dances with all the Boston members of the I.O.C.A.



The HOBBY SHOP has facilities for all types of hobbies; there are wood and metal lathes, a complete carpenter shop, testing equipment for radio work, a darkroom for photographers, type and printing press for amateur printers, and other facilities. Other organizations, shown on the chart, provide outlets and fellowship for other hobby interests.

The LECTURE SERIES COMMITTEE sponsors lectures, recitals, forums, and movies which are an important asset for the entire M.I.T. community. Recent guests under this sponsorship have included Mrs. Franklin D. Roosevelt, Captain Jacques-Yves Cousteau, Ogden Nash, Alistair Cooke, and Harold E. Stassen. There is a year-long program of foreign and special movies.

The Dramashop in "Six Characters in Search of an Author."

DRAMASHOP is the organization of students interested in reading and producing plays. It is devoted especially to producing contemporary and experimental drama. There is a corresponding organization of Faculty members—the Staff Players of M.I.T.—who present more traditional and tested productions. A separate student organization presents *Tech Show,* the annual student musical. As a result, there is an M.I.T. season of important dramatic productions each year using entirely "home talent."

STUDENT PUBLICATIONS at M.I.T. include *The Tech,* biweekly newspaper; *Technique,* yearbook; *Tech Engineering News,* the monthly of the engineering school students; and *Voo Doo,* the humor magazine. In addition, there are other less formal outlets for journalism talents in the newspapers of the undergraduate houses and in departmental newsletters of many kinds.

The DEBATING SOCIETY takes part in many varsity intercollegiate debates, practice debates, special forums, and tournaments. Typical of its success is a first place at the 1954 Brooklyn College Debate Tournament, in competition with teams from 57 other schools.

The ROCKET RESEARCH SOCIETY studies and builds rocket models—and, with special permission of the Coast Guard, tests them on the sands of Monomoy Point off Cape Cod.

The TECHNOLOGY COMMUNITY ASSOCIATION has a diversified program of service to the Institute community. With the help of a permanent staff, it conducts a book exchange, a room registry, and a travel and ticket service. Work with Boston boys' clubs, a handbook for new arrivals on the campus, Tech House for weekend outings, and annual blood donor and clothing drives are a few of the activities sponsored by the student members. The Technology Community Association maintains a circulating gallery of prints to brighten the rooms in M.I.T. dormitories.

Religious activities at M.I.T. center in several groups some of which are listed on the chart on page 64. The Technology Catholic Club, Hillel, and the United Christian Council have programs of worship and study. Chaplains from each denomination have regular office hours at the Institute and conduct services in the Chapel. Neighboring churches welcome student membership.

T.C.A. boys' club work.

Selling tickets

TECH SHOW: FROM VAUDEVILLE TO GRAND OPERA.

Stage hand at work

Djinn and colleagues

The chorus rehearsing

SOCIAL LIFE

"Numbers mean many things at M.I.T.," says the handbook for freshmen published by the Technology Community Association. "Besides the values of π and e," continues the editor, "you'll need to know the telephone numbers of Wellesley, Radcliffe, and Simmons." This quotation is one good way of suggesting the place of social life on this campus.

The social season begins each fall with a series of "acquaintance dances," at which M.I.T. is host to newcomers at all the women's schools in Greater Boston. From that time on things gain momentum; there are dances nearly every weekend, and some sequences of social activities are formed into a full weekend program to provide a special appeal for students' guests.

In winter comes the "All-Tech Sing"—a competition in barber-shop singing by all the dormitories, fraternities, and classes sponsored by the honorary music society—and in the spring the Carnival, where you can win prizes for marksmanship and strength while helping contribute to international student funds. There are "big name" dances in all the seasons: the Junior Prom and the Nautical Association dance in the fall, Christmas Formal and Military Ball in the winter, Assemblies Ball and Senior Dance in the spring. The dormitories and fraternities have their own parties throughout the year.

Social activities for married students center in the organization of wives of M.I.T. students, called the Technology Dames.

The editor of the T.C.A.'s handbook for freshmen gives this advice: "Join some of the activities you have read about, be active in your living group, get a Saturday night date and talk about something besides engineering. You are going to be a lot happier." The opportunities to follow this advice (which everyone at M.I.T. thinks is excellent) are so manifold that truly "there is never a dull moment" on this campus.

Dr. and Mrs. Killian receiving

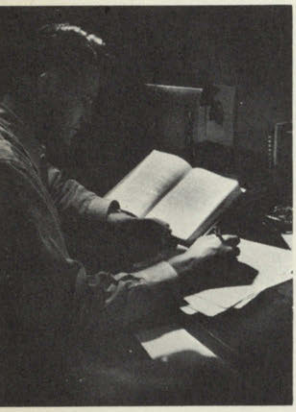
Square dance

Costume party

3 *Entering M.I.T.*

BY now you have learned that the M.I.T. student body is made up of young men and women from many backgrounds and having many abilities, ideas, interests, and goals. Even if there were to be found a completely typical M.I.T. student, no one could surely say that if you are just like him, you would be interested in applying for admission to M.I.T. But if in the description in this catalogue of the Institute—its ideas and purposes, its Faculty, its students, its Courses, its student activities, its campus—if in this description you have found concepts which are to you provocative and appealing, then it is likely that you should be interested in entering M.I.T.

If, furthermore, you possess a good basic intelligence, if you have taken subjects in secondary school which demonstrate that you are interested in science and mathematics—and also in the wide range of humanities,—if your marks indicate that you work consistently well and are seriously and conscientiously concerned with your studies, if your personal record indicates that you are an active person whose interests and experiences include many aspects of living beyond the classroom and textbook . . . if these things are true, then M.I.T. invites you to apply for admission to this community.



In considering your application for admission, M.I.T. will try to study, insofar as possible, your entire record and personality. School marks, although important, are only a part of the things to be considered; a straight A average is *not* prerequisite.

HIGH SCHOOL BACKGROUND

ANY good high school or preparatory school in the United States, and equivalent schools in other countries, will give you adequate preparation for entering M.I.T.—if you take full advantage of the opportunities before you. A broad secondary education—the kind of education that gives high school graduates the ability to think, to learn, and to express themselves clearly—is most desirable. M.I.T. does not recommend specialized technical preparation.

An interest in and an aptitude for mathematics and a general motivation to go further than a superficial introduction to the sciences are of primary importance; a familiarity with history and literature helps to achieve the understanding necessary for meeting the professional as well as the broader demands of life. As science and engineering become increasingly public concerns, this breadth of outlook becomes more valuable for the scientist and the engineer.

Some suggestions to entering students are formalized in specific requirements that have been established for all entering freshmen.[1] These "entrance requirements" are:

English	three units
Algebra	two units
Plane Geometry	one unit
Physics	one unit
Trigonometry	one-half unit

By one "unit" is meant one full year's study—four or five times a week—in a high school subject (except for English, where four years of study are counted as only three units). In some states algebra is completed in one and one half years, and this program satisfies the algebra requirement. Solid geometry, though not required, is recommended.

[1] If you have been unable to complete all these requirements but have an especially good record in those you have studied, special provisions can sometimes be made.

In addition to these subjects, M.I.T. recommends that among high school "electives" should be one year of chemistry and one or more years' study of history. Although there is no language requirement for admission, the study of a modern foreign language in secondary school is desirable and is strongly recommended. No limitations are imposed with regard to languages, except that if a language is offered at all it should total at least two units. The choice of languages should be guided by the student's own interest, by the educational opportunities open to him, and by the nature of his probable future work. For example, those who expect to have contacts with Latin America may need Spanish or Portuguese. Those who look forward to advanced work in research or design in a scientific or engineering field may eventually need a knowledge of German, Russian, or French, since there is an extensive and important technical literature in each of these languages.

ENTRANCE EXAMINATIONS

All applicants are expected to take the test program of the College Entrance Examination Board which is administered at various times each year in many centers in the United States and abroad. All candidates can obtain from this organization an *Information Bulletin* giving the test dates, locations, and fees for the current year.

If you are applying to M.I.T. you should take the following Board tests: in the morning, the Scholastic Aptitude Test; in the afternoon, three one-hour tests: (1) Advanced Mathematics; (2) English Composition; and (3) either Physics or Chemistry. You may take the tests on any date you wish or divide them among different dates as you prefer. A candidate may take one or more College Board tests as early as the eleventh grade. These might well include the Scholastic Aptitude Test and one or two achievement tests. These can be repeated if desired in your senior year.

Application to take the tests should be made to the College Entrance Examination Board, Box 592, Princeton, New Jersey (or, in Western states, to the College Entrance Examination Board, P. O. Box 27896, Los Angeles 27, California). You should ask the College Entrance Examination Board to send your test scores to M.I.T.

THE COST OF ATTENDING M.I.T.

THE Institute is an independent, endowed institution; to provide its facilities and teaching costs an average of $2600 per student per year. The tuition paid by each student covers only a small part of this amount; the balance is met by income from endowment and gifts.

The following is an estimate of an average student's costs for an academic year (37 weeks, with recesses and holidays within the year).

Tuition	$1,100.00
Board	650.00
Room	370.00
Books and Materials	100.00
Health Insurance	22.00
TOTAL	$2,242.00[1]

In addition to these costs, a reasonable allowance (probably $200 per academic year) should be made for personal expenditures which include personal necessities, laundry, clothes, and miscellaneous items. It should be understood that this total will vary according to individual tastes, requirements, and choice.

During the freshman year there are certain non-recurring expenses such as drawing equipment and slide rules, for which $40 should be allowed. Freshmen must make a deposit of $25 to cover breakage, repair of military uniforms, and laboratory equipment. Refunds on this deposit or bills for excess charges are mailed at the close of the year. Institute health insurance, $11 per term, is required unless a waiver is signed.

Here these items of expense are explained in detail:

ACADEMIC EXPENSES

The regular tuition fee, $550 per term, is all-inclusive; there are no extra assessments such as matriculation fees, extra charges for extra subjects, or activity fees.

This tuition is the same for all years of all Courses, with the exception of certain terms during the Co-operative Courses, when students are working at industrial plants. If you find, after arriving at M.I.T., that you are interested in a Co-operative Course, you will want to consult with the Bursar for tuition infor-

[1] This total is the estimate for the academic year 1957-58; it may be adjusted for 1958-59.

mation. Special tuition fees are established for subjects given during the Summer Session, and these figures are given in the Summer Session Catalogue each year.

LIVING COSTS (BOARD AND ROOM)

The rent for rooms in M.I.T. undergraduate houses ranges in 1957-58 from $140 to $215 per person per term, payable in advance. Freshmen—unless they commute to M.I.T. or live in fraternity houses—are required to live in the undergraduate houses up to the limit of accommodations available; a large number of upperclassmen also choose to live on the campus. All students living in Baker House are required to take their meals in the House dining room Mondays through Fridays. Similar service is available in Walker Memorial—on an optional basis—for residents of other dormitories. The present fee for these "commons meals" is $12.50 per week ($212.50 for the Fall Term and $200.00 for the Spring Term), providing three substantial meals each week day; similar dining facilities are available on a cash basis on Saturdays and Sundays and during vacations, but many students choose to explore the famous restaurants in Boston and the surrounding countryside for weekend meals.

HEALTH INSURANCE AND MEDICAL EXPENSES

A health insurance plan is available to students of the Institute for a premium of $11 per term. In return for this sum the insurance agency agrees, with certain limitations, to pay up to $1,000 toward meeting the cost of each injury or illness during the term. If any student does *not* wish to be enrolled in this plan, he must sign a waiver; insurance is not necessary for Army, Navy, or Air Force students or for those veterans enrolled under Public Law No. 894. Any student registering after the official Registration Day will be insured only from the date on which he files registration material.

Any student may receive routine medical care in the clinic without charge. If he is referred to one of the special clinics, a moderate fee is charged. Psychiatric service will be charged for after the fifth interview in any one academic year. Insured students are seen in the various special clinics, including psychiatry, without charge other than the insurance premium. The charges for students in the hospital are low. Food, nursing, and medical care in the wards cost $10 a day. For insured students the cost of these services, too, is borne by the insuring agency.

In cases of serious illness or contagious disease students are sent for treatment and care to hospitals outside the Institute in the Boston area; fees at these hospitals are paid by the insuring agency. If a student is not insured, these fees, of course, are the patient's responsibility.

PAYMENT OF BILLS

Registration instructions issued before the beginning of each term (and sent automatically to all admitted students) specify the date on which payments of tuition, board, room, and insurance premium are due. *No bills are sent;* meeting these deadlines is each student's responsibility.

Those who wish to make periodic payments within each term should consult with the Bursar before the beginning of each term (not later than the Wednesday before Registration Day). This plan for spreading tuition cost over the term—without interest charges—is popular.

FINANCIAL AID FOR STUDENTS

IT is very important that each student make an accurate estimate of his expenses, including the basic expenses outlined in the previous pages, the variable personal expenses, and the needs for transportation. This estimate of expenses should be considered carefully in the light of the funds which he has available: the amounts he may expect to receive from his parents or guardians, savings he may have accumulated, and earnings expected during the summer.

To help meet the costs of attending M.I.T. there are three types of financial aid available through the Institute—scholarships, loans, and part-time campus work. These are administered under a co-ordinated program of financial aids, the purpose of which is to assist well-qualified young people with limited funds and resources who wish to study at the Institute.

SCHOLARSHIPS

Approximately one-quarter of the members of M.I.T.'s entering class each year receive scholarship grants ranging from $300 to $2,000 for the academic year. In certain instances part-tuition grants are augmented by grants to cover room rentals and by assignments to part-time campus jobs. Although the majority of these scholarship grants are for the first year only, the Student Financial Aid Committee has funds for the renewal of grants in

succeeding years to those who make application, who demonstrate academic and extracurricular achievement during the freshman year, and who need continued financial aid.

There are often individual problems which are best discussed as such. The Director of Student Aid will be pleased to hear from you. Your questions should be written as early as possible, since the deadline for scholarship applications must necessarily be set far ahead.

Among the scholarships offered are a limited number of four-year grants which include the Sloan National Scholarships, the William Barton Rogers Scholarships, the Lockheed National Scholarship, the Procter and Gamble Scholarship, the General Motors National Scholarships, the Lawrence D. Bell Scholarship, the Inland Steel Scholarships, the Martin Aircraft Scholarship, and the Development Fund Scholarships. Awards for the first year only are the Alumni Regional Scholarships (from nineteen metropolitan areas), the Freshman Competitive Scholarships, the Hayden Memorial Scholarships, and others. Full information, applications, and instructions for the various scholarships available may be obtained from the Director of Student Aid, Student Aid Center, Room 5-119, Massachusetts Institute of Technology, Cambridge 39.

Most of these scholarships specify that they be awarded on the basis of achievement and financial need. Selection is made by the Student Financial Aid Committee, on the evaluation of such factors as your secondary school record, College Board test scores, qualities of character and personal bearing, professional promise, and participation in school and community affairs.

If you wish to apply for any of these scholarships you should write promptly to the Director of Student Aid. Completed application forms must be filed early in February preceding the fall term in which the scholarship is to be effective.

TECHNOLOGY LOAN FUND

In addition to scholarship grants for the second and succeeding years, after the first year students with satisfactory records may make use of the Technology Loan Fund, the largest in the country, to borrow amounts equivalent to full tuition, or to supplement scholarship grants. Repayment of loans begins six months after the date of graduation and continues at the rate of $50 every half year. The rate of interest is currently one percent.

STUDENT EMPLOYMENT

Through the Office of Student Personnel, M.I.T. stands ready to assist and encourage students who must plan to earn part of their expenses during the college year. Although a new student should not undertake employment until he has fully adapted himself to his new surroundings, experience has shown that young people of good ambition can do a reasonable amount of outside work without detracting from their total education. It is not advisable nor practicable for a new student to anticipate that he may earn *all* of his living expenses during the college year.

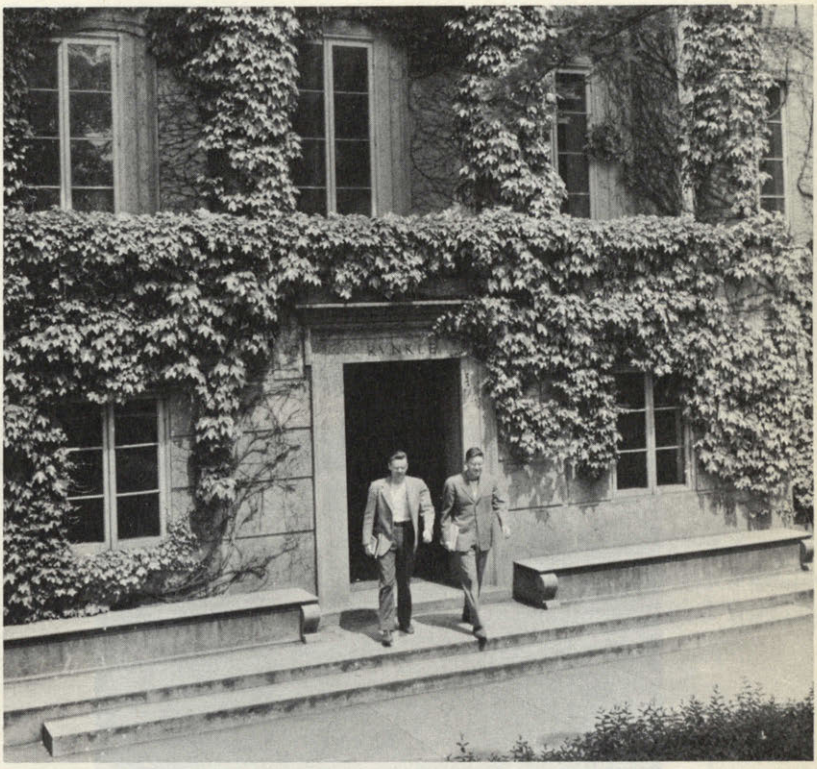
Positions are available in the dormitories, dining services, and other divisions of the Institute. The time that may be devoted to these positions is restricted, with slight variations, to between ten and twelve hours per week, and income will be somewhat more than $150 per term and more than $300 for the academic year.

BANKING FACILITIES

Students are encouraged to maintain their own checking accounts in commercial banks, either in their home communities or in the Boston area. The Institute maintains a Personal Deposit Office where students may deposit their personal funds in amounts up to $1,000 and draw upon them without charge or interest.

Hobbies are shared in the dormitories.

A Christmas party for underprivileged children.



Runkle, on the East Campus

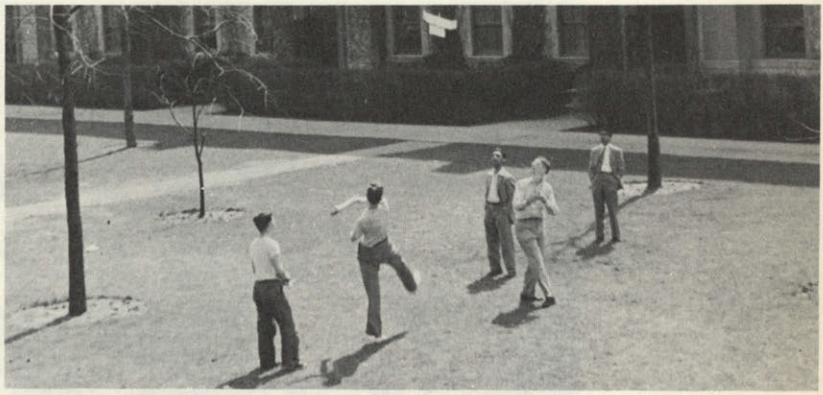
Fraternity stairway

DORMITORIES AND FRATERNITIES

FRESHMEN may live in any of the Institute's undergraduate houses. As soon as you are admitted to M.I.T. you go on a list to receive, when it is ready in mid-summer, complete information about the facilities available, the rates which apply to each room, the equipment and service offered, and the regulations which apply to dormitory residents. In general, it is appropriate to say here that all rooms in the houses are provided with the furniture needed for a comfortable year, and there is telephone service. Residents supply their own blankets, bed linen, soap, and towels. There are attractive lounge rooms in each house, and an active social life centers around each of the Institute's dormitories.

The Everett Moore Baker House

Theta Delta Chi



In the East Campus court

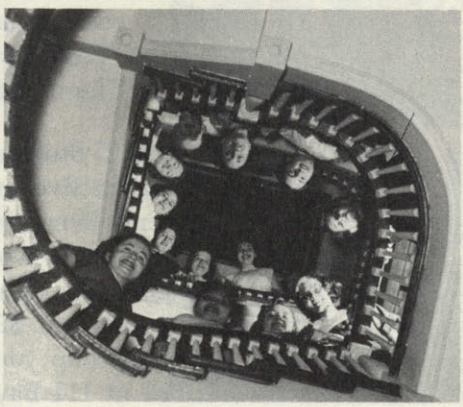
Many of the rooms overlook the Charles River, giving spectacular views of the basin and the Boston skyline beyond. Faculty residents in each of the houses welcome informal and friendly discussions with students and their friends.

You may wish to consider joining one of the 27 fraternities which have active chapters at M.I.T. But whether or not you expect to join a fraternity, you should apply for accommodations in the undergraduate houses. If you are accepted for fraternity membership, you will help all concerned by withdrawing your application as early as possible. Fraternity membership is by invitation only, after the formalities of a Rush Week before the fall term begins each year. Costs in fraternities are not very different from those in the dormitories. Information about fraternities at M.I.T. reaches each admitted freshman several months before the Fall Term, from the Inter-Fraternity Conference.

There is also, in this group of private accommodations, the M.I.T. Student House, organized by a group of alumni to provide attractive and unusually economical living arrangements. Students living here operate the house themselves and do much of their own work—aside from cooking and certain items of maintenance—thus reducing the total of board and room expense by as much as $250 a year. For information about membership in this group you should write directly to the President of the House at 111 Bay State Road, Boston 15.

THE TECH, *student newspaper, welcomes new co-eds to M.I.T. by printing their picture in an early fall issue.*

The Women's Dormitory, at 120 Bay State Road in Boston, accommodates 17 students in an attractively furnished house with a home-like atmosphere. Residence here is required for first-year women who do not live at home. There is a House Mother in residence, and breakfast and dinner are served by the residents of the house in accordance with a schedule planned in advance. The girls also have the privilege of preparing their lunches with food provided by the house. Bexley Hall, in Cambridge, is an apartment dormitory for upperclass and graduate women, with a Faculty Resident and his family.



HOW TO APPLY TO M.I.T.

AS soon as you know that you *may* be interested in coming to M.I.T., you should file with the Director of Admissions (Room 3-108, Massachusetts Institute of Technology, Cambridge 39) a preliminary application. This will put you on the mailing list for all current information about M.I.T.—including new editions of this catalogue. The earlier this is done the better, because it will assure that announcements and final admission forms will be sent automatically at the proper time.

In the fall preceding the date of your probable entrance to M.I.T., you will receive final application papers and two personal endorsement forms. You should complete and return the final application form and send with it a non-returnable application fee of $10. A check or money order is preferred.

At the same time, a school report form will go directly to the principal or headmaster of each secondary school which you have attended; it is to be returned by the school directly to the Institute. Soon after these forms arrive comes the final date for applying for scholarship aid, which must be done on separate forms as described in a preceding section.

INTERVIEWS

Each applicant for admission to the freshman class is expected to have a personal conference either in the Admissions Office or with a designated member of the M.I.T. Educational Council near his home.

Council members are alumni who have been selected for their ability to represent M.I.T. and for their interest in and liking for young people. These men welcome the opportunity to meet students interested in M.I.T. and to help them in their educational plans.

Each applicant will be referred to a member of the Council at the time of his Preliminary Application for admission. The conference should, wherever possible, take place not later than January of the senior year and preferably early in the fall.

Applicants will be welcome at the Admissions Office on Mondays through Fridays between 9 and 5; it is not necessary to make an appointment in advance. Visitors may wish to plan their

time to include one of the student-guided tours of the campus, available at 10 and 2 o'clock each day that the Admissions Office is open.

ADMISSION

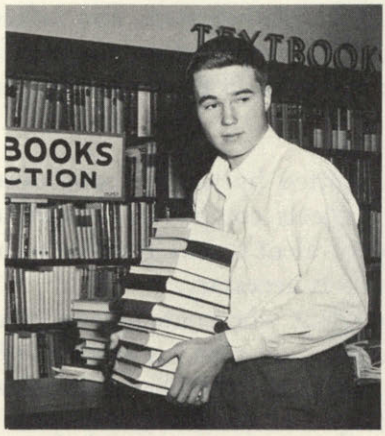
Early in May of each year the Admissions Office reports on the status of most applicants for the class entering the following fall. During the summer, after you have an official admission statement, will come information about registration, dormitory room selection, and Rush Week and fraternities—and a medical form for your family doctor. Dormitory room assignments are completed only after admission has been secured.

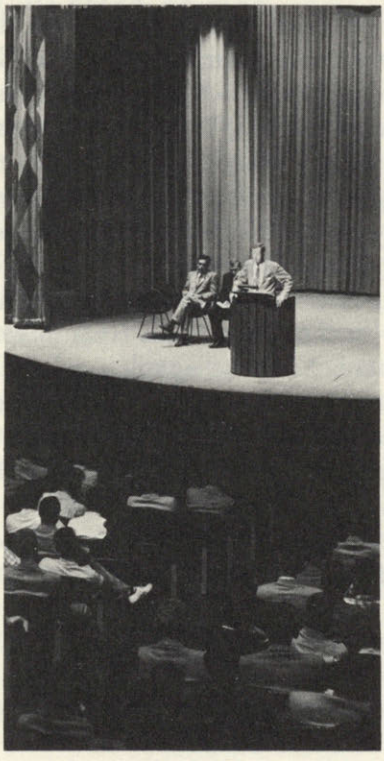
ADVANCED PLACEMENT

Any student from a public, parochial, or independent secondary school which gives college-level courses under the auspices of the College Entrance Examination Board Advanced Placement Program should not hesitate to ask for advanced standing in individual subjects if he wishes to proceed at the next higher level. Under this plan the student takes an advanced placement examination given by the College Board at his school late in the spring of his senior year. These examinations are scored by the College Board and are then forwarded to the college of the student's choice. When the student arrives at M.I.T. in the fall, we shall have his examination paper, his examination grade, a description of his advanced course written by his secondary school teacher, and a recommendation from the school concerning advanced placement. The amount of credit given will then be determined by the Institute's department best qualified to evaluate the material, in consultation with the student.

COLLEGE TRANSFERS

MOST M.I.T. students, of course, enter the Institute directly after graduation from high or preparatory school. A few each year, however, enter as "college transfers," following one or more years of college elsewhere. The eligibility of such applicants for admission will be determined by the Committee on Admissions after a review of their records. They will be expected in every case to have completed the academic preparation required for admission directly from secondary schools.





FRESHMAN WEEKEND . . .

. . . signing in

. . . bookstore patrol

. . . meeting the President

. . . the Dean presides

These applicants for admission with advanced standing should plan to take the same group of College Board tests required of freshman applicants: the morning Scholastic Aptitude Test, and the afternoon achievement tests in English Composition, Advanced Mathematics, and either Physics or Chemistry. With your final completed application form you should enclose a non-returnable fee of $10. Check or money order is preferred.

ADVANCED STANDING

Students admitted by transfer may expect to receive advanced credit for subjects completed at other colleges which are substantially equivalent to M.I.T. subjects; a grade above the lowest passing grade is necessary.

A student who contemplates transfer to M.I.T. from another college should plan his program of study so that he covers the basic subjects of the Course he expects to enter. At least a year of college mathematics and physics should be included.

THE TWO-DEGREE PLAN

A number of liberal arts colleges grant their Bachelor's degree to students who have attended for three years and who have then gone on to qualify for a Bachelor's degree in engineering, science, or architecture at M.I.T. or a similar institution. A student who plans his three college years carefully to include the requisite mathematics and science, as well as humanities and social studies, can usually obtain the Bachelor of Science degree at M.I.T. in two additional years (three for the Bachelor of Architecture).

Students interested in this plan should communicate directly with the college they wish first to attend and secure admission there. Later acceptance at M.I.T. will depend, as with all transfer applicants, on the quality of the college record.

College transfers are, in general, not eligible for financial aid during their first year of attendance. Exceptions may be made for students of outstanding promise who are designated as members of a two-degree plan by their college and are already receiving financial aid there.

Registration Day

HOW TO BEGIN AT M.I.T.

THE Fall Term begins for Freshmen on the Wednesday before Registration Day—which in turn is the next to the last Monday in September. (First-year students are not admitted at other times of the year.) Dormitory rooms for entering students are ready on Wednesday afternoon. Upperclassmen are not due before Registration Day. This means that first-year students arrive on the campus in time for four days of special programs which are designed to help them get acquainted with their classmates and with M.I.T. There are general introductions by members of the Faculty, Administration, and student organizations; there are social activities so that you may get acquainted with your classmates; there are tours and visits to introduce you to the campus; and there are conferences with Faculty Advisers to help you plan your program.

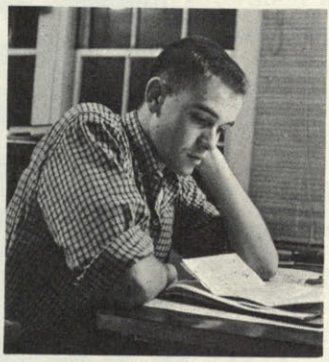
You will have further information about registration itself during the summer before you arrive at M.I.T.

Every entering student is required to be immunized against tetanus and smallpox before he arrives at M.I.T. Soon after you register you will have a complete physical and dental examination, and every second year you will have a chest x-ray.

(text continues on page 98)

"...To find my own goals, values, and rules of life..."

Carl V. Swanson of Elmhurst, Illinois, reports on his first six months as a member of M.I.T.'s Class of 1960.



Last year when I registered for Freshman Weekend, M.I.T. seemed to be a very large place. But we freshmen introduced ourselves to each other (promptly forgetting names) and had an enjoyable though apprehensive time.

M.I.T. no longer seems so large to me, and living and talking with other M.I.T. men is an education in itself. Greece, Burma, Washington, Alabama, Maine, and some other states and countries are represented by the forty guys on my floor. Several are good athletes, others write for one of the four publications, some act, and others are in student government. I consider my education about people, gained by living closely with these students from many different backgrounds, more important than what I've learned in my courses.

The Institute, considering us to be mature young men capable of leading our own lives, imposes very few rules on us—we have a large degree of freedom. It was difficult, yet extremely beneficial, for me to adjust to this freedom. It is the change from a boy's life to a man's life. At first I abused my new-found freedom, but my own ambitions and my grades soon forced me to find my own goals, values, and rules of life. Nobody gave them to me; I had to think them out.

Tech has so many activities that if I joined all those that interest me, I'd spend all my time working on them and flunk out. It is very easy to join the activities. At the Activities Midway during Freshman Weekend, I talked to the track coach and the business manager of *The Tech*. I have since gone out for track and joined the newspaper staff, though I had never run track or written before. Since activities always need more people, anyone may join at almost any time.

The athletic facilities here are for the average many instead of the expert few. Name a sport, and we probably have beginners' instruction in it. So far I've learned to sail, ice skate, ski (in Canada, not M.I.T., during mid-term), play volleyball, and now tennis. During the vacations most of us go home; but some ski or go to Florida, New York, or home with a friend.

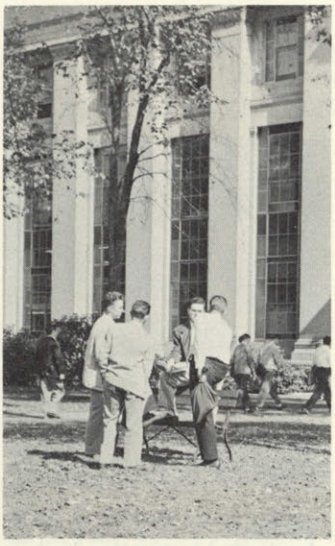
But don't get the wrong impression. The Massachusetts Institute of Technology is a school where first we work and work hard, then enjoy life. I have 31 hours of classes a week counting everything (normally a freshman has 26 to 28 hours a week).

I came here expecting to graduate in mechanical engineering. Soon I found my interest lay in management, not engineering, so I, like many other freshmen, am going to switch my Course.

Even though it is not listed in the catalogue as a freshman elective, I am taking Economics I as an elective—along with many other freshmen. If we can demonstrate our ability and show good reason, the Institute sometimes allows us to take subjects which are not officially open to freshmen.

On weekends we catch up on sleep, studying, washing, cooking, and girls. On Saturday evening maybe we'll see a movie at Kresge, go somewhere, or get a date. Girls (girls outnumber the guys around Boston) are very easy to meet at any of the many acquaintance dances or through friends. We can always take a date to M.I.T. for a dance or party, to a show in Boston, or some afternoon take her sailing.

We study hard at M.I.T. It is a friendly, cosmopolitan atmosphere. We know that while we enjoy a good time, we are here primarily to study and learn. We're proud of Tech. We like it here!



(text continued from page 95)

Your registration is not considered complete until you have paid the tuition, board, room, and other fees at the times specified in the registration instructions. Since no bills are sent by M.I.T., this is a matter of your own personal responsibility; a charge of $5.00 is made if any one of these payments is late.

WHAT TO BRING

The Institute doubts the need of telling you what clothing to bring to M.I.T. (this is a pretty informal place in that respect), what decorations you will want for your room, and to bring your skis or ice skates. But some other things that may not at once occur to you are even more important. Here are a few suggestions:

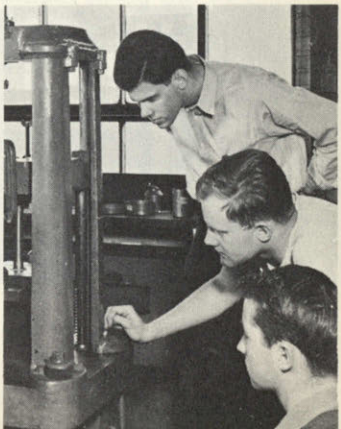
Bring an open mind. The opportunities for activity and study at the Institute are many. If you arrive with an active curiosity and a determination to discover for yourself, you will have many chances to investigate all these things; and if you are a beginner in most of them, as you probably are, you will have plenty of time to look around and to learn the fundamentals of any new field of activity in which you decide to take part. The student organizations and the social clubs make special efforts to welcome freshmen at the start of the year.

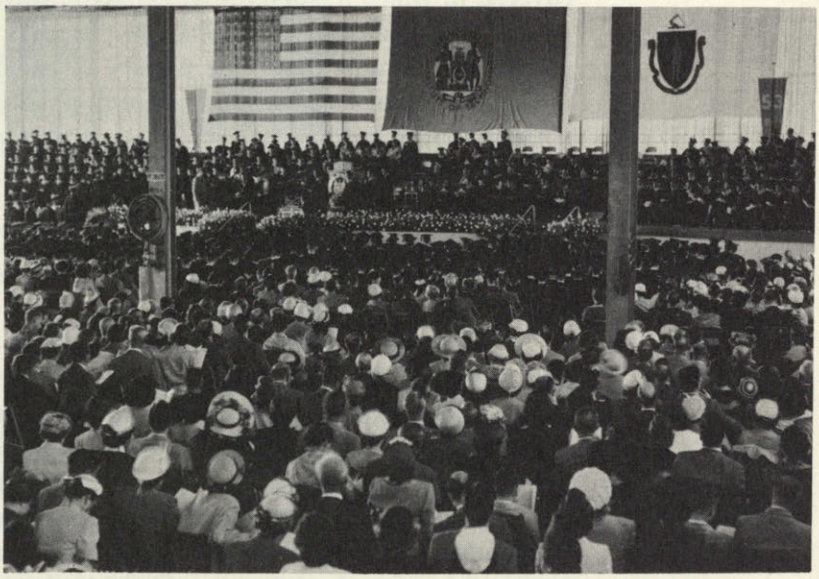
You may gain perspective by exploring your own particular aptitudes as they are revealed by your progress in the fundamental subjects of the first year. You will have time to learn which fields of those at M.I.T. most closely match your own abilities. You will have a chance to discuss these matters with your fellow students, with your instructors, and often with men in industry; you may be able to find out what specific opportunities exist for the combination of ability and application you have discovered in yourself. The initiative is your own.

Self-confidence is important. You will find yourself a beginner in the midst of a wide variety of people at various stages in the pattern of learning and research at the Institute. There is nothing wrong with being a beginner, and a beginner who shows enthusiasm and eagerness to learn, who demonstrates his good attitudes by hard and careful work, and who rewards friendship with an interested and interesting personality . . . such a freshman earns as much respect here as an expert in research or an established leader in campus activities.

A sense of responsibility is essential. As a freshman you will probably have more freedom in managing your own affairs and in making your own decisions in every matter than you have ever had before. There are few rules at the Institute to compel you in these decisions. The key to freedom for everyone lies in the limitations each individual places upon himself in order not to infringe on the freedom of others. You can keep your actions compatible with the interests of your fellow students as well as your own; in doing so, you will be laying the foundation for good citizenship throughout your life.

Be assured that everyone at M.I.T. is looking forward to meeting you and to hearing what you have to say. Friendship is one of the cornerstones of the Institute; even before you arrive, you have friends here waiting for you.





Commencement in the Rockwell Cage

GRADUATION DAY

The Great Court on Graduation Day

4 *Educational Opportunities at M.I.T.*

The chart in Section 2 listing M.I.T.'s professional courses shows that an M.I.T. education may focus on any of a large number of fields which lie within the general influence of science, engineering, architecture, and management. You may learn more about each of these fields as they are presented at M.I.T. by studying, on the following pages, the statements prepared by the heads of each Course. Here, too, you will find the "curriculum" for each Course, showing all the required subjects in the order in which they are best taken, as well as the various choices by which undergraduates may fulfill their special interests within the field.

There are certain fundamentals common to all the specialized fields of science, engineering, architecture, and management. Subjects in these common fundamentals are the principal content of the first year at M.I.T. Thus this first year gives each M.I.T. student an opportunity to gain perspective. He may judge his own aptitudes as they are revealed by his progress in these fundamental subjects. There is time to learn which phases of science or engineering most closely match his own abilities. He will be able, through discussion with fellow students, through conference with

his instructors and advisers[1]—whom he will be seeing frequently,—and perhaps through direct contacts with industry and business, to find what specific opportunities exist for him at M.I.T.

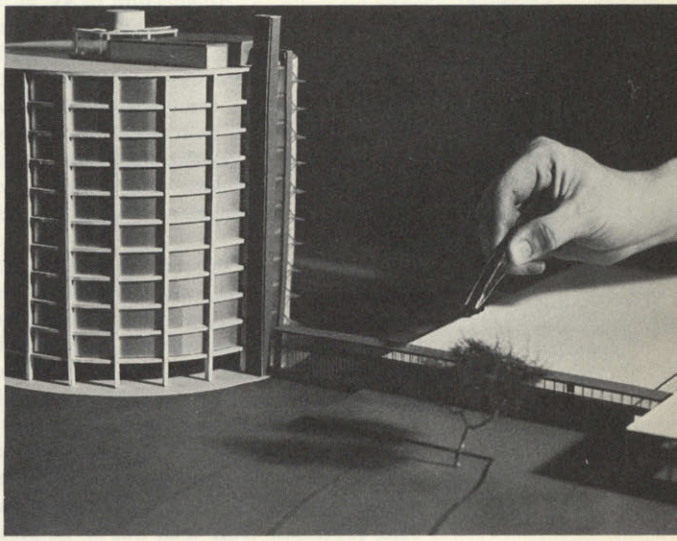
In the last analysis, the responsibility for choosing a curriculum to follow after the first year is the student's; he should be aggressive in seeking the knowledge on which to base his choice, since the decision must be his own, and no one else can make it for him. He should go to his instructors in their offices; he should visit plants; he should, through summer jobs, accumulate experience; he should talk with those who are experienced in the field which interests him. Then, when he enters his profession, he will be equipped to find his place in the new environment with the least waste motion.

FLEXIBILITY WITHIN THE COURSES

Flexibility in planning a program within each Course is provided by options, by the possibility of substituting other subjects for certain of those specified in the Course, and by successfully taking examinations for advanced standing; such examinations enable those students of superior ability or unusual experience to progress more rapidly or to include extra elective subjects in a four-year program. The Courses in Economics, Politics, and Engineering (or Science) and Humanities and Engineering (or Science) are designed to permit students to follow a logical program of study that meets needs and interests not satisfied by one of the more rigidly specified Courses.

You will notice that, although most curricula include study only in the two regular terms of the school year, the three co-operative programs and the Course in Geology and Geophysics have scheduled activities during one or more of M.I.T.'s summer sessions. The calendar at the front of this book gives the dates involved.

[1] A member of the Freshman Advisory Council, described in Section 2.



Dean Belluschi

"The architect must be a competent technician. He must also be a man to whom people and life in all its facets and mysteries are objects of fascination, delight, and concern. His task in society, therefore, is no longer to follow old styles or merely to create new ones but to give meaningful interpretation in physical terms of our complex civilization, to reflect our way of life and the substance of our culture."

—Dean of Architecture Pietro Belluschi, March, 1957.

ARCHITECTURE

Professor Lawrence B. Anderson

Architecture today, as in earlier periods of history, is the art of creating structures and spaces that help to bring satisfying order to the lives of people.

The architect is trained to provide his community with the physical environment that fosters more orderly and creative civic life. Towards that end leading citizens throughout the community—in industry, education, finance, religion, medicine, law, and government—require the services of the architect. He works with energetic, practical, and imaginative designers; he integrates the work of many specialists; and his colleagues are members of a dynamic profession which promotes urban, national, and international exchanges of ideas about the techniques and social objectives of architecture.

In working towards the constructive, humanitarian goals of his profession, the architect must rely both on craftsmanship and theory. He uses his technical skill to make protective shelters perform well, to design buildings that will be safe, convenient, comfortable, durable, economical, in visual harmony with their surroundings, and esthetically satisfying. He uses his understanding of people and institutions to develop cultural aspirations in visual form, to analyze and interpret the needs of his clients, to imagine arrangements in space that will translate these needs into structural form, to develop his concepts verbally and graphically, and to win their acceptance.

Consequently, the architect who has been educated both in engineering technology and in broadly scientific and humanistic ideas will best solve architectural problems. Only then will he be prepared to coordinate effectively the work of the special design consultants upon whom he relies for detailed analyses, to instruct the contractors in the execution of his designs, and to represent and guide his clients until the work is completed.

At M.I.T. the Department of Architecture offers an education in both the craftsmanship and theory of architecture. The general courses in the humanities and in the pure sciences provide a foundation in history, in ideas and verbal expression, in people and social structure, and in methods of scientific investigation. To this is added the special contribution of the Institute: technological training in related engineering fields such as structures, materials, heating, lighting, and acoustics. Another branch of studies, visual design, encourages students to develop their visual experience by learning to think in three dimensions; to investigate the vast resources in the organization of lines, planes, textures and colors; and to bring visual order to their structural inventions. Throughout the Course these specialized fields are co-ordinated in the design classes where the students, with the aid of instructors, solve modern, realistic architectural problems of many kinds.

This five-year program emphasizes the processes and the educational climate that develop in the student the techniques and goals of the professional architect. The internationally recognized achievements of alumni indicate the scope of the architectural education that has been developing for almost a century at M.I.T. In each drafting room students work individually upon a whole problem; each is assisted by instructors and distinguished visiting architects; and each discusses his drawings or models before a group of critics. This experimentation with solutions proposed by individual students of different nations and experience encourages vigorous, productive thinking.

The graduate is equipped to perform a supporting role in an architectural office, where experience accumulates the practical skills that lead to professional licensing and independent practice. He may even choose to specialize in acoustics or lighting, to superintend an industrial development, or to enter the field of housing.

In the United States today about one person in 4,000 is trained and experienced for work in architecture, and even fewer are qualified for leadership and innovation. In the next twenty-five years our expanding population and industry will require a great building program; leadership in this large opportunity will be shared by the architectural graduates of the next few years.

Architecture (Course IV-A)

FIRST YEAR

First Term
Physics (8.01, Mechanics)
Engineering Drawing (D11)
Foundations of Western Civilization (H11)
Calculus (M11)
Military Science (MS11)
or
Air Science (AS11)

Second Term
Physics (8.02, Mechanics, Kinetics)
Descriptive Geometry (D12)
Foundations of Western Civilization (H12)
Calculus (M12)
Military Science (MS12)
or
Air Science (AS12)

In the course of his first year each Architecture student is expected to take at least 16 additional units from among the following elective subjects:
Astronomy, General Chemistry, Earth Science, Elementary Meteorology, Graphics Laboratory, Graphical Processes, Elementary Nomography, Philosophy and Scientific Method, Technology in our Civilization, Basic Machine Drawing, Structure of the City, Man's Food, Perspectives in Life Science, American Character and Institutions, English Composition, Public Speaking, Spoken German, Spoken French, *and* Elementary Number Theory

SECOND YEAR

First Term
Applied Mechanics I
Form and Design
Physics (Electricity, Magnetism)
Humanities
Military Science *or* Air Science

Second Term
Strength of Materials
Architectural Design
Physics (Optics, Atomic Physics)
Humanities
Military Science *or* Air Science

THIRD YEAR

First Term
Architectural Design
Structural Analysis
City Planning Principles
Introduction to Art and Architecture
and one elective in Humanities

Second Term
Architectural Design
Structural Analysis
Modern Art and Architecture
Materials—Wood, Plastics, Fabrics
and one elective in Humanities

FOURTH YEAR

First Term
Heating and Ventilation
Architectural Design
two elective subjects (see right)
and one elective in Humanities

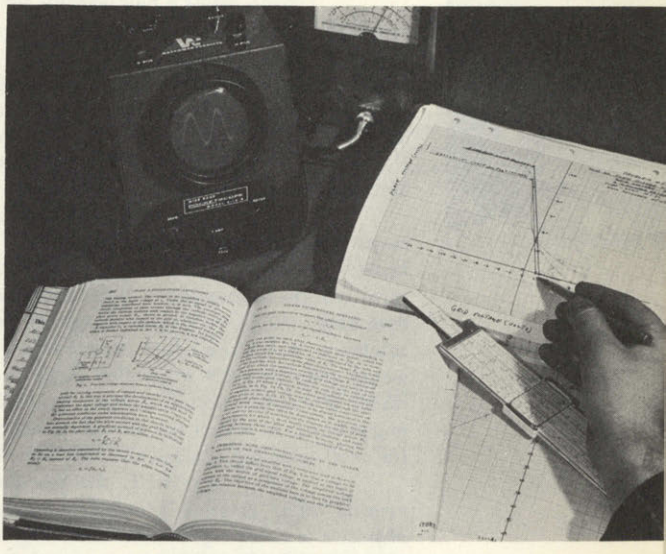
Second Term
Heating and Ventilation
Architectural Design
Materials—Masonry and Metals
one elective subject (see right)
and one elective in Humanities

FIFTH YEAR

First Term
Light and Color
Architectural Design
and one elective subject (see right)

Second Term
Thesis
and several elective subjects (see right)

Each student is expected to plan with his Registration Officer an elective program for the fourth and fifth years based primarily on the subjects listed below. He may include additional subjects in the Humanities, and he may propose appropriate graduate subjects or subjects from other departments if he is properly qualified.
Structures Seminar, Architectural Acoustics, Urban Sociology, Land Economics, Electricity, Illumination, Building Economics, Theories of Architecture, *and* Architectural Criticism



Dean Soderberg

"Technological education, in particular, cannot prosper in sterile academic forms. It must feed on life itself, and anything which is significant in the technological activity of our society is worthy of serious study and the most imaginative application of scientific rigor."

—Dean of Engineering C. Richard Soderberg, in the *Technology Review*, June, 1953.

AERONAUTICAL ENGINEERING

Professor C. Stark Draper

Just a half century ago two young men from Dayton, Ohio, taught the world the secret of powered flight. Their success began one of the most fantastic technological developments of modern science. Since that historic flight of 1903, the speed of aircraft has increased 50 times, their weight has been multiplied by 500, and the power developed by a single aircraft engine has increased by 1000; air transport has become one of the world's great industries. These accomplishments have chiefly resulted from the work of a rapidly enlarging group of men and women who today call themselves aeronautical engineers.

As specialists, aeronautical engineers concern themselves with every major technical area contributing to the manufacture of airplanes and guided missiles. Included are aerodynamics—to learn the forces and other effects of air in motion; structural design—to provide a light framework strong and rigid enough to withstand all operating conditions; engine design—to produce the huge amount of thrust needed with minimum weight and fuel consumption; and instrumentation and automatic control—to insure safe, properly controlled flight even under adverse conditions. Recent developments of combat aircraft suggest an addition to this list of specialties: weapons systems engineering, in which the aircraft is analyzed as one component of an integrated system for accomplishing a particular military objective.

At M.I.T. the four-year undergraduate course in aeronautical engineering offers vigorous training in applying fundamentals to all these problems. The objective is to train potential "chief engineers"—the men who can direct the entire design of an aircraft. But a firm groundwork is also provided for those who wish to specialize further in graduate work. As a basic foundation, the undergraduate course first requires general training in mathematics, physical sciences, and the humanities; then follow the professional subjects of aeromechanics, aerodynamics, stability, instrumentation and automatic control, structures and power plants. Practical design problems and laboratory assignments in wind tunnels, structural testing, control systems, and electronics are important parts of the work.

Undergraduates may select the cooperative program and be employed for six months during their junior year by one of several aircraft manufacturers or research laboratories. Others, who have made superior records, are invited by the Department in their senior year to follow an Honors Course, which includes a year of graduate study and leads to simultaneous award of the S.B and S.M. degrees.

Some outstanding undergraduate students participate in sponsored research in aerodynamics, instrumentation, aeroelasticity, structures, power plants and design projects, which gives invaluable experience in research methods.

Training in aeronautical subjects such as structures and automatic control usually prepares graduates to enter many industries other than aircraft, but the serious shortage of aeronautical engineers rarely permits this to happen. The converse is more commonly true: although aircraft manufacturers prefer aeronautical engineers for most engineering positions, they are forced by the limited supply to employ engineers holding degrees in other areas.

In no technical field do recent research developments suggest greater challenges or more rapidly expanding horizons. Consider only the case of high speed flight: the barrier to supersonic flight has been pierced, but sustained high speeds give rise to a host of related unknowns. What structural materials can be used, for example, at speeds which produce surface temperatures which will soften aluminum? How shall we build wings with little more relative thickness than a razor blade? What of flutter, the unpredictable vibration that can tear off skin panels, rudders, or even whole wings at high velocities? Will we be able to slow the hurtling motion of the supersonic airplane when it must land on ordinary airfields at 150 miles per hour? These are a few of the multitude of problems that will provide material for creative aeronautical engineers for decades to come. Here indeed is a profession with ceiling unlimited!

FIRST YEAR

First Term	General Chemistry (5.01) Physics (8.01, Mechanics) Foundations of Western Civilization (H11) Calculus (M11) Military Science (MS11) *or* Air Science (AS11) *and at least one additional first-year subject (see the descriptions in Section 5) during the freshman year* (Descriptive Geometry (D12) *is recommended)* *or* Naval Science (NS11)	*Second Term*	General Chemistry (5.02) Physics (8.02, Heat, Kinetic Theory) Foundations of Western Civilization (H12) Calculus (M12) Military Science (MS12) *or* Air Science (AS12) *and at least one additional first-year subject (see the descriptions in Section 5) in the first year* (Descriptive Geometry (D12) *is recommended)* *or* Naval Science (NS12)

SECOND YEAR

First Term	Applied Mechanics I Physics (Electricity, Magnetism) Aircraft Detail Design Introduction to Aeronautical Engineering Humanities Calculus Military, Air, *or* Naval Science	*Second Term*	Strength of Materials Physics (Optics, Atomic Physics) Aeromechanics Humanities Differential Equations Military, Air, *or* Naval Science

	Aeronautical Engineering (Course XVI)		**Co-operative Course (Course XVI-B)**
		Summer	*At M.I.T. (first six weeks):* Heat Engineering Aeromechanics *Vacation (approximately two weeks)* *At plants (remainder of summer):* Industrial Practice
THIRD YEAR	*During his third year, each student is expected to include in his program either the courses marked (a) or those marked (b) below:*		
First Term	Heat Engineering (b) Fundamentals of Electrical Engineering Aeromechanics Applied Aerodynamics (a) Aircraft Structures *and one elective in* Humanities	*First Term*	*At plants:* Industrial Practice
Second Term	(a) Fundamentals of Electrical Engineering Aircraft Propulsion Aerodynamics Airplane Stability and Control (b) Aircraft Structures *and one elective in* Humanities	*Second Term*	*At M.I.T.:* Aerodynamics Applied Aerodynamics Aircraft Structures Aircraft Propulsion *and one elective* in Humanities
		Summer	*At M.I.T.:* Fundamentals of Electrical Engineering Airplane Stability and Control *and one elective* in Humanities

FOURTH YEAR

First Term	Principles of Automatic Control Aeronautical Engineering Laboratory Aeronautical Engineering *one elective in such professional subjects as:* Gas Turbines, Elementary Internal Combustion Engines, Principles of Aerodynamics, Electronic Instrumentation, Aircraft Structures, Aircraft Structural Design, Aeronautical Systems, Advanced Calculus for Engineers, *or* Orbital Vehicles. *and one elective* in Humanities
Second Term	Aeronautical Engineering Thesis or Project *and three elective subjects, of which one must be in* Humanities *and one in* Aeronautical Engineering

CHEMICAL ENGINEERING

Professor Walter G. Whitman

Applying the principles and theories of chemistry to meet great human needs is the job of chemical engineers: to utilize physics and chemistry in mass production, to improve on nature with synthetics, and to process raw materials for highest yields of chemical products.

The chemical and petroleum industries start with coal, petroleum, natural gas, salt, sulfur, limestone and other raw materials and convert them by chemical reactions into a wide variety of useful things: drugs, dyes, glass, fuel, paint, paper, explosive, rubber, soap, building board, adhesives . . . The chemical industry supplies fertilizer and insecticides to the farmer; synthetic fibers to the textile industry; fuels for faster and faster aircraft; and so-called "plastics" to be formed into radio cabinets, telephone handsets, and countless other items. Many of its products, such as acids and alkalies, are intermediates primarily sold to other industries which will form the desired final products.

The early college training of chemical engineers is similar to that of chemists, since both must have a thorough knowledge of chemistry as well as of physics and mathematics. The chemist and chemical engineer are close partners in industry, too, but the engineer is concerned with large-scale and expensive equipment; he must carry out with larger quantities the chemical reactions and separations which the chemist has pioneered on a small scale. The chemical engineer is usually more closely associated with the business operations of his company than the chemist, and he must be constantly aware of costs.

The chemical industries as a group are growing three times as rapidly as the rest of U. S. industry. They spend large amounts of money on new products and new manufacturing processes. Chemical engineering education must therefore prepare its students to handle competently the new and unfamiliar situations they will constantly face in this kind of industry. Chemical engineering students at M.I.T. must learn to think for themselves. Since their opportunities will be so varied and changing, the undergraduate program of studies is along fundamental lines without emphasis on any particular field or any one particular group of chemical problems.

America's first curriculum in chemical engineering was organized here at M.I.T. in 1888; since then, members of this faculty have been responsible for many of the basic concepts of chemical engineering, and graduates of the course have become leaders in the chemical industries.

The Course in Chemical Engineering Practice gives M.I.T. chemical engineering students a unique opportunity to spend the second half of the senior year at two of three practice schools which M.I.T. maintains in the plants of three companies. Here they can learn to apply principles toward improving equipment under actual industrial conditions, with the guidance of two members of the M.I.T. academic staff who are in residence at the plants.

Most chemical engineers are employed by industry, although a few are teachers, consultants, or operators of their own businesses. Some supervise production, some develop ways of making new chemicals or better ways of making present products, some design plants, some are technical salesmen. Many chemical engineers have advanced to positions in administration and management. The rapid and continuing growth of these chemical process industries assures challenging problems and good opportunities.

FIRST YEAR

First Term

General Chemistry (5.01)
Physics (8.01, Mechanics)
Foundations of Western Civilization (H11)
Calculus (M11)
Military Science (MS11)
or
Air Science (AS11)
and at least one additional first-year subject (see the descriptions in Section 5) during the freshman year (subjects in Graphics *are especially recommended)*
or
Naval Science (NS11)

Second Term

General Chemistry (5.02)
Physics (8.02, Heat, Kinetic Theory)
Foundations of Western Civilization (H12)
Calculus (M12)
Military Science (MS12)
or
Air Science (AS12)
and at least one additional first-year subject (see the descriptions in Section 5) during the freshman year (subjects in Graphics *are especially recommended)*
or
Naval Science (NS12)

SECOND YEAR

First Term

Organic Chemistry I
Organic Preparations I
Physics (Electricity, Magnetism)
Industrial Chemistry
Humanities
Calculus
Military Science, Air Science, *or* Naval Science

Second Term

Physics (Optics, Atomic Physics)
Humanities
Differential Equations
Military Science, Air Science, *or* Naval Science
and two elective subjects

THIRD AND FOURTH YEARS

Chemical Engineering (Course X)

The third and fourth year programs are entirely elective, but the subjects chosen must include at least 35 units of Chemistry, *at least 60 units of* Chemical Engineering, *at least 25 units of an integrated professional minor in a field other than these, and at least 4 subjects in* Humanities. *There must be at least 25 units of laboratory work. The undergraduate* thesis *is a fourth-year requirement.*

Chemical Engineering Practice (Course X-B)

The third and fourth year programs are entirely elective, but the subjects chosen must include at least 35 units of Chemistry, *at least 45 units of* Chemical Engineering, *at least 15 units of an integrated professional minor in a field other than these, and at least 4 subjects in* Humanities. *There must be at least 15 units of laboratory work. The undergraduate* thesis *is a fourth-year requirement.*

Each student in the Chemical Engineering Practice *program spends the second semester of the fourth year at the field stations:*
Bangor (Maine) Station
Parlin (New Jersey) Station
Buffalo (New York) Station

CIVIL ENGINEERING

Professor John B. Wilbur

Civil engineering has been called the foundation of modern civilization. You need only think of the modern city of today to see why this is true. Can you imagine a city without its transportation systems—without highways, expressways, and parking facilities—without railways and rapid-transit facilities—without airports—without transmission systems and pipelines—and without sanitary facilities—without a water-supply system with its dams, aqueducts, and treatment plants that bring water from distant points and purify it for domestic and industrial use—and without a disposal system that collects, treats and disposes of the industrial and domestic wastes of the city? Can you imagine a city without large structures such as skyscrapers and industrial buildings? These things are all built by civil engineers, and without them cities—as we know them today—could not exist.

Civil engineering is the planning, design, and construction of the fixed structures and ground facilities that provide the arteries of transportation, that control the use of water, and that provide protection against the elements of nature. The reference to *fixed* structures is important; it means structures that do not move. For example, the civil engineer builds the superhighways with bridges and tunnels but not the automobiles that are driven over them; he builds powerhouses but not the power generating equipment that they shelter.

The civil engineer deals with things that are big in stature. He truly changes the landscape when he builds a Boulder Dam to create a new lake miles in length, when he builds a George Washington Bridge that spans a great river, when he builds an aerial expressway such as the Boston Central Artery through the heart of a metropolitan area, or when he builds the framework of an Empire State Building.

These and similar projects cost vast sums of money, often running into millions or even hundreds of millions of dollars. Planning, designing, and constructing such ventures is a great responsibility. It requires not only technical knowledge of a high order but great personal character and integrity as well. The civil engineer probably spends more money than any other kind of engineer; but in the main he is spending other people's money, and he must always strive to get full value for every dollar spent.

Because these large projects have such major effects on the lives of so many people, they are frequently built for some branch of the government—either city, state, or Federal. For this reason some civil engineers are employed by government. Others, however, work for private organizations such as railroad or power companies. They may work in the offices of consulting engineers and eventually become engineering consultants themselves. They may work for construction companies and later operate their own contracting businesses. Throughout this whole range of employment opportunities there is a distinct shortage of civil engineers that shows no sign of lessening.

Perhaps our greatest asset in the Civil Engineering Department at M.I.T. is our Faculty of men who are themselves leaders in the field—men who combine teaching ability with engineering achievement—who themselves have planned and designed great highway systems, for example, or major hydroelectric plants, or important sanitary projects. Equally important is the fact that among these are many men leading the way to new developments in civil engineering through research . . . . in our structures laboratories, hydraulics laboratory, soil mechanics laboratory, sanitary engineering laboratory, highway and traffic center, and aerial surveying laboratory.

For those who are challenged by outdoor life and the romance of far-away places, civil engineering in the many under-developed portions of the world may be appealing. But even greater opportunities lie in our own country—and, in fact, in our own cities—where slum areas, building shortages, water shortages, industrial waste pollution, and traffic congestion are all demanding attention.

Expenditures for construction represent one-tenth of our total national income. To spend this money wisely is the challenge to the civil engineer.

Civil Engineering (Course I)

FIRST YEAR

First Term

General Chemistry (5.01)
Physics (8.01, Mechanics)
Foundations of Western Civilization (H11)
Calculus (M11)
Military Science (MS11)
or
Air Science (AS11)
and at least one additional first-year subject (see the descriptions in Section 5) during the freshman year (subjects in Graphics *are especially recommended)*
or
Naval Science (NS11)

Second Term

General Chemistry (5.02)
Physics (8.02, Heat, Kinetic Theory)
Foundations of Western Civilization (H12)
Calculus (M12)
Military Science (MS12)
or
Air Science (AS12)
and at least one additional first-year subject (see the descriptions in Section 5) during the freshman year (subjects in Graphics *are especially recommended)*
or
Naval Science (NS12)

SECOND YEAR

First Term

Surveying I
Civil Engineering Projects I
Physics (Electricity, Magnetism)
Humanities
Calculus
Military Science, Air Science, *or* Naval Science

Second Term

Surveying II
Statics and Dynamics
Physics (Optics, Atomic Physics)
Civil Engineering Projects II
Humanities
Differential Equations
Military Science, Air Science, *or* Naval Science

THIRD YEAR

First Term

Materials and Mechanics
Fluid Mechanics
Engineering Construction
Fundamentals of Electrical Engineering
Engineering Geology
and one elective in Humanities

Second Term

Soil Mechanics
Materials and Mechanics
Elementary Structural Design
Fluid Mechanics
and one elective in Humanities

FOURTH YEAR

First Term

Structural Design
Structural Analysis
Thesis
four of the following (those recommended for special fields are indicated):

CONSTRUCTION ENGINEERING:
Advanced Materials, Building Construction, Dwelling House Construction, Structural Design

HYDRAULIC ENGINEERING:
Fluid Mechanics Laboratory, Hydrology and Hydraulic Engineering

SANITARY ENGINEERING:
Fluid Mechanics Laboratory, Hydrology and Hydraulic Engineering, Sanitary Science

STRUCTURAL AND FOUNDATION ENGINEERING:
Soil Engineering, Structural Design

TRANSPORTATION ENGINEERING:
Transportation Planning, Soil Engineering

OTHER ELECTIVES:
Introduction to Industrial Management, Finance, Accounting, Business Law
and one elective in Humanities

Second Term

Reinforced Concrete Design
Heat Transfer
Thesis
three of the following (those recommended for special fields are indicated):

CONSTRUCTION ENGINEERING:
Construction Management, Reinforced Concrete Design, Structural Analysis

HYDRAULIC ENGINEERING:
Hydrology and Hydraulic Engineering

SANITARY ENGINEERING:
Hydrology and Hydraulic Engineering, Sanitary Engineering

STRUCTURAL AND FOUNDATION ENGINEERING:
Reinforced Concrete Design, Structural Analysis

TRANSPORTATION ENGINEERING:
Advanced Surveying, Transportation Engineering

OTHER ELECTIVES:
Introduction to Industrial Management, Finance, Business Law
and one elective in Humanities

ELECTRICAL ENGINEERING

Professor Gordon S. Brown

The field of electrical engineering has become one of great variety and scope. Its products and services influence the daily living and business of most of the world's population. Much of its growth has been compressed into such a short period of time that the changes appear almost revolutionary. The growth and change that will prevail for many years to come offer young men a wide range of interesting and expanding professional careers with rich intellectual and spiritual rewards.

Electrical engineering at M.I.T. supports two major human motivations: to transmit and process information; and to convert, control, and utilize energy. The former involves such things as radar, radio and wire telephony, measurement, electronics, computation, and control. The latter furnishes the means to substitute machines for human muscle and to keep the wheels of industry turning—power, light, heat, and control—and so provides the basis of our modern civilization; here the issue is to exploit energy for energy's sake. This barely suggests the widely diversified areas with which M.I.T. electrical engineering students are familiar.

To provide an *enduring* basis upon which to establish successful careers in any of the rapidly changing professional, industrial, or business areas which depend upon electrical technology, students in electrical engineering must first develop a working mastery of the basic sciences of mathematics and physics. On these is built study of the principles of electrical engineering and their applications.

An electrical engineer's career is influenced quite as much by his understanding of people, his judgment, his sense of values, and his breadth and responsibility of outlook as by his technical competence. The humanities and social studies therefore form an important and integral part of our program.

A major feature of the professional studies of the second, third, and fourth years is the group of eight classroom-laboratory subjects which are required for all students. In the classroom we emphasize basic principles and methods of analysis; then we consider their applications to a broad range of specific electrical processes and equipment. Students discover that these principles and applications form a closely integrated body of electrical science. By applying it in elective subjects and thesis research, they achieve a still deeper understanding of that basic science.

While the laboratory program is coordinated with the work of the classroom, its objectives go beyond the mere mastery of experimental facts, methods, and techniques. Here students encounter the need for engineering judgment, team work, and careful planning. The major objective is to develop independent, creative thought and initiative through a program which requires students to assume progressively increased responsibility for the planning and execution of their work.

The four-year program, Course VI, leading to the degree of Bachelor of Science, is believed best suited to the student who desires to defer the decision on graduate study until late in his program. This Course permits the student to choose free elective subjects in his senior year and hence to prepare for many different careers.

For a selected group of students who feel relatively confident at the sophomore level that their interest will lead them to go on to graduate school and who wish to take advantage of an early opportunity to build up the required background in the engineering sciences, we offer a Course VI-B in Electrical Science and Engineering. Selection of students for this Course comes normally at the beginning of the sophomore year. The Course extends for a total of five years, after which we award both Bachelor of Science and Master of Science degrees.

For another selected group of students who want to combine industrial or research experience with education in electrical engineering, we offer Co-operative Course VI-A—an interlinking of classroom and laboratory work with sixty weeks of experience in one of nine industrial organizations. Selection for this Co-operative Course comes at the end of the sophomore year; the industrial experience extends this co-operative curriculum to five years instead of four, after which we award both the Bachelor of Science and the Master of Science degrees.

FIRST YEAR

First Term	General Chemistry (5.01) Physics (8.01, Mechanics) Foundations of Western Civilization (H11) Calculus (M11) Military Science (MS11) *or* Air Science (AS11) *and one additional first-year subject (see the descriptions in Section 5) during the freshman year (subjects in* Graphics *are especially recommended)* *or* Naval Science (NS11)	*Second Term*	General Chemistry (5.02) Physics (8.02, Heat, Kinetic Theory) Foundations of Western Civilization (H12) Calculus (M12) Military Science (MS12) *or* Air Science (AS12) *and one additional first-year subject (see the descriptions in Section 5) during the freshman year (subjects in* Graphics *are especially recommended)* *or* Naval Science (NS12)

SECOND YEAR

First Term	Applied Mechanics I Introductory Circuit Theory Physics (Electromagnetism) Humanities Calculus Military Science, Air Science, *or* Naval Science	*Second Term*	Applied Mechanics II Introductory Circuit Theory Physics (Electromagnetism) Humanities Differential Equations Military Science, Air Science, *or* Naval Science

	Electrical Engineering (Course VI)	**Co-operative Course (Course VI-A)**	**Electrical Science and Engineering (Course VI-B)**
Summer		*At M.I.T.:* Electronic Devices and Circuits Fields, Energy, and Forces *and one of the following:* Heat Engineering *or* Atomic and Nuclear Physics I	
THIRD YEAR			
First Term	Electronic Devices and Circuits Fields, Energy, and Forces Advanced Calculus for Engineers *one elective in* Humanities *one of the following:* Heat Engineering *or* Atomic and Nuclear Physics I	*At Plants:* Advanced Calculus for Engineers Industrial Practice	Electronic Devices and Circuits Fields, Energy, and Forces Atomic and Nuclear Physics I Advanced Calculus for Engineers *and one elective in* Humanities
Second Term	Electromechanical Energy Conversion Electronic Circuits and Signals *one elective in* Humanities *two electives in such subjects as:* Dynamics, Heat Engineering, Advanced Calculus for Engineers, *or* Atomic and Nuclear Physics II	*At M.I.T.:* Electromechanical Energy Conversion Electronic Circuits and Signals Economic Principles I *one elective in* Humanities *one elective in such subjects as:* Dynamics, Heat Engineering, *or* Atomic and Nuclear Physics II	Electronic Circuits and Signals Electromechanical Energy Conversion Atomic and Nuclear Physics II Probability *and one elective in* Humanities
Summer		*At Plants:* Advanced Calculus for Engineers Industrial Practice	
FOURTH YEAR			
First Term	Molecular Engineering Energy Transmission and Radiation Thesis *two professional electives* *and one elective in* Humanities	*At M.I.T.:* Energy Transmission and Radiation Molecular Engineering *two electives in* Humanities *and two professional electives*	Energy Transmission and Radiation Seminar *one elective in* Mathematics *one elective in* Humanities *and one or two professional electives*
Second Term	Thesis *three or four professional electives* *and one elective in* Humanities	*At Plants:* Industrial Practice *and one elective subject*	Molecular Science and Engineering Statistical Mechanics and Thermodynamics Seminar *one elective in* Humanities *and one professional elective*
FIFTH YEAR			
		During the Fifth Year, each student must take the following: Industrial Practice (one semester), Graduate Study *and* Thesis (two semesters), *and one elective subject*	*During the fifth year, each student must register for* Thesis *and for* Graduate Study.

MECHANICAL ENGINEERING

Professor Jacob P. Den Hartog

Mechanical engineering is the engineering of machines—the machines which we use and see every day, and the machines that make the goods we use. It is designing and producing machine tools, engines, turbines, pumps, boilers, furnaces, automobiles, refrigerators, trains—and the printing presses upon which this book was printed. It includes, too, the design and operation of plants to manufacture these machines or to use them to make other products.

Mechanical engineers have played a central and vital role in the whole history of our industrial society from before the DeWitt Clinton steam locomotive to the latest jet engine. New discoveries in basic science give mechanical engineers new materials to work with and new problems to solve—the development of atomic power, the gas turbine, and jet propulsion. Now there are also new devices, such as the robot pilots for aircraft and the thermostat in your house, needed for automatically controlling processes and operations. In such assignments as these, mechanical engineers are seeking commercial applications of the most advanced scientific developments.

We at M.I.T. stress that our mechanical engineering students must have a broad training—commensurate, indeed, with the breadth of the profession into which they go. Our basic subjects—after we have provided a foundation of fundamental science—deal with the relationships between heat and work, forces and motion, and forces and materials. These principles are later applied in professional courses dealing with broad categories of processes and machines.

The co-operative program, Course II-B, offers this same curriculum but also includes about six months of actual plant experience. This option is especially valuable for those of our students who would otherwise have no first-hand experience in industry before graduation.

Many of our Faculty are leaders in the profession of mechanical engineering, with broad industrial experience. Research on a wide number of topics is an important activity of the Department, and many students are able to participate in it during their upperclass years. The range of interests of staff and students is indicated by this list of the ten professional divisions into which the facilities of our Department are organized: heat engineering (including thermodynamics, heat transfer, heat measurements, steam power plants, refrigeration, and air conditioning); applied mechanics (including elasticity, statics, and dynamics); fluid mechanics; properties of materials; machine design (including automatic controls and product design); machine tools and metals cutting (including lubrication); gas turbines; automotive and aircraft engines (including Diesel engines); mechanical laboratory (including measurements); and textile technology. This diversity itself contributes to a professional environment which many of our students find keenly stimulating.

About two-thirds of all mechanical engineers work in the manufacturing industries. Here they find a wide use for their skills—contributing to all phases of the industrial process from research to design, development, production, maintenance, sales, and management. Mechanical engineering studies at M.I.T. mean confident anticipation of an interesting and useful career.

FIRST YEAR

First Term	General Chemistry (5.01) Physics (8.01, Mechanics) Foundations of Western Civilization (H11) Calculus (M11) Military Science (MS11) *or* Air Science (AS11) *and at least one additional first-year subject (see the descriptions in Section 5) during the freshman year (subjects in* Graphics *are especially recommended)* *or* Naval Science (NS11)	*Second Term*	General Chemistry (5.02) Physics (8.02, Heat, Kinetic Theory) Foundations of Western Civilization (H12) Calculus (M12) Military Science (MS12) *or* Air Science (AS12) *and at least one additional first-year subject (see the descriptions in Section 5) during the freshman year (subjects in* Graphics *are especially recommended)* *or* Naval Science (NS12)

SECOND YEAR

First Term	Applied Mechanics I Machine Drawing Introduction to Machine Tools Physics (Electricity, Magnetism) Humanities Calculus Military Science, Air Science, *or* Naval Science	*Second Term*	Applied Mechanics II Engineering Metals Physics (Optics, Atomic Physics) Humanities Differential Equations Military Science, Air Science, *or* Naval Science

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	Mechanical Engineering (Course II)		**Co-operative Course (Course II-B)**
		Summer	*Vacation (approximately seven weeks)* *At plants (remainder of summer):* Industrial Practice

THIRD YEAR

First Term	Applied Mechanics III Heat Engineering Machine Design Fundamentals of Electrical Engineering *and one elective in* Humanities	*First Term*	*At plants:* Industrial Practice
Second Term	Fluid Mechanics Mechanical Behavior of Materials Heat Engineering Machine Design Machine Tool Fundamentals *and one elective in* Humanities	*Second Term*	*At M.I.T.:* Applied Mechanics III Heat Engineering Machine Design Fundamentals of Electrical Engineering *and one elective in* Humanities
		Summer	*At M.I.T.:* Fluid Mechanics Heat Engineering Machine Design Machine Tool Fundamentals

FOURTH YEAR

The following subjects are required during the year: Mechanical Engineering Problems Engineering Laboratory *(or other engineering laboratory)* Thesis *and two electives in* Humanities *In addition, each student must take a total of at least 52 units of approved elective subjects, of which two may be in the Humanities.* *The additional subjects will include appropriate combinations of such subjects as:*	*The following subjects are required during the year:* Mechanical Engineering Problems Mechanical Behavior of Materials Engineering Laboratory *(or other engineering laboratory)* Thesis *and three electives in* Humanities *In addition, each student must take a total of at least 36 units of approved elective subjects, similar to those in the regular Mechanical Engineering Program.*

Fluid Mechanics, Heat Engineering, Air Conditioning, Refrigeration, Power Plant Engineering, Strength of Materials, Mechanical Properties of Materials, Internal Combustion Engines, Machine Design, Production, Production Management, Principles of Fabric Structure, Elements of Textile Manufacturing, Principles of Textile Manufacturing, Automation, Physics: Atoms, Molecules, and Nuclei, Aircraft Propulsion, Gas Turbines, Hydraulic Machinery and Controls, Elementary Statistics, Atomic Power

METALLURGY

Professor John Chipman

Metallurgy is an engineering science that deals with the production, utilization, and behavior of metals and their alloys. The field is quite broad because it is based on physics and chemistry which are necessary for an understandng of the metallic state; it also relates to chemical engineering in the extraction of metals from their ores, and to mechanical engineering in the fabrication of metals into useful forms for ultimate service. There are three main reasons for focussing these disciplines on metals: metals comprise about three-fourths of the elements in the periodic system, and thus are of immense scientific interest as fundamental matter of the universe; metals have remarkable properties as a class of materials that make them particularly useful to mankind; and many metals are available in nature in such quantity and form that they can be produced at reasonable cost in pure or alloyed condition. Accordingly, to a large extent, metals have become the "working substance" of modern industry; it has been estimated that forty per cent of all the jobs in America are connected directly or indirectly with the manufacture and use of steel alone. Moreover, the field is a lively one in research and development because it is now clear that the efficient operation of such complex devices as gas turbines, jet engines, guided missiles, and nuclear reactors will depend not only on the design but also on the materials of construction.

The Course in Metallurgy offers opportunity for study in all phases of the science and engineering of metals. In view of the scope of this area of knowledge, the curriculum contains a core of basic science and engineering and, in the junior and senior years, a wide choice among numerous elective subjects.

The core consists primarily of mathematics, physics, chemistry, and the humanities, along with an introduction to metal science and the engineering principles involved in the extraction and application of metals. The student learns the basic thermodynamics, unit processes, and mechanical operations which underlie the making and shaping of metals; he also studies the inner structure of metals as a foundation for understanding their properties and for selecting the right materials to meet service requirements. He is introduced to the laws governing the alloying of metals and the principles by which new alloys may be developed.

The large block of elective time permits the student to polarize his metallurgical studies in the direction of his interests, or to take additional subjects in metallurgical engineering, metal processing, and physical metallurgy. For example, students who are interested in ores and their beneficiation will elect subjects in mineral engineering and geology. A combined program of metallurgical and chemical engineering is feasible for those who wish to concentrate more on the production of metals. Students who are mechanically inclined can elect sequences of subjects leading to machine design, stress analysis, and metal forming. Opportunities are also afforded for combining metallurgy with other disciplines, such as electrical engineering, nuclear engineering, the humanities, or business administration. For students who lean toward science, the curriculum may include a substantial block of subjects in mathematics and physics.

Graduates in metallurgy find many kinds of jobs. Some enter the metal-producing field in companies that make copper, brass, aluminum, titanium, special alloys, or that giant among industries, steel. Many metallurgists are active in selecting, testing, and supervising the application of metals; the automotive and aircraft industries, for example, employ many metallurgists and wish they could find more. Every atomic energy project in the country depends on metallurgists and needs more. The principal challenges in jet engine manufacture and in developing nuclear power are metallurgical problems. And in the immediate future the demand for mineral engineers will continue to exceed the supply as our higher-grade ores are depleted.

The world needs more metallurgists. It is difficult to name one modern product that does not contain metal or that does not require the help of metal. Yet only half the known metals are in commercial use today. Truly the horizon is a wide one.

Metallurgy (Course III)

FIRST YEAR

First Term	General Chemistry (5.01) Physics (8.01, Mechanics) Foundations of Western Civilization (H11) Calculus (M11) Military Science (MS11) *or* Air Science (AS11) *and at least one additional first-year subject (see the descriptions in Section 5) during the freshman year; subjects in* Graphics *are especially recommended* *or* Naval Science (NS11)	*Second Term*	General Chemistry (5.02) Physics (8.02, Heat, Kinetic Theory) Foundations of Western Civilization (H12) Calculus (M12) Military Science (MS12) *or* Air Science (AS12) *and at least one additional first-year subject (see the descriptions in Section 5) during the freshman year; subjects in* Graphics *are especially recommended* *or* Naval Science (NS12)

SECOND YEAR

First Term	Applied Mechanics I Engineering Metals Physics (Electricity, Magnetism) Humanities Calculus Military Science *or* Air Science	*Second Term*	Applied Mechanics II Extractive Metallurgy Physics (Optics, Atomic Physics) Humanities Differential Equations Military Science *or* Air Science

THIRD YEAR

First Term	Physical Metallurgy I Physical Chemistry I *three or four elective subjects in* Metallurgy *and other related fields (see the list of* Metallurgy *subjects below)* *and one elective in* Humanities	*Second Term*	Metallurgical Engineering I Metallurgical Engineering Laboratory Physical Chemistry II *or* Statistical Mechanics and Thermodynamics *three elective subjects in* Metallurgy *and other related fields (see the list of* Metallurgy *subjects below)* *and one elective in* Humanities
Summer	Metallurgical Plant Visits		

FOURTH YEAR

First Term	Metallurgical Thermodynamics X-ray Metallurgy Thesis *three or four elective subjects in* Metallurgy *and other related fields (see the list of* Metallurgy *subjects below)* *and one elective in* Humanities	*Second Term*	Thesis *three or four elective subjects in* Metallurgy *and other related fields (see the list of* Metallurgy *subjects below)* *and one elective in* Humanities

The following subjects within the Department of Metallurgy are among the recommended electives for the third and fourth years: Metallurgical Engineering, Foundry Engineering, Welding Engineering, Powder Metallurgy, Plastic Working of Metals, Physical Metallurgy, Electrochemistry, Physics of Metals, Electric and Magnetic Materials, Ceramics, Mineral Engineering, Quantitative Mineragraphy, Ore Testing, *and* Technology of Nuclear Reactor Materials. *Students are expected also to choose subjects from other departments.*

NAVAL ARCHITECTURE AND MARINE ENGINEERING

Professor Laurens Troost, Ir.

The ship is the biggest moving object that man has devised. Its design and construction is a problem without parallel in modern engineering: ships must move efficiently through water; they must be structural entities capable of taking on severe forces at sea; they must perform their transportation service with unmatched efficiency; they must provide such diverse services as water supply, refrigeration, ventilation, sewage disposal, communications, and cargo handling; they must contain specially designed power plants, often of hundreds of thousands of horsepower. This power must be produced and transmitted efficiently with regard to cost of construction, space, weight and fuel consumption.

Designing a ship is indeed a demanding profession—yet one as fascinating as the stories and folklore of the men and ships that sail the sea.

At M.I.T., we begin education in naval architecture and marine engineering with the fundamentals of basic subjects including applied mechanics, fluid mechanics, heat engineering, and structural theory. During the second year we discuss the ship as a whole in a qualitative manner; then in the last two years we study separately the various specific phases of ship design, with emphasis on technical aspects. In the latter part of the senior year, we return again to discussing the ship as a complete entity, but this time on a technical and professional level.

Business management and economics play a very important role in all phases of the shipbuilding and maritime industry, and there is a need for competent men with a basic knowledge of naval architecture and marine engineering as well as the fundamentals of various areas of business management and economics. To provide this background for students interested in the business phases of shipbuilding and shipping, we offer a five-year course in Shipping and Shipbuilding Management, numbered XIII-B, in association with M.I.T.'s Departments of Economics and Engineering, and Business and Engineering Administration. This course in shipping management begins to differ from the naval architecture and marine engineering course only in the senior year, when students enter subjects that are necessary for advanced study in business management and economics. The fifth year of work in these fields and in Naval Architecture and Marine Engineering leads to both S.B. and S.M. degrees.

The Department's laboratory facilities are an important factor in both these courses, and there are excellent opportunities for theses and research. These facilities include the Ship Model Towing Tank, for studies of the hydrodynamics of ships' hulls; the Propeller Tunnel, for controlled underwater tests of model ships' propellers under simulated ship conditions; and the Ship Structures Laboratory, for research in structural arrangements for ships.

Modern ships are larger and faster. New ship construction materials are being used for strength and lightness. A seagoing nuclear power plant is already afloat. The S. S. *United States* represents a triumph in modern naval architecture and marine engineering. These achievements suggest the creativeness which will be demanded of tomorrow's ship designers, builders, and managers; they further indicate the breadth of interest and ability required in this field. M.I.T. is one of a handful of American universities preparing men for the future of this profession.

FIRST YEAR

First Term

General Chemistry (5.01)
Physics (8.01, Mechanics)
Foundations of Western Civilization (H11)
Calculus (M11)
Military Science (MS11)
or
Air Science (AS11)
and at least one additional first-year subject (see the descriptions in Section 5) during the freshman year (Descriptive Geometry (D12) *is recommended)*
or
Naval Science (NS11)

Second Term

General Chemistry (5.02)
Physics (8.02, Heat, Kinetic Theory)
Foundations of Western Civilization (H12)
Calculus (M12)
Military Science (MS12)
or
Air Science (AS12)
and at least one additional first-year subject (see the descriptions in Section 5) during the freshman year (Descriptive Geometry (D12) *is recommended)*
or
Naval Science (NS12)

SECOND YEAR

First Term

Applied Mechanics I
Machine Tool Laboratory
Physics (Electricity, Magnetism)
Elementary Ship Design and Construction I
Humanities
Calculus
Military Science, Air Science, *or* Naval Science

Second Term

Applied Mechanics II
Engineering Metals
Physics (Optics, Atomic Physics)
Elementary Ship Design and Construction II
Humanities
Differential Equations
Military Science, Air Science, *or* Naval Science

THIRD YEAR

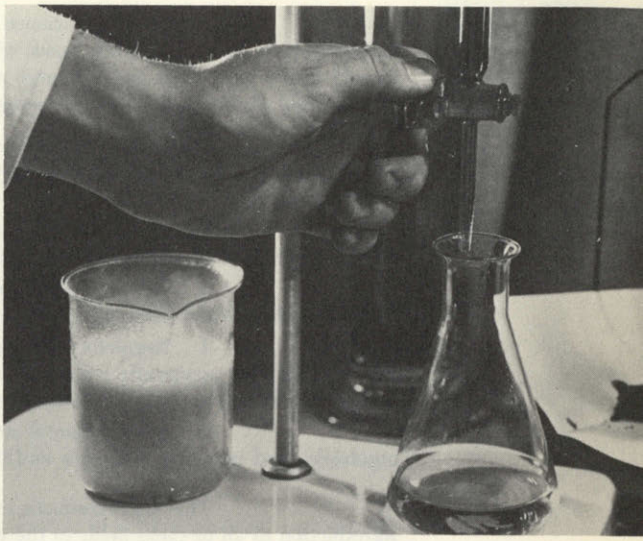
First Term

Fluid Mechanics
Strength of Materials
Heat Engineering
Naval Architecture I
Hull Form Design
and one elective in Humanities

Second Term

Heat Engineering
Fundamentals of Electrical Engineering
Naval Architecture II
Ship Structures
Marine Engineering I
and one elective in Humanities

	Naval Architecture and Marine Engineering (Course XIII)	**Shipping and Shipbuilding Management (Course XIII-B)**
FOURTH YEAR		
First Term	Testing Materials Laboratory Engineering Laboratory Ship Structural Drawing Marine Engineering II Marine Engineering Design III *three electives, at least one in* Humanities *and one professional elective*	Testing Materials Laboratory Engineering Laboratory Ship Structural Drawing Marine Engineering II Marine Engineering Design III *three electives, at least one in* Humanities *and one professional elective*
Second Term	Ship Design Marine Engineering Dynamics Marine Engineering Design IV Thesis *one elective subject* *and one elective in* Humanities	Ship Design Marine Engineering Dynamics Marine Engineering Design IV *three electives, at least one in* Humanities *and one professional elective*
FIFTH YEAR		
First Term		Thesis Graduate Study
Second Term		Thesis Graduate Study



Dean Harrison

"To a considerable degree, our form of government is determined by our economics, our economics by our industry, our industry by our technology, and our technology by our science."

—Dean of Science George R. Harrison, in *Life,* January 4, 1954.

BIOLOGY

Professor Irwin W. Sizer

Biology is the science of *life*—of all living organisms from the smallest microorganism (we still do not know whether the tiny viruses are "alive" in the usual sense!) to the giant trees and the large mammals and fish. The subject matter has been conveniently divided into these five categories:

1. Molecular biology—a study of the molecules which make up living things, what they do in life and how they do it. Included in this category are biophysics and biochemistry.

2. Genetic biology—including genetics, evolution, and all the aspects of reproduction of the countless forms which life displays in our world.

3. Developmental biology—the science of individual development from embryo to death—through growth, maturity, and aging.

4. Regulatory biology—how organisms regulate themselves, including, indeed, such apparently simple phenomena as how humans feel hunger and so are lead to periodically replenish their energy.

5. Environmental and group biology—the mutual relations among organisms, and between organisms and their environment.

The undergraduate curriculum in Biology (Course VII) provides an introduction to all of these fields in the courses taken in the sophomore and junior years. We at M.I.T. have chosen to lay special emphasis on the physics and chemistry of living organisms—molecular biology. This is a natural emphasis in the M.I.T. environment, where the skills of chemistry, physics, and instrumentation are the special concern of many of our colleagues. This emphasis is reflected in the senior course in general biochemistry and physiology and in the elective courses which we offer.

From the standpoint of its contribution to the welfare of man, this analytical approach is richly justified. Experimental biology of this sort provides the basis of modern medicine and man's attempt to adapt more successfully to his environment. So it is that this kind of undergraduate experience is the most popular selection of premedical students who come to M.I.T.—although they may also fulfill premedical requirements in many of the other courses here. From one-half to two-thirds of the undergraduates who major in biology are premedical students; the record of our alumni in the medical field is an impressive one.

With advancing knowledge of tissues and microorganisms, biological scientists are making discoveries of ever-increasing importance in fighting disease, in understanding fermentation and in providing new sources of food. The keys to this kingdom—the key molecules in living organisms—are the proteins; they form the basis of the genes which determine heredity, the enzymes which catalyze all energy-giving reactions in the body, and the structural proteins which make up the machinery of such tissues as muscle, skin, and tendon. So it is most important that we discover the intimate structure of the proteins; and to do this we are applying the full armamentarium of biophysics, using electron microscopy, X-ray diffraction, polarization optics, ultracentrifugation, and other physical chemical tools as well as advanced analytical biochemistry. Biology seeks to become an exact science devoted to learning about living things in terms of the basic processes which occur in their most elementary units.

The Biology Department at M.I.T. is a world center for this type of work. Graduates occupy key positions in these fields in universities, research institutions, and in industry. It is this combination of biophysics, biochemistry, and cell physiology which gives the Department its particular stamp and reputation.

Quantitative Biology (Course VII)

FIRST YEAR

First Term

General Chemistry (5.01)
Physics (8.01, Mechanics)
Foundations of Western Civilization (H11)
Calculus (M11)
Military Science (MS11)
or
Air Science (AS11)
and at least one additional first-year subject (see the descriptions in Section 5) during the freshman year.

Second Term

General Chemistry (5.02)
Physics (8.02, Heat, Kinetic Theory)
Foundations of Western Civilization (H12)
Calculus (M12)
Military Science (MS12)
or
Air Science (AS11)
and at least one additional first-year subject (see the descriptions in Section 5) during the freshman year.

SECOND YEAR

First Term

General Biology I
General Biology Laboratory I
Physics (Electricity, Magnetism)
Humanities
Calculus
Military Science *or* Air Science
one elective subject

Second Term

Quantitative Analysis
Quantitative Analysis Laboratory
General Biology II
General Biology Laboratory II
Physics (Optics, Atomic Physics)
Humanities
Differential Equations
Military Science *or* Air Science

THIRD YEAR

First Term

Organic Chemistry I
Organic Preparations I
Physical Chemistry I
Physical Chemistry Laboratory I
Genetics and Cytology
and one elective in Humanities

Second Term

Physical Chemistry II
Physical Chemistry Laboratory II
Embryology
three elective subjects, including at least one in Humanities

FOURTH YEAR

First Term

General Biochemistry and Physiology I
General Biochemistry and Physiology Laboratory I
Thesis
three elective subjects, including at least one in Humanities

Second Term

General Biochemistry and Physiology II
General Biochemistry and Physiology Laboratory II
Thesis
three elective subjects, including at least one in Humanities

CHEMISTRY

Professor Arthur C. Cope

There are approximately one hundred chemical elements and several hundred thousand known chemical compounds. The elements vary in properties from the light gases hydrogen and helium through the metals such as iron and nickel and non-metals such as chlorine and sulfur to the currently important uranium and trans-uranic elements; the compounds have infinite variety—from the familiar table salt and sugar to recently discovered things that have reshaped our lives and economy within the past few years. Included in the products of recent research are the life-saving antibiotic "wonder drugs" such as penicillin, streptomycin, terramycin, aureomycin and tetracycline; the sulfa drugs; new textile fibers, plastics, dyes, fuels, explosives—things unknown a decade ago, commonplace today, and apt to be superseded by still greater discoveries of the chemical research of tomorrow.

Chemistry deals with the properties and reactions of these elements and compounds—the study of those which are known, and the search for others remaining to be discovered. The chemistry curriculum at M.I.T. begins with an introduction to the subject in first-year general chemistry, followed by work in the four major branches of the science: organic chemistry, which concerns the limitless number of compounds of carbon; inorganic chemistry, concerned primarily with all of the elements except carbon; physical chemistry, dealing quantitatively with the principles governing the behavior of chemical substances; and analytical chemistry, based on inorganic, organic, and physical chemistry and including modern instrumental methods of analysis.

The undergraduate chemistry curriculum at M.I.T. includes work in mathematics, physics, the humanities, languages, and allows considerable time for electives which provide an opportunity to extend knowledge in fields of special interest. An experimental senior thesis which constitutes an introduction to chemical research is a most important and interesting part of the senior year; it helps seniors to decide whether they want to pursue chemical research as candidates for advanced degrees or enter industry immediately after receiving the S.B. degree.

Some students completing degrees in chemistry take positions in chemical research in the constantly growing chemical industry; others continue in universities, or go to research foundations or government laboratories. The job of the chemist in such employment is that of the original investigator or inventor, as distinguished from the chemical engineer who works with the chemist and then takes over in process design, pilot-plant, and eventual production of useful products.

Chemists not primarily interested in research usually find employment in the production, business, or sales activities of the chemical industries, in which a demand for competent chemists at all levels will exceed the supply for years to come.

Chemistry (Course V)

FIRST YEAR

First Term

General Chemistry (5.01)
Physics (8.01, Mechanics)
Foundations of Western Civilization (H11)
Calculus (M11)
Military Science (MS11)
or
Air Science (AS11)
and at least one additional first-year subject (see the descriptions in Section 5) during the freshman year
or
Naval Science (NS11)

Second Term

General Chemistry (5.02)
Physics (8.02, Heat, Kinetic Theory)
Foundations of Western Civilization (H12)
Calculus (M12)
Military Science (MS12)
or
Air Science (AS12)
and at least one additional first-year subject (see the descriptions in Section 5) during the freshman year
or
Naval Science (NS12)

SECOND YEAR

First Term

Organic Chemistry I
Organic Preparations I
Physics (Electricity, Magnetism)
Humanities
Calculus
Language
Military Science, Air Science, *or* Naval Science

Second Term

Organic Chemistry II
Organic Preparations II
Physics (Optics, Atomic Physics)
Humanities
Differential Equations
Military Science, Air Science, *or* Naval Science

THIRD YEAR

First Term

Principles of Inorganic Chemistry
Qualitative Organic Analysis
Physical Chemistry I
Physical Chemistry Laboratory I
one elective subject (see below)
and one elective in Humanities

Second Term

Analytical Chemistry I
Analytical Chemistry Laboratory I
Physical Chemistry II
Physical Chemistry Laboratory II
one elective subject (see below)
and one elective in Humanities

FOURTH YEAR

First Term

Analytical Chemistry II
Analytical Chemistry Laboratory II
Thesis
two elective subjects (see below)
and one elective in Humanities

Second Term

Thesis
two elective subjects (see below)
and one elective in Humanities

Among their electives students are expected to take Topics in Theoretical Organic Chemistry *or* Radiochemistry, Advanced Organic Chemistry, *and* Introduction to Atomic and Molecular Structure, Kinetics of Chemical Reactions, Chemical Thermodynamics, *or* Atomic Structure and Atomic Spectra.

FOOD TECHNOLOGY

Professor Bernard E. Proctor

The food industry is at present the largest single industry in the United States, accounting for over 26 per cent of our national income. Its present magnitude may be attributed in part to our increase in population and our increasing longevity. Most important, however, is the general increase in our living standards, resulting in increased expenditures for foods and particularly in the popularity of "convenience foods." Food processing today demands greatly increased numbers of young men scientifically trained in food technology to undertake research, quality control, production, and management in the food industries.

In fact, there are but few foods now on the market that need no processing to improve their quality, preserve their value, or expedite their distribution. Refrigeration, canning, packaging, drying, and freezing are every-day processes which affect most of what we eat. They are basic processes of the vast food industry, which is only now coming to apply scientific knowledge to its many different problems and procedures.

Bringing science to food—chemical science to find the reactions and mechanisms that make better flavor, color, and nutrition; biological science to discover spoilage mechanisms; biochemical science to improve the nutritional values of food; engineering to improve food machinery, packaging, and handling; psychology to analyze public preferences for flavors and colors, business to administer the vast food industry . . . . all these are part of food technology.

Our undergraduate studies in Food Technology at M.I.T. are planned to lay a sound foundation in these many sciences upon which food technologists rely for basic concepts. The specific information on applying these concepts to food problems is presented in the second year of the curriculum, in such subjects as bacteriology, food production, food engineering, chemistry and technology of food supplies, technology of food products, and chemical engineering food applications. Studies in nutrition show the elements that human beings require in their foods, how foods may be analyzed to show their content of these elements, and how food processes may preserve and enrich these essentials. Pioneering studies on new ways of preserving foods by ionizing radiations suggest a potentially important use of atomic energy. New electronic techniques are being applied to evaluating the physical properties of foods.

The student who studies this basic Food Technology course can look forward to an interesting and satisfying career in an industry concerned with vital human needs and on which rests marked social responsibility. Positions of executive as well as technical responsibility are waiting.

The course in Biochemical Engineering, XX-B, is basically the undergraduate curriculum in chemical engineering, modified to include studies of biology, bacteriology, microbiology, and biochemistry, particularly as they relate to the beneficial uses of microorganisms for producing antibiotics and other important chemicals. The result is an unusual program for those interested in industries based on the antibiotics and vitamins, where microscopic plants and animals are made to do so much for us.

The food industry is the largest manufacturing enterprise in the United States, with more individual processing companies than in any other field of industrial activity. It gathers raw materials from farms throughout the world and by processing converts these to thousands of products. The total value of these products is greater than for any other industry, and so is the increase in their dollar value during the processing.

For every four hungry Americans sitting down to a meal this year there will be a fifth citizen to satisfy twenty years hence. The nutritional standards of vast areas of the world suggest that the science of food technology has barely begun to meet even our current needs. Who can doubt the opportunities ahead in this new science?

FIRST YEAR

First Term

General Chemistry (5.01)
Physics (8.01, Mechanics)
Foundations of Western Civilization (H11)
Calculus (M11)
Military Science (MS11)
or
Air Science (AS11)
and at least one additional first-year subject (see the descriptions in Section 5) during the freshman year.

Second Term

General Chemistry (5.02)
Physics (8.02, Heat, Kinetic Theory)
Foundations of Western Civilization (H12)
Calculus (M12)
Military Science (MS12)
or
Air Science (AS12)
and at least one additional first-year subject (see the descriptions in Section 5) during the freshman year.

SECOND YEAR

First Term

General Biology I
General Biology Laboratory I
Physics (Electricity, Magnetism)
Food Production
Humanities
Calculus
Military Science *or* Air Science

Second Term

Quantitative Analysis
Quantitative Analysis Laboratory
Physics (Optics, Atomic Physics)
Bacteriology
Humanities
Probability and Operations Analysis
Military Science *or* Air Science

	Food Technology (Course XX)	**Biochemical Engineering (Course XX-A)**
THIRD YEAR		
First Term	Organic Chemistry I Physical Chemistry I Chemistry and Technology of Food Supplies I Industrial Microbiology *and two elective subjects, of which one must be in* Humanities	Organic Chemistry I Organic Preparations I Physical Chemistry I Physical Chemistry Laboratory I Industrial Chemistry Industrial Microbiology *and one elective in* Humanities
Second Term	Physical Chemistry II Instrumental Analysis Instrumental Analysis Laboratory Chemistry and Technology of Food Supplies II *and two elective subjects, of which one must be in* Humanities	Instrumental Analysis Instrumental Analysis Laboratory Organic Chemistry II Qualitative Organic Analysis Physical Chemistry II Physical Chemistry Laboratory II *and two elective subjects, of which one must be in* Humanities
FOURTH YEAR		
First Term	Food Engineering General Biochemistry and Physiology I Technology of Food Products Chemical Engineering Food Applications Chemistry of Nutrition Thesis *and one elective in* Humanities	General Biochemistry and Physiology I Chemical Engineering Food Applications Chemistry of Nutrition Biochemical Engineering Thesis *and one elective in* Humanities
Second Term	Food Engineering Technology of Food Products Chemical Engineering Food Applications Thesis *one professional elective* *and one elective in* Humanities	Chemical Engineering Food Applications Biochemical Engineering Thesis *and two or three elective subjects, one of which must be in* Humanities

GEOLOGY AND GEOPHYSICS

Professor Robert R. Shrock

The origin, age, and composition of the earth, the physical state of the earth's interior, and the origin of the oceans and atmosphere are among the most challenging and perplexing problems of science. They all lie within the domain of the earth scientists—geologists, geochemists, geophysicists, meteorologists, and oceanographers —but they can be successfully attacked only by using the latest contributions from the physical and engineering sciences.

Graduates from M.I.T.'s Course in Geology and Geophysics are in great demand because their specialized training in geology rests on a broad foundation of the basic sciences, and they have many opportunities to tackle difficult geological problems involving the use of these basic sciences.

Geology is concerned mainly with the study of minerals, rocks, and earth structures as they are found in the field; geologists spend much of their time determining the geologic history of the earth as a basis for locating all kinds of raw materials for industry—petroleum and natural gas, metals, nuclear fuels, and building and construction materials. Laboratory geologists investigate the physical and chemical properties of earth materials by many techniques, using the most modern equipment and instruments that can be obtained.

Geophysicists are interested in the physical characteristics of the earth—magnetism, gravity, electrical conductivity, elasticity and radioactivity—and in measuring these in the field and in the laboratory. Anyone interested in applied mathematics, physics or electrical engineering will find geophysics a challenging profession, but it is only for the well-trained scientist who wants to tackle difficult problems. So our curriculum at M.I.T. is heavily weighted in mathematics and physics in order to give interested students the fundamentals they will need for professional practice. Most geophysicists have traveled widely over the earth by the time they have reached middle age, and they have had to solve a wide variety of problems involving mathematics, physics, electrical engineering, and geology.

Modern earth scientists need to be able to work in the field as well as in the laboratory. M.I.T. requires, after the sophomore year, a summer's work in the well-equipped field camp which we share with the Nova Scotian Universities near Antigonish, Nova Scotia. Here students learn surveying, mapping, and geological field methods during a ten-week period, five weeks of which are spent in tent camps.

An optional cooperative program of geophysical field training has been arranged with Geophysical Service, Inc., of Dallas, Texas, for the summer following the third year. During this summer, students who participate in the program are employed by the company; and after a week of orientation lectures in Dallas, they join field parties engaged in seismic exploration in a part of the continent where active petroleum search is going on. Other juniors may find summer work with petroleum and mining companies and may go to areas as distant as Mexico, California, British Columbia, New Brunswick, and Newfoundland.

The nation's expanding industrial economy is making heavy demands on the petroleum and mineral industries and on the companies that find and develop the raw materials for these industries. Reserves of petroleum and natural gas, of metallic ores, and of many non-metallic substances—even water supplies—are increasingly difficult to maintain; likewise, reserves of nuclear fuels are now being sought everywhere. The easy discoveries have been made, the low-cost deposits have been exhausted, and we now are dependent on improvements and new developments in geological, geochemical, and geophysical methods.

Geological science is young; it dates from about 1800, but its growth to national prominence is much more recent. A current survey shows that 70 per cent of those in the profession are between 25 and 45 years of age. The number of trained geologists almost doubled between 1940 and 1950; we expect it to double again by 1970. This young profession has plenty of room for promising graduates.

FIRST YEAR

First Term

General Chemistry (5.01)
Physics (8.01, Mechanics)
Foundations of Western Civilization (H11)
Calculus (M11)
Military Science (MS11)
or
Air Science (AS11)
and at least one additional first-year subject (see the descriptions in Section 5) during the freshman year.

Second Term

General Chemistry (5.02)
Physics (8.02, Heat, Kinetic Theory)
Foundations of Western Civilization (H12)
Calculus (M12)
Military Science (MS12)
or
Air Science (AS11)
and at least one additional first-year subject (see the descriptions in Section 5) during the freshman year.

SECOND YEAR

First Term

Physics (Electricity, Magnetism)
Mineralogy I
Physical Geology
Humanities
Calculus
Military Science *or* Air Science

Second Term

Physics (Optics, Atomic Physics)
Historical Geology
Humanities
Differential Equations
Military Science *or* Air Science
and one elective subject (see below)

Summer

At the Nova Scotia Centre for Geological Sciences:
Geological Surveying
Field Investigations and Reports

Four-Year Course (Course XII)

THIRD AND FOURTH YEARS

In consultation with registration advisers, students plan individual programs of elective subjects for both the third and fourth years. Each student must register for Thesis *during the fourth year. In addition, during the third and fourth years, each must register for four subjects in* Humanities; *four to six subjects in* Mathematics, Physics, Chemistry, *and* Electrical Engineering; *and five to seven subjects in* Geology. *Other electives (three or four subjects) may be chosen from any department at the Institute.*

Five-Year Course (Course XII-A)

THIRD, FOURTH, AND FIFTH YEARS

In consultation with registration advisers, students plan individual programs of elective subjects for the third, fourth, and fifth years. Each student must register for Thesis *work during the fifth year. In addition, during the three years each student must register for four subjects in* Humanities, *four to six subjects in* Mathematics, Physics, Chemistry, *and* Electrical Engineering; *and eight to ten subjects in* Geology *(including graduate subjects). Other electives (six to eight subjects) may be chosen from any department at the Institute.*

This wide choice of electives makes it possible for students to concentrate their work in one or a combination of these fields: Basic Geology, Crystallography, Engineering Geology, Geochemistry, Geophysics, Mineralogy, Mineral Industry, Mineral Deposits, Mineral Fuels (Petroleum and Natural Gas), Petrology, Sedimentation, Stratigraphy and Paleontology, Structural Geology, *and* Theoretical Geology.

MATHEMATICS

Professor William T. Martin

The study of mathematics as a professional major may have as its goal one or both of the following objectives:

1. The application of mathematics in engineering, science, or business;
2. Preparation for teaching mathematics.

In both of these, the creation of new mathematics is also an important aim.

One of the postulates underlying scientific research is the assumption of the existence of "laws of nature." We assume that effect follows cause, that nature is not capricious and chaotic but possesses an inherent harmony and beauty. Mathematics has played a significant role in the discovery of physical laws, and it has provided a simple language for expressing them. But beyond this, mathematics provides what is probably the most economical tool for exploring the consequences of these laws and for predicting the outcome of experiments. For example, the planet Pluto was discovered after mathematical calculations showed that there was a discrepancy between the observed position of Neptune and the position predicted for it on the basis of the laws of gravitation. Similarly, one of the crucial tests of Einstein's theory of relativity (the bending of light rays under gravitational attraction) was first worked out mathematically, then verified experimentally. More dramatic, of course, has been the development of atomic energy, first predicted by mathematical calculations applied to basic physical laws expressed in mathematical language.

One of the noticeable trends during the past decade has been the increasing demand from industry and from governmental research organizations for persons trained in mathematics. These jobs range over such fields as communications, aeronautics, atomic energy, oil exploration, guided missile control, and design and operation of high-speed computers. No longer is it true (if indeed it ever was) that the only careers to which a mathematics major can look forward are in statistics or in teaching, though these fields are also expanding and are calling for more qualified people.

Some people are surprised to learn that mathematics is a living, growing science in its own right and not just a collection of formulas discovered long ago and passed on from generation to generation. To the student who finds that mathematics has its own fascination, quite apart from its function as "handmaiden of the sciences," we especially offer a word of encouragement. If you can see beauty in, and feel a glow of satisfaction from understanding, a mathematical theorem—or if you have been lucky enough to discover some interesting mathematical facts for yourself—you may be one of those destined to become a mathematician in the true sense of the word—namely, a creative scientist who discovers or invents new mathematics. There is no guarantee of success, for there can never be such a guarantee in acts of discovery or invention, but you will surely derive a great deal of pleasure from the process of trying.

Only a brief word about the M.I.T. course in Mathematics need be added: as you can see, it provides in the junior and senior years a very wide choice of subjects. This means that the course can fulfill the needs of all who are interested in mathematics; we work with each student to develop his program to meet his special requirements.

Mathematics (Course XVIII)

FIRST YEAR

First Term

General Chemistry (5.01)
Physics (8.01, Mechanics)
Foundations of Western Civilization (H11)
Calculus (M11)
Military Science (MS11)
or
Air Science (AS11)
and at least one additional first-year subject (see the descriptions in Section 5) during the freshman year
or
Naval Science (NS11)

Second Term

General Chemistry (5.02)
Physics (8.02, Heat, Kinetic Theory)
Foundations of Western Civilization (H12)
Calculus (M12)
Military Science (MS12)
or
Air Science (AS12)
and at least one additional first-year subject (see the descriptions in Section 5) during the freshman year
or
Naval Science (NS12)

SECOND YEAR

First Term

Physics (Electromagnetism)
Humanities
Calculus
Military Science, Air Science, *or* Naval Science
Language
and one elective in Engineering *or* Science (*not* Mathematics)

Second Term

Physics (Electromagnetism)
Humanities
Differential Equations
Military Science, Air Science, *or* Naval Science
Language
and one elective in Engineering *or* Science

THIRD YEAR

First Term

Linear Algebra
Analysis
and three elective subjects, of which one must be in Mathematics (*or* Engineering *or* Science) *and one in* Humanities

Second Term

Analysis
and four elective subjects, of which one must be in Mathematics (*or* Engineering *or* Science) *and one in* Humanities

FOURTH YEAR

First Term

Analysis
Thesis
and five elective subjects, of which three must be in Mathematics (*or* Engineering *or* Science) *and one in* Humanities

Second Term

Elementary Differential Geometry
Thesis
and three or four elective subjects, of which one or two must be in Mathematics (*or* Engineering *or* Science) *and one in* Humanities

PHYSICS

Professor Nathaniel H. Frank

Understanding of the quantitative description of our physical environment—for example, of the laws of dynamics or of the structure of matter—is essential for proper education in pure or applied physical science. The rapidly evolving nature of standard engineering practice and especially its application to unusual and novel situations can be grasped more effectively by the man capable of relating it to a basic picture of the physical world. In its undergraduate curriculum the Physics Department attempts to develop the necessary insight through rigorous courses encompassing not only the fields of classical physics but also the many ideas of modern physics. This physical picture relates such diverse things as individual atoms to chemistry or metallurgy and the nucleus of the atom to the intense energy radiated by stars.

The physics subjects in the first two years at M.I.T. provide thorough grounding in Newtonian mechanics and its range of applicability; then in electromagnetism, not only for its application to electrical circuits but also for its interaction with matter and the radiation of electromagnetic waves. Such wave motions give useful insight into optics and acoustics. They also lead into the modern conceptions of the wave nature of matter. An important role of these physics subjects is to supply a sound scientific foundation on which each student can build his own professional career.

In the last two years of the Physics undergraduate curriculum, students are able to satisfy their individual interests by choosing from a great number of more advanced and more specialized subjects. The curriculum for those who major in physics is flexible. Opportunity exists to delve into one subject deeply, and the possible choices are many. The Department provides opportunities to see how physics research is really done, and, indeed, to participate in it in one of many active laboratories.

Both prospective physicists and those who will use their knowledge of physics for application in other fields benefit from the Physics Department's two closely interrelated objectives—good teaching and good research. The research program guarantees contact with current problems of physics and with the growth of the science. Here research groups in solid state, low temperature, nuclear, high energy, and theoretical physics, optics, spectroscopy, electronics, and many other fields of physics attack the current problems. Furthermore, physics at M.I.T. is not isolated. The members of the Department share problems which extend into other fields and other departments of M.I.T. Often these are shared unofficially, but there are so many cross connections that several interdepartmental laboratories are in active operation. The challenge of diverse problems and intimacy with current work illuminates teaching.

The Physics Department does not expect that all its graduates will work in the field of physics. There are opportunities for the trained physicist in many places. Advanced work is often done by our graduates in allied fields. They may become metallurgists or physical chemists, to give some examples. In recent years industry has hired an increasing number of physicists to do development work—work which might previously have been assigned to engineers. Applied physics work has increased industrially and also has played a great role in the development of the defensive strength of our country. Some physicists even go farther afield and join the biologists in attacking the fundamental problems of life. At the moment a serious shortage of science teachers exists in secondary schools throughout the country. The opportunities for applying or working in physics seem to be almost limitless.

Physics (Course VIII)

FIRST YEAR

First Term

General Chemistry (5.01)
Physics (8.01, Mechanics)
Foundations of Western Civilization (H11)
Calculus (M11)
Military Science (MS11)
or
Air Science (AS11)
and at least one additional first-year subject (see the descriptions in Section 5) during the freshman year
or
Naval Science (NS11)

Second Term

General Chemistry (5.02)
Physics (8.02, Heat, Kinetic Theory)
Foundations of Western Civilization (H12)
Calculus (M12)
Military Science (MS12)
or
Air Science (AS12)
and at least one additional first-year subject (see the descriptions in Section 5) during the freshman year
or
Naval Science (NS11)

SECOND YEAR

First Term

Physics (Electromagnetism)
Humanities
Calculus
Military, Air, *or* Naval Science
two or three elective subjects (one term of Chemistry *beyond first-year* Chemistry *is required in the First or Second Term)*

Second Term

Elementary Electric Circuit Theory
Physics (Electromagnetism)
Humanities
Differential Equations
Military, Air, *or* Naval Science
one elective subject

THIRD YEAR

First Term

Physics: Atoms, Molecules, and Nuclei I
Electronics
Experimental Atomic Physics I
Advanced Calculus for Engineers
and one elective in Humanities

Second Term

Electronic Circuits
Physics: Atoms, Molecules, and Nuclei II
Experimental Atomic Physics II
elective subject in Mathematics
and one elective in Humanities

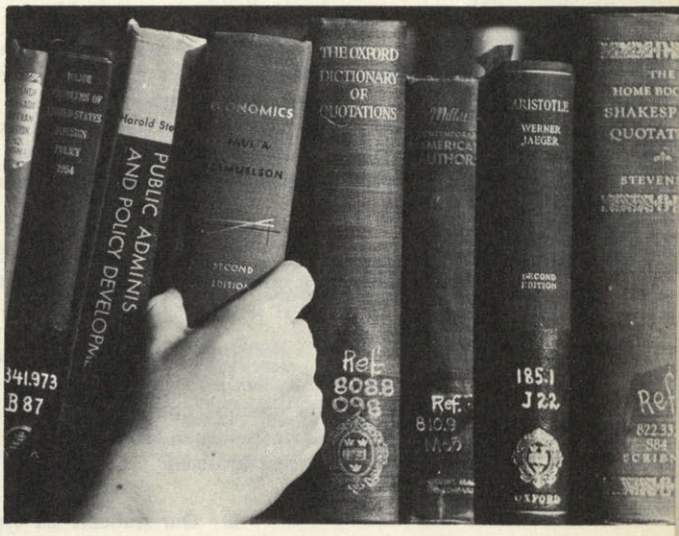
FOURTH YEAR

First Term

Experimental Physics *and* Thesis
Introduction to Theoretical Physics II
two elective subjects
and one elective in Humanities

Second Term

Statistical Mechanics and Thermodynamics
Introduction to Theoretical Physics I
Thesis
one elective subject
and one elective in Humanities



Dean Burchard

". . . again and again in the Bible, we are enjoined to love our neighbors as ourselves. To make love for our neighbor effective, perhaps even to make it possible, we must first know our neighbor. To gain this knowledge in a large and restless world will be extremely difficult. But the search is all-important."

—Dean of Humanities John E. Burchard in *The Saturday Review*, November 3, 1951.

ECONOMICS, POLITICS, AND ENGINEERING OR SCIENCE

Professor Ralph E. Freeman

The Courses in Economics, Politics, and Engineering or Science are another evidence of M.I.T.'s pioneering role among technological institutions. These two new courses were designed to combine study in the social sciences with concentrated work in a selected field of engineering or science . . . once more emphasizing the Institute's interest in developing graduates who can help effect a melding of technology with the human environment in which it operates.

These are the essential features which we think distinguish these Courses from other offerings at the Institute—and from offerings at other schools:

1. Our students in these Courses are ordinarily those who have innate curiosity both about technical and scientific matters and about social problems. They ask, for instance, questions like this: "What are the probable consequences of the automation of a factory in terms of the economic position of the firm *and* the well-being of the employees involved?"

2. Our students are typically interested in going into industry after graduation, because they are aware of the particular challenge to be found there for the man who understands technical processes and who can also think along the broadest analytical lines in seeking to understand social processes.

3. While at M.I.T. students choose one engineering or science field in which to major. Whatever field is chosen, we adhere to this one general rule: this technical work will involve the fundamental subjects included in the curriculum of students taking their degrees in that field. There are no special "watered-down" subjects for Course XIV students.

4. Approximately 40 per cent of our students' course work is done in social science. This includes certain required work in economics, humanities, and political science. In addition, there is a wide choice of electives in economics and political science—studying, in economics, the structure in which business is conducted and technologic change takes place; and, in political science, the increasing range of problems of direct concern to scientists and engineers arising in connection with government. We do not encourage narrow specialization but we do permit some degree of concentration along the lines of industrial economics, labor relations, or political science.

M.I.T. does not claim to have found the best way to bridge what is often a wide gap between technology and the social sciences. But our experience in these Courses suggests that all concerned—students, teachers, and employers—can afford to be very optimistic. Industry in particular has watched the program develop with special interest: this synthesis of economics and technology promises to be a valuable one for the training of future executives. Perhaps one recent comment from an employer will best describe the need which the Courses seek to meet: "We can hire good engineers when we need them. We can also get special help on our financial or personnel problems when we need that. But what we can really use now for top-level jobs are a few men who don't think in terms of separate pigeon-holes but think instead in analytical terms about all the problems we face that are *both* engineering and social science problems."

Economics, Politics, and Engineering (Course XIV-A) or Science (Course XIV-B)

FIRST YEAR

First Term	General Chemistry (5.01) Physics (8.01, Mechanics) Foundations of Western Civilization (H11) Calculus (M11) Military Science (MS11) *or* Air Science (AS11) *and at least one additional first-year subject (see the descriptions in Section 5) during the freshman year.*	*Second Term*	General Chemistry (5.02) Physics (8.02, Heat, Kinetic Theory) Foundations of Western Civilization (H12) Calculus (M12) Military Science (MS12) *or* Air Science (AS12) *and at least one additional first-year subject (see the descriptions in Section 5) during the freshman year.*

SECOND YEAR

First Term	Physics (Electricity, Magnetism) Economic Principles I Humanities Calculus Military Science *or* Air Science *and one elective in* Language, Engineering, *or* Science*	*Second Term*	Physics (Optics, Atomic Physics) Economic Principles II *or* Government, Politics, and Technology Humanities Differential Equations Military Science *or* Air Science *and one elective in* Language, Engineering, *or* Science*

THIRD YEAR

First Term	Elementary Statistics *or* *one elective in* Political Science *(see below)* *one elective in* Economics *(see below)* *three electives in* Engineering *or* Science* *and one elective in* Humanities	*Second Term*	Business and National Income Accounting *or* *one elective in* Political Science *(see below)* *one elective in* Economics *(see below)* *three electives in* Engineering *or* Science* *and one elective in* Humanities

FOURTH YEAR

First Term	Thesis *and five or six elective subjects, of which two must be in* Economics *(see below) and two or three in* Engineering *or* Science*	*Second Term*	Thesis *and five elective subjects, of which three must be in* Economics *(see below) and one in* Engineering *or* Science*

The following are among the recommended elective subjects in Economics: Prices and Production, Money and Income, Public Finance, International Trade, Labor Relations, Labor Economics and Public Policy, Personality and Social Structure, Organization and Communication in Groups, Learning, Industrial Organization and Public Policy, Economics of Invention, Finance, Management Laboratory, Business Leadership in the American Economy, Statistical Quality Control, Statistical Theory, *and* Industrial Accounting.

The following are among the recommended elective subjects in Political Science:
American Political System, Comparative Political and Economic Systems, Seminar on Issues in Contemporary American Politics, Basic Ideas of Western Politics and Ethics—500 B.C. to 1500 A.D., Rise of Modern Political and Social Science—1500 to 1914, Contemporary Ideas on Political and Economic Development, International Relations, Principles and Problems in American Diplomacy, Seminar in International Politics, Politics, Society, and Policy Making, Influences on Political Decisions, *and* Nationalism and National Development.

*Students enrolled in Economics and Science will take science subjects and those in Economics and Engineering will take engineering subjects—in both cases as recommended in consultation with the Economics Department and the science or engineering department concerned.

HUMANITIES AND ENGINEERING OR SCIENCE

Professor Howard R. Bartlett

The broad objective of M.I.T.'s two Courses in Humanities and Engineering and Humanities and Science is to provide a kind of general education based on science or engineering. At the same time, either Course provides the foundation for graduate work in science or engineering, in medicine, law, business, or public administration, and even in some fields of the humanities.

Each Course consists of about 60 per cent basic science or engineering and about 40 per cent humanities and social science. The work in science or engineering is concentrated in one area; it includes the core subjects and other subjects recommended by one department in the School of Science or the School of Engineering. The subjects in humanities are combined to make up programs emphasizing either American Industrial Society or Philosophy and Literature.

Both curricula lead in four years to the Bachelor of Science degree in the School of Humanities and Social Studies, without specification of science or engineering department. In a fifth year any graduate of this Course may complete the requirements for an additional S.B. degree (and in some cases an S.M. degree) in the engineering or science department in which he has concentrated his technical studies. Or, after his four years at M.I.T., any graduate of this Course should be able to enter a liberal arts graduate school for advanced study in the area of his humanities concentration.

This Course appeals to a considerable number of undergraduates who want a broader education than is possible when one is concentrating in one technical or scientific field. The Course is unique, for example, as preparation for law school; there are very few attorneys who have the background for dealing with the very complex legal matters touching upon science in industry. It is consonant in purpose and rigor with all the traditions of M.I.T. It is not rigid, but it is carefully planned to be comparable in depth with that carried by any other M.I.T. student.

In the first two years there are the basic subjects in both humanities and science which are familiar to all M.I.T. students. And there are classes in philosophy and the social sciences, with emphasis on the viewpoints of social psychology, sociology, cultural anthropology, and philosophy. In the last two years comes the specialized work in the science or engineering of each student's choice and a series of subjects in one of two areas in the humanities or social sciences:

American Industrial Society emphasizes the development of contemporary American culture and the social interrelationships within it. Its studies include the nature of change in the United States; the persistence of certain processes and attitudes of mind, the transmutation of others; the contributions and problems of scientists and engineers as instruments of change; and the ways by which conflicting interests are peacefully reconciled in a democratic society.

Philosophy and Literature focusses on the relationships between scientific and other kinds of thought. It emphasizes the structure as well as the meaning of creative efforts in literature, the arts, and philosophy—to the end that students may become aware of the similar character of creative activity in many different disciplines, including science and engineering.

In the final year each student does a special project—a thesis which combines the approach of engineering or science with that of political science, economics, or philosophy.

We call this Course a "double major", because it includes concentrated studies in one field of humanities *and* one field of technology. As such, it encourages students to probe deeply in two fields. Under the rigorous standards characteristic of M.I.T., students in this Course acquire a thorough grounding in science and technology, and a knowledge of humanities commensurate with that required of students in a liberal arts college.

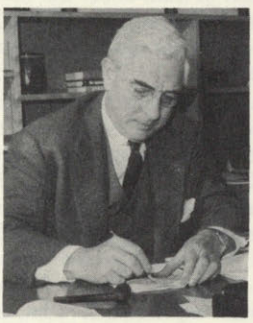
	Humanities and Engineering (Course XXI-A) or Science (Course XXI-B)	**Science and Mathematics Teaching (Course XXI-C)**
FIRST YEAR		
First Term	General Chemistry (5.01) Physics (8.01, Mechanics) Foundations of Western Civilization (H11) Calculus (M11) Military Science (MS11) *or* Air Science (AS11) *and at least one additional first-year subject (see the descriptions in Section 5) during the freshman year* *or* Naval Science (NS11)	General Chemistry (5.01) Physics (8.01, Mechanics) Foundations of Western Civilization (H11) Calculus (M11) Military Science (MS11) *or* Air Science (AS11) *and at least one additional first-year subject (see the descriptions in Section 5) during the freshman year.*
Second Term	General Chemistry (5.02) Physics (8.02, Heat, Kinetic Theory) Foundations of Western Civilization (H12) Calculus (M12) Military Science (MS12) *or* Air Science (AS12) *and at least one additional first-year subject (see the descriptions in Section 5) during the freshman year* *or* Naval Science (NS12)	General Chemistry (5.02) Physics (8.02, Heat, Kinetic Theory) Foundations of Western Civilization (H12) Calculus (M12) Military Science (MS12) *or* Air Science (AS12) *and at least one additional first-year subject (see the descriptions in Section 5) during the fr year.*
SECOND YEAR		
First Term	Physics (Electricity, Magnetism) Economic Principles I *or* Introduction to Literature Humanities Calculus Military, Air, *or* Naval Science *and one elective subject in* Language, Engineering, *or* Science**	Systematic Inorganic Chemistry *and* Qualitative Analysis Laboratory *or* Organic Chemistry I *and* Organic Preparations I Physics (Electricity, Magnetism) Introduction to Literature Humanities Calculus Military Science *or* Air Science
Second Term	Physics (Optics, Atomic Physics) Economic Principles II *or* Government, Politics, and Technology *or* Literary Theory Humanities Differential Equations Military, Air, *or* Naval Science *and one elective subject in* Language, Engineering, *or* Science**	Physics (Optics, Atomic Physics) Introductory Psychology *or* Literary Theory Humanities Differential Equations Military Science *or* Air Science *and one elective subject in* Science
THIRD YEAR		
First Term	Politics, Society, and Policy Making *and* Growth of American Industrial Economy *or* Science and Philosophy from Antiquity to Copernicus *and* Philosophic Problems and Systems *one elective in* Humanities *(see below)* *and two or three electives in* Engineering *or* Science**	Atomic and Nuclear Physics Science and Philosophy from Antiquity to Copernicus Philosophic Problems and Systems *one elective subject in* Science *Curriculum and Methods in Mathematics
Second Term	Political Process in Industrial America *and* Business Leadership in the American Economy *or* Science and Philosophy from Galileo to the Present *and* Philosophic Problems and Systems *one elective in* Humanities *(see below)* *and two or three electives in* Engineering *or* Science**	Science and Philosophy from Copernicus to the Present Philosophic Problems and Systems Elementary Statistics *one elective subject in* Science *Educational Psychology and Measurements
FOURTH YEAR		
First Term	Philosophy and Literature Seminar *or* American Industrial Society Seminar *and four or five electives, of which two must be in* Humanities *(see below) and one or two in* Engineering *or* Science**	Fundamentals of Electrical Engineering *or* Electronics Philosophy and Literature Seminar *one elective subject in* Science *one elective subject in* Humanities *Educational Policy
Second Term	Philosophy and Literature Seminar *or* American Industrial Society Seminar Thesis *and three or four electives, of which one must be in* Humanities *(see below) and one in* Engineering *or* Science**	Philosophy and Literature Seminar Thesis *one elective subject in* Science *one elective subject in* Humanities *College Algebra and Geometry
FIFTH YEAR		
First Term		*Two elective subjects in* Science *The American School *Teaching of Science *Curriculum and Methods Seminar
Second Term		*Two elective subjects in* Science *Supervised Teaching *Curriculum and Methods Seminar

The following are among the recommended elective subjects in American Industrial Society: American Society and Intellectual History, Political Process in Industrial America, Religious Thought and American Society, American Foreign Policy in Action, Economic Problems Seminar, Economics of Invention, History of American Technology, The Labor Force in Industrial America, Elementary Statistics, Industrial Relations, Personality and Social Structure, *and* Influences on Political Decisions.

The following are among the recommended elective subjects in Philosophy and Literature: Religious Thought and American Society, Art and Industrial Civilization, Basic Ideas of Western Politics and Ethics–500 B.C. to 1500 A.D., Rise of Modern Political and Social Science–1500 to 1914, Classical Philosophy, Symbolic Logic, Problems in Contemporary Philosophy, Philosophy of Science, Topics in the History of Science, Epic Tradition in Literature, Nineteenth Century American Literature, Twentieth Century American Literature, Dostoevsky, Tolstoi, and Modern Russian Literature, Modern Novel, *and* The Comic Sensibility.

**Students enrolled in Humanities and Science will take science subjects and those in Humanities and Engineering will take engineering subjects–in both cases as recommended in consultation with the Humanities Department and the science or engineering department concerned.

*At Harvard Graduate School of Education



Dean Brooks

"The basic requirement of executive capacity is the ability to create a harmonious whole out of dissimilar disciplines. The America we know today—its high living standards, its strength, its position as a world power—would literally have been impossible to achieve without the executive function."

—Crawford H. Greenewalt (M.I.T. '22), President of E. I. du Pont de Nemours and Company, Inc., in *Chemical and Engineering News,* May 25, 1953.

BUSINESS AND ENGINEERING ADMINISTRATION

Assistant Dean W. Van Alan Clark, Jr.

The dominant characteristic of our society is evolutional change. Among those chiefly responsible for such advance are the scientist, the engineer, and the manager. Indeed, the manager of both private and public enterprise must play a major role in making effective the work of the scientist and engineer.

M.I.T.'s undergraduate course in the School of Industrial Management is specifically designed for the student who wishes to make his contribution to society as a manager of people rather than of things. Dealing with people from a variety of interested groups—owners, employees, customers, and the "body politic"—and acting effectively through people are the essential, fascinating, and demanding elements of administration. And while much is known about a theory of administration, the fact that so much of management rests upon the still vast imponderables of human behavior makes it certain that management should still be classed among the "lively arts."

This program in management might be called a "breadth" program. It requires a considerable grounding in basic physics, chemistry, and mathematics. Furthermore, it demands a rigorous exposure to the fundamentals of technical application in a chosen broad field (for example, the field of chemical sciences). It demands a sound investigation of humanities. Finally, it calls for a study of both the analytical aspects of management decision-making and the practical or human problems of administration.

Students become solidly grounded in an area of basic science or engineering and proceed to some depth in a limited area of application. This is crucial to the sound administrator who would manage in industry with rapidly developing technology; the administrator need not know a great deal about the specific engineering involved, but he should have studied enough in some area of applied technology to have a genuine understanding of how the engineer or scientist behaves and what are his needs.

The mathematics, science, and engineering fundamentals which together make up about one-half of the subjects in the undergraduate program do more than supply a grounding in science and technology in themselves. Much is being learned about rigorous and quantitatively sophisticated decision-making in many areas of business. Our students are peculiarly qualified to learn about the use of probability, statistics, mathematical models, and modern data-processing concepts. These men are now and will increasingly be among those who contribute to the development of theoretical principles and scientific methods in administration.

We think it especially important that our students be encouraged to think about a variety of problems from the point of view of the individual enterprise and of those people who are responsible for its direction and success. This point of view must always take into account social forces as well as individual human impulses, economic relationships as well as engineering considerations. Our students are expected to learn an appreciation of the intangibles of modern industry while they are learning to reduce the number of these intangibles. They are expected to recognize the shortcomings of many business practices as well as their uses. To the fullest extent possible, S.I.M. undergraduates come into contact with experimental administrative techniques and methods of analysis which are advanced well beyond the current practice of industry.

We emphasize contacts with experienced management people. Students typically spend a good portion of their time in our advanced courses studying live problems in cooperating industrial plants, and they must work with the men actually responsible for the operations of the firm. We have many seminars, most of which are student-organized, with special visitors who bring a particular competence or problem to us.

As in any other profession, the possibilities for individual growth are exceeded only by those of the field as a whole. The phenomenal growth of the national economy and the projected growth in the future will create an even faster-growing demand for managerial talents.

FIRST YEAR

First Term	General Chemistry (5.01) Physics (8.01, Mechanics) Foundations of Western Civilization (H11) Calculus (M11) Military Science (MS11) *or* Air Science (AS11) *and at least one additional first-year subject (see the descriptions in Section 5) during the freshman year; subjects in* Graphics *are especially recommended* *or* Naval Science (NS11)	*Second Term*	General Chemistry (5.02) Physics (8.02, Heat, Kinetic Theory) Foundations of Western Civilization (H12) Calculus (M12) Military Science (MS12) *or* Air Science (AS12) *and at least one additional first-year subject (see the descriptions in Section 5) during the freshman year; subjects in* Graphics *are especially recommended* *or* Naval Science (NS12)

	Based on Physical Sciences (Course XV-A)		**Based on Chemical Sciences (Course XV-B)**
SECOND YEAR			
First Term	Applied Mechanics I Introduction to Machine Tools Physics (Electricity, Magnetism) Economic Principles I Humanities Calculus Military, Air, *or* Naval Science	*First Term*	Organic Chemistry I Organic Preparations I Physics (Electricity, Magnetism) Economic Principles I Humanities Calculus Military, Air, *or* Naval Science
Second Term	Applied Mechanics II Physics (Optics, Atomic Physics) Industrial Management I Humanities Probability and Operations Analysis Military, Air, *or* Naval Science	*Second Term*	Organic Chemistry II Physics (Optics, Atomic Physics) Industrial Management I Humanities Probability and Operations Analysis Military, Air, *or* Naval Science
Recommended during Summer	Industrial or Business Practice	*Recommended during Summer*	Industrial or Business Practice
THIRD YEAR			
First Term	Heat Engineering Engineering Metals Industrial Management II Accounting Marketing	*First Term*	Industrial Chemistry Chemical Engineering Thermodynamics Physical Chemistry I Industrial Management II Accounting Marketing
Second Term	Fluid Mechanics Heat Engineering Personnel Administration Finance Production Management *and one elective in* Humanities	*Second Term*	Physical Chemistry II Chemical Engineering Personnel Administration Finance Production Management *and one elective in* Humanities
FOURTH YEAR			
First Term	Fundamentals of Electrical Engineering Thesis *and four elective subjects, of which one must be in* Engineering, *one in* Humanities, *and one in* Industrial Management	*First Term*	Fundamentals of Electrical Engineering Chemical Engineering Thesis *and three elective subjects, of which one must be in* Industrial Management *and one in* Humanities
Second Term	Electronic Instrumentation Thesis *and three elective subjects, of which one must be in* Industrial Management *and one in* Humanities	*Second Term*	Chemical Engineering Thesis *and three elective subjects, of which one must be in* Industrial Management *and one in* Humanities

5 *The First-Year Subjects*

The following descriptions are of the subjects ordinarily recommended for and taken by first-year students. Before coming to M.I.T. you may wish to consider which of these you will include in your first-year schedule; this should of course be done in accordance with the sample "recommended" curriculum of the Course which you now expect to follow at M.I.T. as given in the previous chapter. And when you arrive at M.I.T. you will want to discuss your choices with your advisor and perhaps modify them in accordance with his suggestions.

HOURS AND CREDITS

With the descriptions on the following pages you will see the credit hours given for each first-year subject. These are presented so as to best show the *total* work which a subject requires. Thus, in the case of the first course shown:

1.001 Conservation of Natural Resources 2-4

the credits mean that 2 hours per week are required in class and laboratory and 4 hours per week are required by an average student for outside preparation, for a total of 6 hours. On this basis the normal undergraduate schedule is approximately 50 hours per

week total time, including classrooms, laboratories, and preparation. A student taking this much work in one semester is said to be registered for 50 units of credit for that semester.

As you will see, the subjects are numbered according to the department under which they are given. For example, subject 5.01 is given in the Chemistry Department, though it appears in the schedules of many Courses as well as Chemistry.

1.002 **TECHNOLOGY IN OUR CIVILIZATION** 2–4

Fundamental resources of civilization: power, materials, and man. Principal technological agencies of civilization: transportation, communications, environment control, and food production. Needs of civilization as they affect and are affected by technology and the technical professions.

4.00 **STRUCTURE OF THE CITY.** 2–4

Lectures, field trips, and reading to familiarize students with the visual form and functioning of their physical environment; to suggest a responsibility and some of the means for its improvement; and to sharpen the powers of observation and the sense of design. Greater Boston will be studied as an example of urban structure —its historical development and current physical problems and the future possibilities of its industry, commerce, living areas, public institutions, and related services.

5.01 **GENERAL CHEMISTRY.** 7–4

Fundamental principles of chemistry: gas laws; mass and energy relationships in chemical changes; writing and the use of chemical equations for quantitative calculations; factors affecting the rate and equilibrium of a chemical reaction; correlation of equilibrium conditions through the mass-action law and the electromotive force of voltaic cells; atomic structure, chemical reactivity of elements, and the Periodic Table; chemistry of certain elements in groups 1, 2, and 3 of the Periodic Table. The laboratory work is largely quantitative in nature and is closely integrated with lectures and recitations.

5.02 **GENERAL CHEMISTRY.** 7–4

Application of chemical principles to the correlation of the chemical behavior of the common elements; stability of the various oxidation states; chemistry of the ionic species; quantitative application of the principles of rate and equilibrium to chemical reactions; structural chemistry of crystals and of molecules; acid–base systems; introduction to the chemistry of carbon; nuclear reactions. The laboratory work emphasizes the important chemical facts of the elements. Facts and principles are used to develop a scheme for the qualitative separation of the elements, with stress on the analysis of unknown mixtures.

7.00 **PERSPECTIVES IN LIFE SCIENCE.** 3–3

Lectures and demonstrations present the place of man in the world of living organisms; factors important in man's successful adaptation to his external environment, animate and inanimate; and the processes which make possible the various functions of man's body in health and disease, including major concepts of genetics, growth, development, and physiology. Concluding lectures are on the growing importance of biophysics and biochemistry in the shaping of modern biological concepts (biology at the molecular level) and the outlook for theoretical biology.

8.01 **PHYSICS (MECHANICS).** 5–6

The fundamental laws of mechanics of particles and rigid bodies; principles of conservation of mass, energy, momentum and angular momentum. There is free use of elementary calculus during the second half of the subject.

8.02 **PHYSICS (MECHANICS: HEAT AND KINETIC THEORY).** 5–6

Oscillations and waves; hydrodynamics; the equations of the state of gases, liquids, and solids; elementary kinetic theory.

12.00 **EARTH SCIENCE (GEOLOGY, GEOPHYSICS, GEOCHEMISTRY).** 2–4

Lectures and demonstrations on the more important aspects of the origin, history, physical behavior, and chemical constitution of the earth and the methods of reasoning and investigation by which the major concepts, laws, and hypotheses of earth science were formulated. The general topics discussed are: earth origin and methods of determining the sequence of events in geologic history; development of continents, oceans, and mountains; evolution of plants and animals through geologic time; formation, distribution, and methods for discovering minerals, rocks, ores, coal, petroleum, and natural gas; reshaping of the earth's surface features by water, ice, and wind; activities associated with earthquakes, volcanoes, and hot springs; and discussion of the kinds of work carried on by earth scientists as geologists, geophysicists, and geochemists. Local field trips are planned.

12.001 **ASTRONOMY.** 3–3

Survey of the history of astronomy and its contributions in philosophy and science to our modern civilization. Emphasis on present theories of the age, origin, and evolution of the Universe. Lectures on the basic physical and chemical principles and the instruments used in modern astrophysics, followed by a study of the planets and their relation to the Universe. Discussion of concepts of stellar magnitudes, spectral classification, stellar energy production, galactic dynamics, Universe expansion, and element origin. Orientation of the Earth to the Universe. Field trips to local observatories.

19.003 **ELEMENTARY METEOROLOGY I.** 3–3

An introduction to meteorological science through examples from all scales of atmospheric motions; radiation balance and the global circulation; air masses and fronts; cyclones and weather forecasting; hurricanes; sea breeze; thunderstorms; micrometeorology; cloud physics; climatology. Laboratory exercises with weather maps.

20.00 **MAN'S FOOD.** 3–3

A survey of the natural and cultivated sources of food for mankind from the viewpoint of production, transportation, processing, packaging, and consumption. General topics discussed will be: history of the foods of mankind through the ages; natural food resources; nutritional requirements of man; effects of geography on dietary patterns; food habits and fads; environment, soils and agriculture; plant and animal breeding; harvest, storage and distribution of food; international movement of food; food economics; agricultural economics; federal regulation of agriculture; food industry of the U.S.; food laws and regulations; science and engineering in food technology; population and the world food problem.

D11 **ENGINEERING DRAWING.** 4–2

The effective use of graphical techniques; solution of real problems in a variety of areas of interest: mechanical, electrical, aeronautical, chemical, and civil engineering, physics, metallurgy, meteorology, geology, and architecture. Spatial visualization, experience in creative thinking and the ability to convey ideas by free-hand sketches. Technical sketching, including orthographic projects and isometric and perspective pictorials.

D111 **GRAPHICS LABORATORY I.** 3–2

Freehand drawing exercises to develop accurate observation and skill in graphic representation. Linear, light and shadow, detail, and perspective renderings of varied subject matter. Control of line, value, color, texture, and form using pencil, pen, and brush.

D12 **DESCRIPTIVE GEOMETRY.** 4–2

This subject includes analysis of three dimensional space relations on a two dimensional surface; analysis of problems involving points, lines, planes and surfaces into fundamental components and development of methods of attack; and development of capacity to think in space terms.

D121 **GRAPHICS LABORATORY II.** 3–2

Continuation of practice in representational techniques. Exercises employing graphic devices useful in all types of free-hand drawing. Use of charcoal pencil, ink wash, and water color as effective means to create the graphic equivalent of what is observed or visualized.

D13 **GRAPHICAL PROCESSES.** 2–4

Methods of graphical solution of physical problems: graphical arithmetic and algebra; conic constructions, projective geometry, coordinate systems, graphical calculus, scales, nomograms, empirical curves, and periodic curves. An individual project is included in this subject.

D14 **ELEMENTARY NOMOGRAPHY.** 2–4

Introduction to graphical solution of equations through alignment diagrams based on plane geometry.

D15 **BASIC MACHINE DRAWING** 4–2

Fundamentals of representation by projection. Section views; auxiliary views; dimensioning; fasteners; shop terms and processes; reproduction of drawings. Free-hand sketching and instrumental drawing are used where appropriate. (This subject is not intended for students planning to enter Mechanical or Aeronautical Engineering.)

E11 **ENGLISH COMPOSITION.** 2–4

A study of the principles of effective written communication. Particular attention is given to logical organization of papers and to precise and coherent expression of facts and opinions. Numerous papers are required.

E37 **PUBLIC SPEAKING.** 3–3

Principles of effective oral communication: instruction in the delivery, content, and logical development of subject matter; individual training in the extemporaneous and impromptu speech situation; and practice and individual criticism.

E38 **PUBLIC SPEAKING.** 3–3

This is a continuation of E37, but it may be taken separately with the permission of the instructor. The content and organization of subject matter; emphasis on delivery; and practice in specific speech situations: group discussions, sales talks, speeches to entertain, introduce, and present or receive an award, welcome and response, expert witness, and chairman or master of ceremonies.

H1 **PHILOSOPHY AND SCIENTIFIC METHODOLOGY.** 2–4

A study of the nature of science and scientific inquiry, and of philosophy and its problems: the language problem in science and philosophy; the subject matter of logic; the nature and role of induction and deduction, "facts," hypotheses, laws; experimental methods, prediction, and operational definition; science as a description of experience; scientific law as explanation; critical evaluation of scientific results. Lectures will be implemented by discussion of various key concepts from the physical and biological sciences—their role in science and the light they shed on philosophical problems.

H2 **AMERICAN CHARACTER AND INSTITUTIONS.** 2–4

A study of the role of technology and technological innovation in shaping social institutions and influencing the formation of American character. Consideration will be given to the impact of technology on social organization, social changes, group solidarity, status and mobility, urbanization, family, and personality formation.

H11, H12 **FOUNDATIONS OF WESTERN CIVILIZATION.** 3–5, 3–5

A survey of man's attempts to work out answers to his perpetual questions about himself, his fellows, his universe, and his God, with careful reading of selected classics in history, literature, and philosophy, class discussions, and intensive writing exercises. The work concentrates on selected periods in history—in the First Term Fifth Century Athens and medieval Christendom, and in the Second Term the 16th Century crises of Renaissance and Reformation and science and the secular state in the 17th Century.

L21, L22 **SPOKEN GERMAN.** 3–3, 3–3

This is a two-term sequence for students with three years of high-school German, or the equivalent, but with little or no experience in using the spoken language. Recently developed techniques are used to convert reading knowledge into ability to comprehend the spoken language. Full use is made of mechanical devices for improving intonation and pronunciation. Emphasis is upon development of the basic vocabulary of words and phrases used in everyday conversation.

L61, L62 **SPOKEN FRENCH.** 3–3, 3–3

This is a two-term sequence for students with three years of high-school French, or the equivalent, but with little or no experience in using the spoken language. It follows for French the pattern and methods described in L21 and L22, above.

M100 **ELEMENTARY NUMBER THEORY.** 2–4

The elementary theory of whole numbers includes such topics as divisibility, prime and composite numbers, greatest common divisors, solutions of equations in integers, the congruence notation and its application, and sums of squares.

M11 **CALCULUS.** 3–6

The fundamental ideas of differential and integral calculus: differentiation and graphical representation of algebraic functions and of the sine and cosine; integration of simple algebraic and trigonometric functions; applications to problems in geometry and mechanics: maxima and minima, velocity and acceleration, plane areas, volumes, arc length, areas of surfaces of revolution, center of gravity, and moment of inertia; analytic geometry of the straight line and the conic sections.

M12 **CALCULUS.** 3–6

Further study of differentiation and integration: trigonometric, inverse trigonometric, exponential, logarithmic and hyperbolic functions; polar coordinates and parametric representation; complex numbers; and elementary vector analysis in the plane.

AS11, AS12 **AIR SCIENCE.** 3–0, 3–0

Study of the fundamentals of aviation and aerodynamics, global geography, international tensions and security organizations, and the military's function in national policy; and training in military drill and courtesy.

MS11, MS12 **MILITARY SCIENCE.** 3–0, 3–0

Basic training is provided in drill, the school of the soldier, exercise of command, military organization, American military history, individual weapons and marksmanship, and the United States in world affairs.

NS11, NS12 **NAVAL ORIENTATION AND HISTORY OF SEA POWER** 4–5, 4–5

Fundamentals of naval knowledge. Concepts of the use of sea power from geographical, geopolitical, and national strategic considerations. Historical influence of sea power in shaping world affairs socially, politically, and economically.

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JEROME HAZELTON BARRAFORD, B.S.
Assistant Superintendent of Buildings and Power

EDWARD THOMAS PIEPER, B.A., S.B.
Assistant Superintendent of Buildings and Power

MILES PAYNE COWEN
Assistant to the Superintendent of Buildings and Power

THEODORE JORDAN
Assistant to the Superintendent of Buildings and Power

MARK JOHN DONDERO, B.S.
Safety Engineer

HAROLD EMIL DREYER, PH.D.
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JAMES JOSEPH FANDEL, B.A., M.S.
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JOSEPH FRANCIS O'CONNOR, A.B.
Assistant to the Personnel Officer

FRANK MOFFETT BALDWIN, A.B.
Director of Dining Services

HENRY KENNETH DOW, A.B.
Manager of the Dormitories

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RALPH THEODORE JOPE, S.B.
Director, Development Office

WALTER HENRY GALE, S.M.
Special Assistant

JOHN WESLEY SHEETZ, III, S.M.
Executive Secretary for Development

JOHN JAMES ROWLANDS
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JOHN ISHAM MATTILL, M.A.
Director of Publications;
Assistant to the Director of Public Relations

WALTER LING MILNE, A.M.
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VOLTA WRAY TORREY, A.B.
Director of Television

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Assistant to the Dean of Students

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ARTHUR LAWRENCE TOWNSEND, S.B.
Director of the Lowell Institute School

THE FACULTY

as of April 1, 1957

INSTITUTE PROFESSORS

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ISIDOR ISAAC RABI, PH.D. *(Visiting)*
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JOHN CLARKE SLATER, PH.D., SC.D.

AERONAUTICAL ENGINEERING

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Executive Officer

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Lecturer

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Professor of Aircraft Engines

JOHN RAYMOND MARKHAM
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SHATSWELL OBER, S.B.
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KAY FISKER
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Professor of Physical Chemistry
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WALTER HUGO STOCKMAYER, PH.D.
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Professor of Chemistry
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LLOYD RODWIN, PH.D.
Associate Professor of Land Economics
KEVIN ANDREW LYNCH, B.C.P.
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CIVIL AND SANITARY ENGINEERING

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WALTER CHARLES VOSS, S.M.
Professor of Building Construction, Emeritus; Lecturer
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Professor of Sanitary Engineering
ARTHUR THOMAS IPPEN, PH.D.
Professor of Hydraulics
ROLF ELIASSEN, SC.D.
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CLAIR NATHAN SAWYER, PH.D.
Professor of Sanitary Chemistry

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Professor of Hydraulics
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Assistant Professor of Surveying
SAUL NAMYET, S.B.
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ECONOMICS AND SOCIAL SCIENCE

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CHARLES POOR KINDLEBERGER, PH.D.
Professor of Economics
MAX FRANKLIN MILLIKAN, PH.D.
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Professor of Economics (Visiting)
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FOOD TECHNOLOGY

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Professor of Biochemistry of Nutrition
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WALT WHITMAN ROSTOW, PH.D.
Professor of History
ERNST LEVY
Professor of Music
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Professor of English
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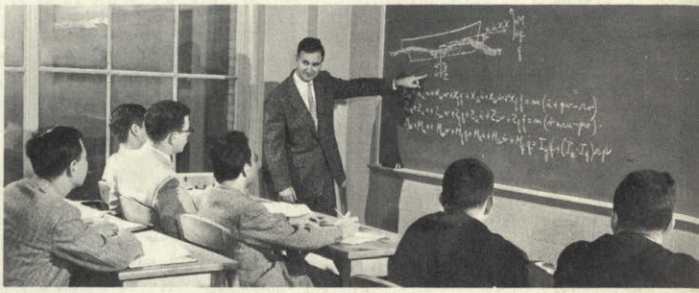

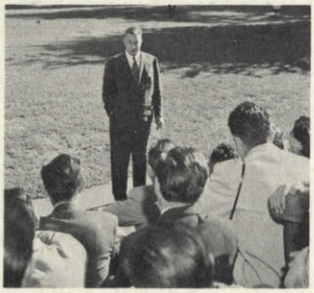

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