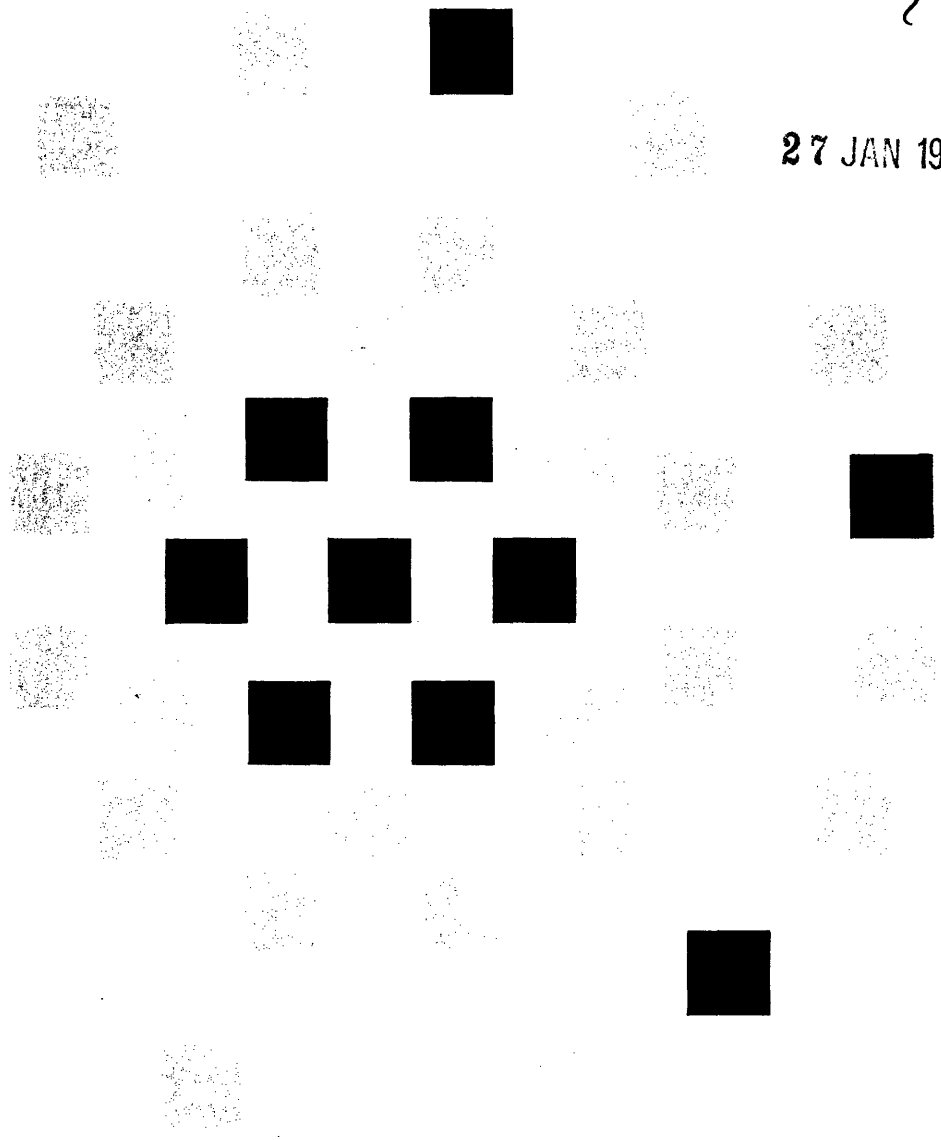
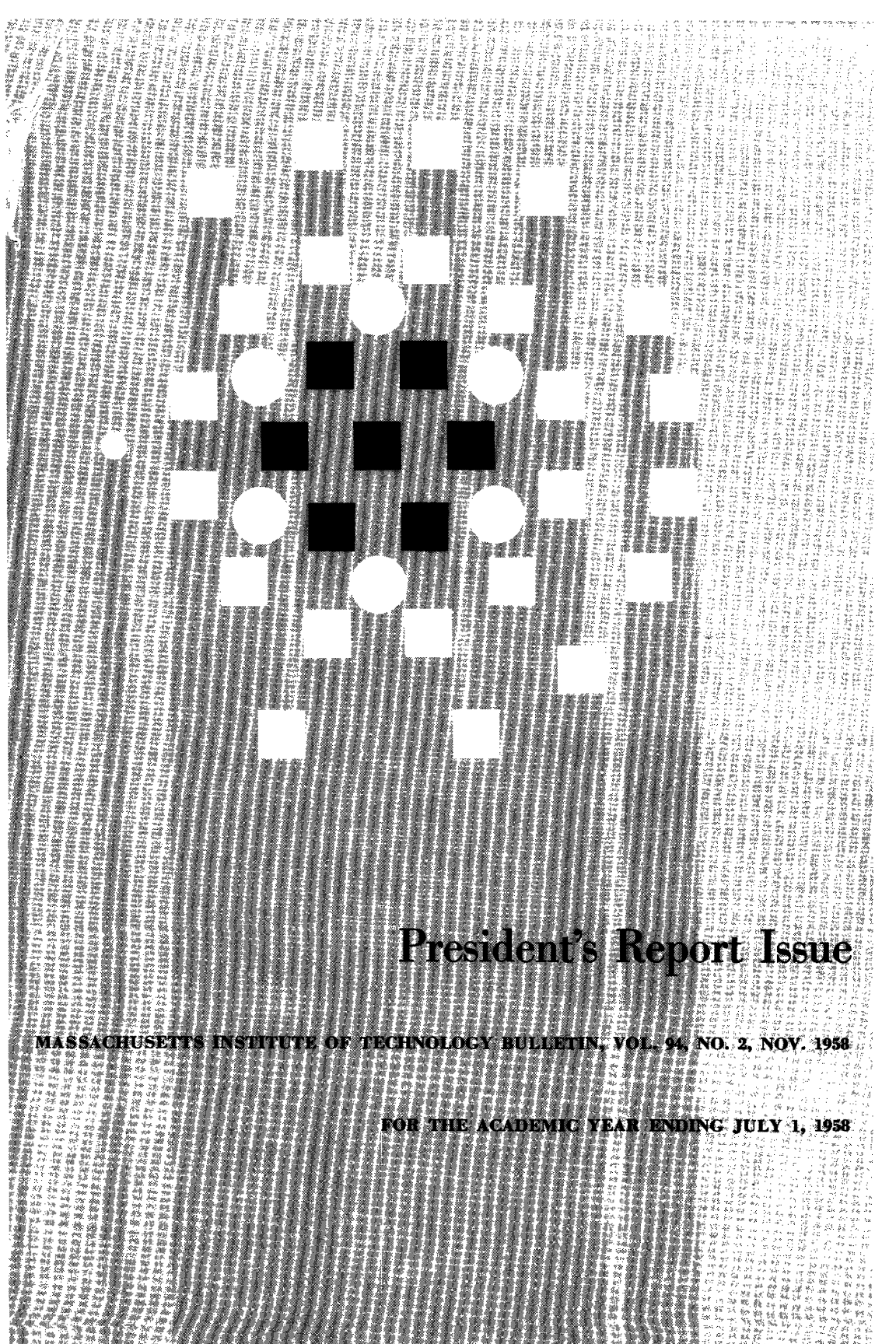


President's Report Issue, 1958

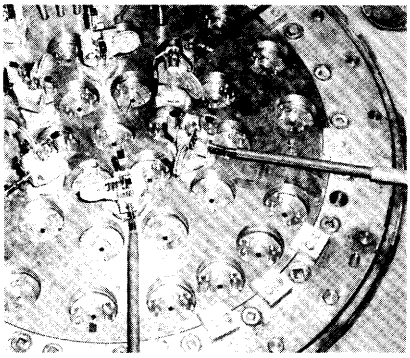
MASSACHUSETTS INSTITUTE OF TECHNOLOGY BULLETIN



President's Report Issue

MASSACHUSETTS INSTITUTE OF TECHNOLOGY BULLETIN, VOL. 94, NO. 2, NOV. 1958

FOR THE ACADEMIC YEAR ENDING JULY 1, 1958



THE COVER design is based on the arrangement of fuel elements and control rods in core of the M.I.T. nuclear reactor, which first "went critical" in July, 1958. The reactor itself, centered in an air-tight vault of concrete and steel, is shown on page 14, and other views appear on page 20.

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***the* PRESIDENT'S REPORT**
***the* SUMMER SESSION CATALOGUE**
***the* GENERAL CATALOGUE**
***and* THE UNDERGRADUATE CATALOGUE**

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Report of the President

To Members of the Corporation:

I have the honor to present this annual report on the state of the Massachusetts Institute of Technology.

The most significant event of the academic year 1957–58 was the appointment last November of Dr. James R. Killian, Jr., as Special Assistant for Science and Technology to the President of the United States. He was called to Washington at a moment when M.I.T. was most in need of his great, constructive energy. But on the larger national scene, his departure reflected a mounting concern for the state of science in this country. It was evidence of a new national awareness that the hopes for our survival as a free and prosperous nation rest in large measure upon the quality of our education and upon our capacity for scientific research.

Political and economic developments of the past decade, and particularly those of recent months, have had a profound influence upon the growth and character of the Institute. It is inevitable that we should respond sharply to these great events, for M.I.T. moves in the midstream of modern life. Indeed, the salient quality of

our philosophy of education, of the methods and substance of our teaching, and of our attitude toward public responsibility is a sense of direct relevance to the world and to the times in which we live. This relatedness to the world of action as well as to the world of thought brings to us a variety of problems and responsibilities seldom found within the confines of a university. It imparts an intensity to the life of the institution that at times has seemed excessive; in compensation there are but few of us, whether students or faculty or staff, who fail to respond to the challenge of participating in a great enterprise or who remain unmoved by the sense of excitement that comes with work in the front lines.

M.I.T. has served and will continue to serve the nation effectively in many ways. Members of our faculty and administration have made countless personal contributions to the public interest — many of them at a sacrifice to professional advancement. Theirs is a superb record of achievement and public spirit. Laboratories such as Instrumentation and Lincoln are playing a key role in the development of an adequate national defense. The Schools of Science and Engineering have made notable additions to our understanding of the basic laws and processes of the physical world, and are pursuing imaginative explorations of their application.

Toward Excellence in Education

Public service, defense research, and the broad advancement of scientific knowledge are essential parts of the total mission of M.I.T. But we bear ever in mind that our first obligation, our foremost concern, must be for the education of our students. If there is any one thing which events of the past year have made clear, it is the imperative need to augment the corps of highly educated

men and women in the United States. This need is apparent in every field of professional endeavor. Nowhere is it more critical than in science and engineering. The quality and fruitfulness of American research through the coming decades, the character of industrial statesmanship a generation hence, will be determined by the wisdom and effort we show now in the education of our youth. M.I.T., in the years ahead, can hope to supply only a diminishing fraction of the total number of scientists and engineers essential for the political and economic security of this country, for no private university can keep pace in its growth with this expanding need. There rests upon such institutions as ours, however, a heavy responsibility to provide highest standards of excellence, to set new patterns, to give leadership, and to lift the sights of all.

Four Years to Span a Gulf

The most fundamental problem, and the most difficult with which to cope, is the widening gap between the mean level of academic achievement in the average American secondary school on the one hand and the intellectual maturity of our top graduate professional schools on the other. For at least thirty years, the foremost departments of science and engineering in the United States have compared favorably at the graduate level with the best to be found in Europe. But we can make no such claim for our high schools. This is the gulf that must be bridged in the brief span of four undergraduate years.

For an extended period of our national development this discrepancy had no serious consequence. Relatively few undergraduates chose science as a profession; and among those who did, a considerable number supple-

mented their basic training with advanced study abroad. With a few notable exceptions, serious research and development in industry, as currently conceived, were unknown. The basic engineering needs of the country could be met by four-year college graduates with a good grasp of physics, chemistry, and elementary calculus to bolster their professional subjects and shop practice. But the Second World War and the more recent political developments abroad have brought to light our urgent need for scientists and engineers with a complete command of all the knowledge and techniques necessary to advance science and to exploit it to the utmost for our own use.

As a consequence, the task of bringing even the most talented undergraduate student, in four years, to such a point of intellectual maturity that he may deal effectively either with the requirements of the top-rate graduate school or with the pressures of modern industry is a great and difficult one.

But the need is also great, and the country looks to M.I.T. and to its sister institutions for leadership.

The basic step toward alleviating some of the pressures on undergraduates in professional schools must eventually be taken within the high schools themselves, and our colleges should join forces in a national effort to lift the levels of achievement in elementary science and mathematics. In this connection, the Institute can be particularly proud of the contributions being made to the teaching of high school physics by the Physical Science Study Project, under Professor Jerrold R. Zacharias.

Realistically, however, it may be many years before we can count upon the kind of rigorous training in our secondary schools that is expected of every candidate for admission to a French, German, or Russian technical institute or university. In the interim, we must accept

the preparation of the entering freshman as it in fact is. Our task is to develop his confidence as well as his competence and to feed the flame of his interest as he masters the fundamentals.

Toward Independence and Responsibility

The plight of the average undergraduate in any first-class technical school is further aggravated by the fact that he usually expects the same spoon-feeding system of education that marked his secondary schooling. He needs time to understand that from now on he must be his own teacher. It is the true function of a university to inspire the student; to provide him with abundant examples of significant scholarship; to counsel him on the direction and progress of his studies; to furnish him with the most ample resources of library and laboratory; and to afford him the incalculable benefit of intimate association with first-class minds.

The typical entering freshman at M.I.T. is far from ready to cope with such a mature concept of learning. The transition at best is certain to be painful, but we must keep steadfast our aim to help each individual student achieve as easily and rapidly as possible his highest intellectual potential and to develop fully his capacity to pursue a free and independent way.

Finally, in our assessment of undergraduate life at M.I.T., we must take account of the fact that the Institute itself is evolving rapidly into a new kind of university. There was a time, not so many years ago, that our activities were centered almost exclusively in undergraduate education. This is no longer true; today's undergraduate feels himself anywhere but at the center of this particular academic universe. Almost daily in the

press he reads accounts of Institute activities in which he has had no part — which he may even assume are entirely foreign to his own interests. He learns of celebrated professors who are members of our faculty but whom he has not yet met, and he feels that he has missed a fair share of his educational experience. And finally, for many a freshman, a most serious disorienting factor is the discovery that instead of being at the top of his class in a local high school, he is now only one among many exceptionally able students.

These are some of the basic conditions that temper the environment of our undergraduates, conditions which we must deal with realistically if we are to strengthen our educational base. Here M.I.T. has, I am convinced, not only an overriding responsibility but also an extraordinary opportunity.

A Richer Community Experience

This year there have been many new plans and new experiments designed to improve the effectiveness of instruction in many departments. This is a never ending task, and the Institute must be prepared to devote substantial resources to research in teaching and to the development of our undergraduate laboratories. There is much still to be done to stimulate interest in the teaching problem and to reward those who teach with skill and devotion.

But while these measures are important, I think that there is an even more immediate need to convey to the undergraduate a keener sense of belonging, of personal participation in the great enterprise which is M.I.T. A year ago, Dr. Edwin H. Land dealt with this problem in his stimulating and provocative Arthur D. Little Lecture.

A variety of interesting projects are being discussed by members of our faculty, all with the common aim of bringing undergraduates into association sooner with the senior members of our academic community. It is my sincere hope that these ideas will bear fruit.

As a corollary to these developments in classrooms and laboratories, we must take steps to enrich the campus life beyond the provision of bed, roof, and board. The residential program ought to make a major contribution to the intellectual and moral development of all students; and it can, aided by those activities, cultural and otherwise, which do so much to make college life a memorable experience.

Two Views of Engineering Education

Among the current discussions of educational policy at the Institute, none is more complex nor more important than that dealing with trends in engineering education. The issues involved are of fundamental significance, as any action M.I.T. ultimately takes to resolve them will largely determine the Institute's future character and set an example which may affect materially the course of engineering education in the United States.

There are two basic positions. I am tempted to refer to them as the liberal, or radical, and the conservative. These designations are neither quite accurate nor perhaps entirely fair to the respective protagonists, but they are convenient for our present purpose. There are also, of course, a number of people in the middle, or "independents."

The extreme liberal party contends that the traditional curricula of engineering schools are essentially obsolete. They point out that industry itself has passed

beyond the stage of simple technology and into a domain of enormously complex problems. As we all know, the industrial importance of research and development has been vastly enhanced. But wholly apart from the laboratory, the engineer today has to deal with a wide range of subjects, which may include such diverse fields as materials, fluid flow, combustion, or information theories. Whatever it may be, he is unlikely to make important contributions in these areas without the benefit of fundamental and thorough training in physics, chemistry, and mathematics.

As a consequence, no one disputes the new status of research in industry or the need to enlarge the professional group of applied scientists competently trained to work on these new frontiers. The real question at issue is whether or not M.I.T. may be shaping its undergraduate curriculum too strongly in this direction, to the disadvantage of other facets of the engineering profession taken in its entirety. Specifically, how far should we go in discarding all the drafting and design, the shop, and the more practical, immediately useful professional subjects?

On this question our liberal friends argue that the whole broad field of technology is now advancing at such an accelerating pace that the best undergraduate education in engineering will steep the student in basic science and in the true fundamentals of his future profession, leaving him free to decide after his bachelor's degree whether to pursue a career in research, development, design, or industrial management. On this hypothesis an undergraduate curriculum in engineering, centered increasingly in science, mathematics, the basic professional subjects, and the humanities, would approach

more nearly the counterpart of liberal education which is the foundation of the professions of medicine and law.

But against this argument our conservative wing — and this includes many of our alumni as well as some of the most thoughtful members of our faculty — raises certain serious objections. Granted that engineering rests squarely on science and mathematics, the function of the engineer in society nonetheless differs profoundly from that of the pure scientist. The engineer outside the research laboratory experiences a very different relation to his client or to his firm. He is invested with a different kind of responsibility. He is called upon for a variety of judgments and decisions that are normally foreign to the affairs of scientists. At every point his thinking is tempered by questions of cost and reliability and the problems of maintenance and replacement. These modes of thinking and working, quite different from the methods used to solve differential questions, must be instilled in the student at the earliest possible stage of his development. These are the attributes that will distinguish the builders of industry in the future, even as they have in the past.

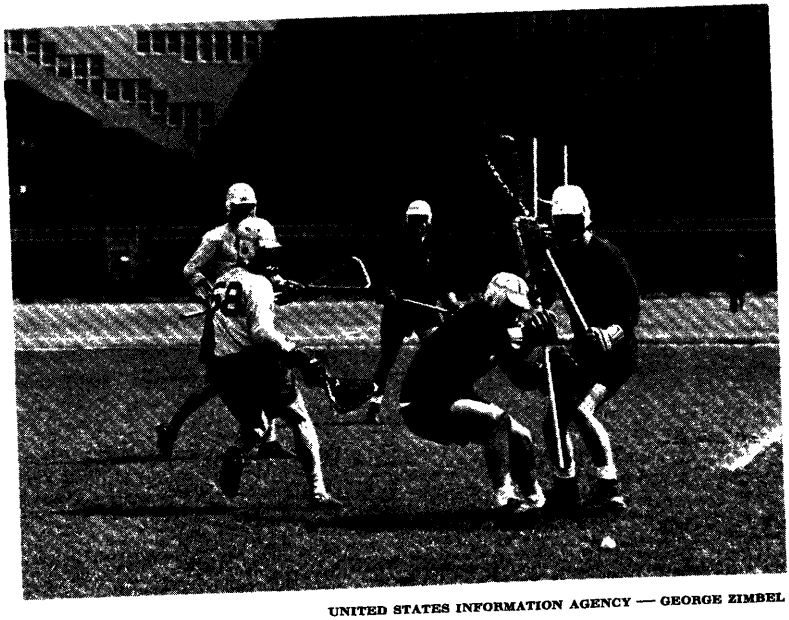
The apparently easy way to resolve these contending views is to say that the country needs both types of leaders — the applied scientist, and the more empirical engineer. In this belief, many engineering schools within the past few years have introduced a new curriculum designated, for lack of a better term, as "engineering science." M.I.T. itself has undertaken its share of experimentation in this area. The Department of Electrical Engineering, for example, has instituted a Course, Electrical Science and Engineering, which has a strong emphasis on physics and mathematics; and several other departments have plans for comparable options. An

ad hoc committee on engineering education has also considered the desirability of experimenting with an entirely new course in engineering science distinct from our existing departments.

However, the more deeply one delves into these difficult questions, the more elusive the answers appear, the less easy their resolution. There is a serious objection, for example, to concentrating a faculty of applied science in a single new department, for this concentration obviously must take place at the expense of our present fields of specialization. Doubts also have been expressed as to whether, in the long run, parallel options — one centered in applied science and the other expressing the more traditional approach to engineering education — can successfully coexist with one another in a single department.

And there are even more critical questions for the long-range future of M.I.T.: What effect, for example, will an increasing emphasis upon mathematical ability have upon the character and quality of the students admitted to our freshman class? Have we unwittingly engaged in a selective process that may work to the ultimate disadvantage of the engineering profession itself?

Clearly these issues in engineering education are of consuming importance, both to M.I.T. and the country. Clearly they are difficult to resolve. It is reassuring, therefore, to observe the vigor and insight with which our engineering faculty is attacking them.



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" . . . activities which do so much to make college life a memorable experience."

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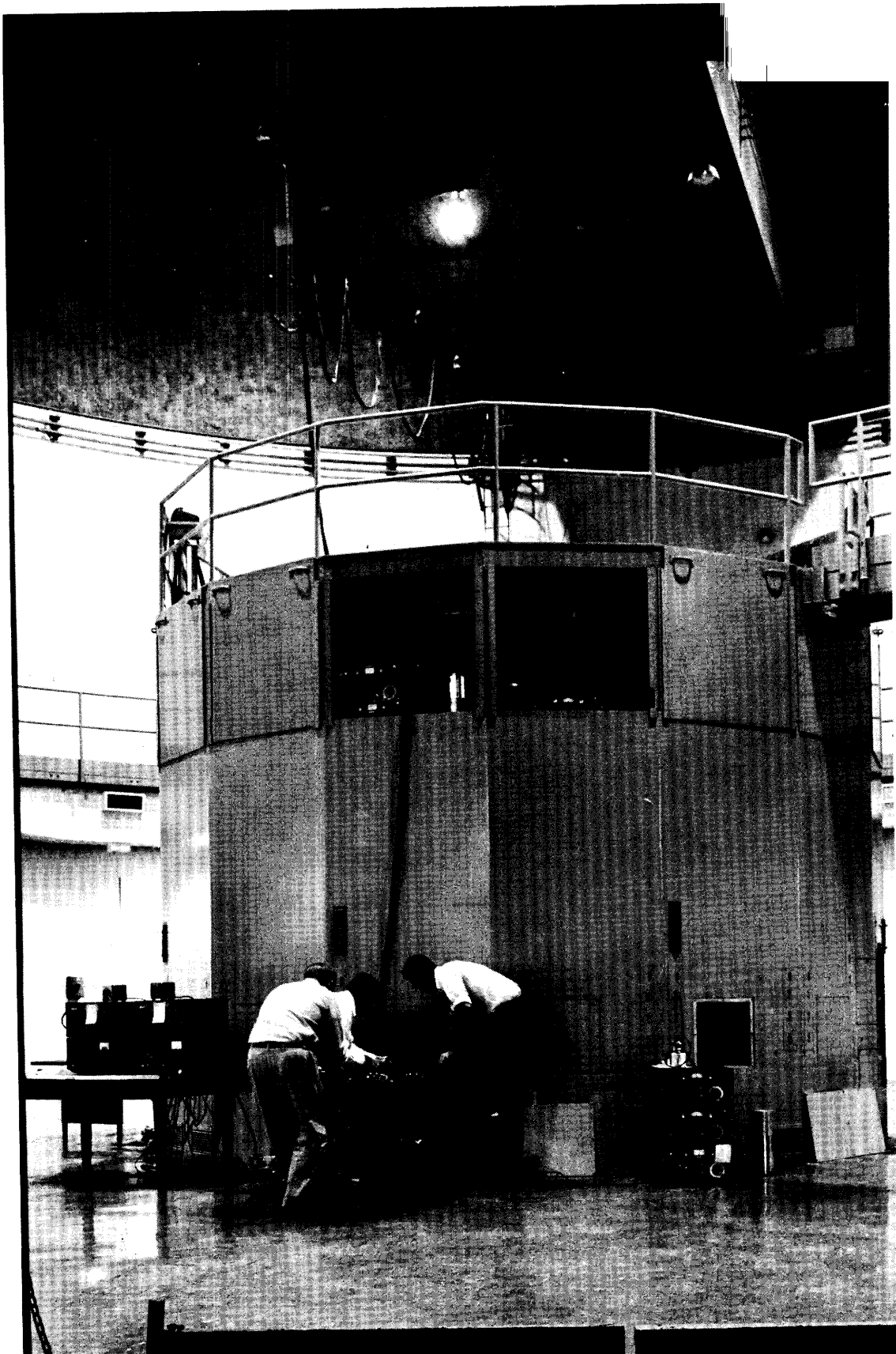
" . . . to enrich the campus life . . . to make a major contribution to the intellectual and moral development of all students."



THE YEAR IN REVIEW

From a long list of notable achievements, changes, and events of the past year, I select the following for special mention:

Some Educational Advances and Opportunities

1. To meet the changing needs of our technological society, there has been at the Institute this year, as I have described earlier in my Report, a ferment of re-examination and experimentation with the educational program in all schools.

In the School of Engineering, the Faculty Committee on Engineering Education has continued its comprehensive review of our various undergraduate curricula. Some of the areas being studied are: the factors determining a student's choice of an engineering profession, the possibilities of a tutorial system, the replacement of requirements with electives in the last two years, and better opportunities for the gifted student to do independent research. In addition, two separate committees are now also evaluating the role of applied science in engineering education and in the general field of materials, both in teaching and research. These are studies of first-order importance.

In the School of Science, the trend towards flexibility is reflected in modifications of several undergraduate curricula. The Biology Department has broadened the scope of its subjects in biophysics to make them suitable for all science majors. The Mathematics Department has made a thorough reorganization of its course

offerings in order to furnish stronger mathematical training for engineers and scientists who are continuing beyond the normal three-semester sequence in calculus. The Meteorology Department is providing needed integration between theoretical and experimental aspects of meteorological study, particularly regarding the possibilities of large-scale control of weather and climate. The Physics Department has devoted major efforts to improving its undergraduate program in order to provide better training, not only for engineers and scientists, but also for those students who want to enter the teaching profession at either the high school or college level.

The School of Industrial Management has continued to enrich its curriculum so that all its students — ranging from the beginning students in management in the undergraduate Program to the corporate officers in the Senior Executive Program — have intimate contact with the applications of science and engineering to the many complex elements of modern management. The use of high-speed computers, emphasis on economic forecasting, study of policy determinants, evaluation of various factors in the control and direction of finance, and a deeper understanding of society and man himself are only some of the major areas in which research and teaching are now being undertaken by the School.

The faculty and Corporation have authorized the awarding of the degree of Doctor of Philosophy in City and Regional Planning. Graduate and advanced study in this important field was greatly enhanced by the establishment during the year of the Center for Regional and Urban Studies, under the direction of Professor Lloyd Rodwin. Research will focus upon the physical environment of cities and regions, the forces that shape them, and the interrelationships between urbanization and society.

The Institute's programs in political science, both graduate and undergraduate, continue to gain momentum. Dr. Francis O. Wilcox, Assistant Secretary of State, was among special lecturers in 1957–58.

In the School of Humanities and Social Studies, the authorization to award the degree of Doctor of Philosophy in Political Science will open the way for advanced work in such important areas as national security, military technology, and public administration, areas in which the Institute offers unique opportunities for study. M.I.T.'s program in political science is based on a dual recognition: political developments today are heavily influenced by technology; and educated man, regardless of profession, must become more familiar with public policy questions.

It is generally agreed that Americans today must seek an improvement, too, in their ability to use and to understand foreign languages. To help meet this critical need, the Department of Modern Languages has expanded its program in Russian, German, and French language and literature. There is increased emphasis upon the spoken word rather than upon grammar and translation.

2. The activities in nuclear engineering, which until now have been a part of the Chemical Engineering Department, were organized during the year into a graduate Nuclear Engineering Department under the

direction of Professor Manson Benedict. While reactor technology and fission now dominate the program, the new group is already active in fusion and thermonuclear reactions. The unfolding activities here and in the related field of gas dynamics will bring together in a joint undertaking several of the departments of both the School of Engineering and the School of Science.

3. During the past year we have established a Center for Communications Sciences, to engage in research in the broad field involving the processing and transmission of information in both man-made and living systems. By providing basic research through collaborative efforts among mathematicians, electrical engineers, physicists, linguists, psychologists, physiologists, and others, we will be able to make notable advances in this challenging area of information theory pioneered by such M.I.T. scientists as Vannevar Bush and Norbert Wiener.

4. The Physical Science Study Project, under the direction of Professor Zacharias assisted by Professor Francis Friedman, has continued to expand its work in planning a new approach to the teaching of physics in the secondary schools. During the summer of 1958, some 350 additional teachers were trained in the aims and methods of this new curriculum, and it is expected that some 12,000 students will be taught the new program this year. Negotiations have been completed to transfer, with the assistance of the National Academy of Sciences, the Institute's major administrative responsibility for the project to Educational Services, Inc., a nonprofit corporation.

5. After a comprehensive study, the faculty has voted to modify the compulsory first two years of R.O.T.C., beginning with the Class of 1962. This action places all military training at the Institute on a voluntary basis

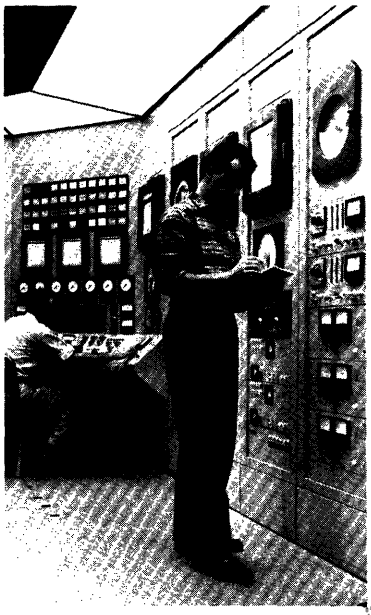
and should produce a better qualified and more enthusiastic corps of reserve officer trainees.

6. The Computation Center, made possible by the International Business Machines Corporation, completed its first year of operation in June. Using its great digital computer (I.B.M. Type 704), the Center has furthered M.I.T.'s pioneering work in data processing, automation, and computation. It is almost impossible to suggest in brief the breadth of research which has been carried out at the Center. This research has covered both the physical and social sciences, ranging from numerical weather predictions to the machine translation of languages. The Center has also provided important educational opportunities: during the year, at least six academic departments have used the computer in their curricula.

New Facilities

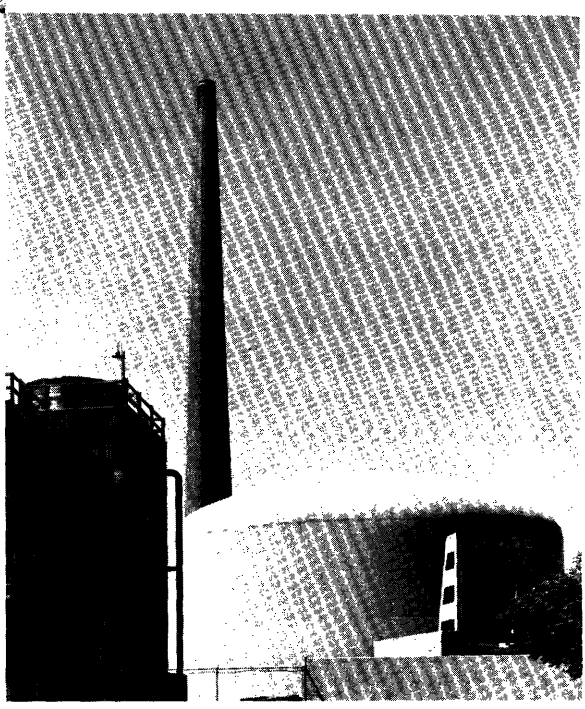
During the year, the Institute moved forward with important additions to its resources for education and research.

Of prime importance is the $3,000,000 nuclear reactor, which "went critical" during the summer. The first privately owned heavy water reactor in the United States, it is one of the most versatile ever constructed for research and teaching purposes and will furnish nuclear particles and radioactive materials for research in medicine and industry, as well as in the basic sciences. By providing students with first-hand experience with fission energy, the reactor will be the chief laboratory facility of the Institute's new Department of Nuclear Engineering. It may well become a prime agency for the training of young men who will be leaders in developing the peacetime uses of atomic energy.



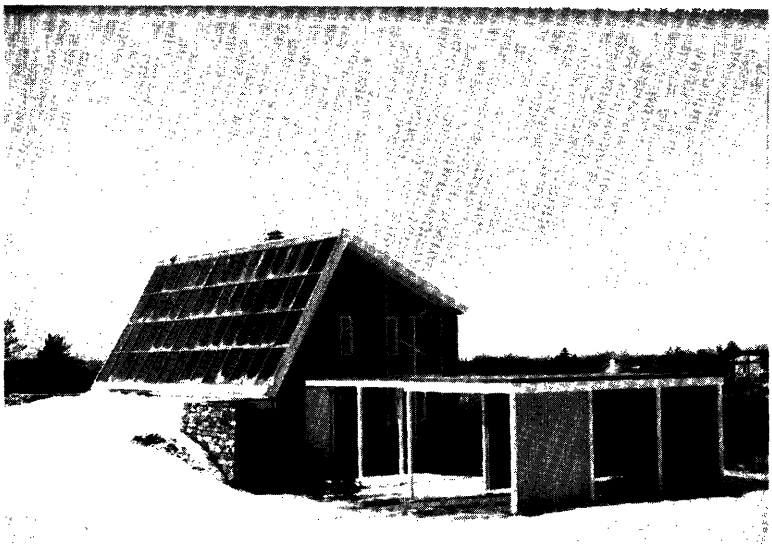
From this instrument center, operators have full control of the reactor's activity.

The nuclear reactor makes a dramatic new landmark on the Cambridge skyline.



At groundbreaking ceremonies, the staff of the Athletic Department mounted the pile driver to demonstrate their enthusiasm for the new David Flett du Pont Memorial Athletic Center.

New athletic and recreational facilities will greatly strengthen the Institute's physical education program. Foremost in importance of the year's developments has been the start of construction of the David Flett du Pont Memorial Athletic Center on the West Campus. An $800,000 building, it will provide added space for intercollegiate sports, six squash courts, facilities for women, and a locker room for faculty members. Twelve new tennis courts, which were an integral part of the bequest of David du Pont '56, have already been completed; and tennis, both in intercollegiate and in intramural competition, has become one of the popular athletic and recreational activities on the M.I.T. campus. With the acquisition and renovation of the Cambridge Armory on Massachusetts Avenue, the Institute has achieved for the first time in its history adequate gymnasium space for intramural sports. The old drill floor alone has provided two indoor tennis courts, eight badminton courts, and four volleyball courts.



BERNARD P. SPRING

This sun-heated house which began operation last winter will add still more to what is known about engineering this practical application of the sun's vast energy.

New quarters for the religious counselors of the Institute were provided with the acquisition of a private dwelling at 317 Memorial Drive. This attractive house, with adequate provision for seminar facilities and located in the dormitory area adjacent to the Chapel, has given a physical unity and strong stimulus to our religious counseling program.

Sponsored Research

The Institute has always accepted sponsored research projects as an integral part of its educational system. Such work, whether in the campus or in the defense laboratories, provides unusual opportunities for both graduate students and faculty to participate in research at the frontiers of their respective fields. We recognize also that urgent demands will be made upon our resources in times, such as the present, when the safety and strength of the free world depend so greatly on advanced science and technology. Such responsibilities we continue to accept on a selective basis, when the work is in fields in which the Institute has particular competence and which will benefit our educational mission.

A major organizational move during the year, designed to promote this trend, has been the cooperative effort of M.I.T. and the Department of Defense in the formation of Mitre, a new independent, nonprofit corporation to undertake a major advisory role in the systems engineering of the country's air defense. Much of this responsibility, relating to the electronic ground environment of air defense, has previously rested on the Lincoln Laboratory. One objective of this organizational move is to permit the Lincoln Laboratory to devote more of its time to the type of advanced research which fits most naturally and productively into the scheme of an educational institution.

It seems imperative, however, that some form of long-term funding of government-sponsored research programs be adopted with ample warning of termination. The present system of funding on an annual basis is not suitable for colleges and universities where educational programs are of necessity arranged by academic terms. If there is to continue an urgent need for academic contributions to defense research, then surely there is an equally urgent need for review of this problem by the government itself.

The past year, reflecting the state of national need, has witnessed an increase both in cash expenditures and in numbers of staff personnel for our research projects. However, the Acoustics Laboratory and the Dynamic Analysis and Control Laboratory were disbanded during the year as administrative units, although several of their programs of research have been continued in academic department projects.

The Instrumentation Laboratory of the Department of Aeronautical Engineering, moving steadily into the "space age," accelerated its research and development work in guidance and controls systems for satellites and

ballistic missiles, including the Navy's "Polaris." An important contribution has been the development of devices for inertial navigation by submarines on extended underwater cruises. Such systems have special importance for operation under the polar ice cap, where magnetic readings are extremely ineffective. Under the leadership of Professor Charles S. Draper, Director of the Laboratory, a major and vigorous basic research program is being undertaken on the future needs of astronautical navigation.

A coast-to-coast flight guided solely by inertial navigation equipment developed in the Instrumentation Laboratory was the feature of a 1958 national television show narrated by Eric Severeid of CBS-Television (left).

At the Lincoln Laboratory, the year was marked by significant new advances in fundamental research and by substantial progress in the development of the SAGE System and in other extensions of air defense technology. Existence of two kinds of excitons in germanium has been quantitatively established for the first time, using infrared measuring techniques and powerful magnetic fields. These new techniques may well serve to open up a new field in solid state spectroscopy.

The first full sector of the SAGE System for air defense of the continental United States went into operation in June, 1958, for the improved protection of the New York-Philadelphia area. By far the largest information processing and control system ever attempted, SAGE utilizes a network of large digital computers teamed with skilled operators to sift out potentially hostile aircraft from tens of thousands of daily routine flights and to direct interceptors and missiles against the enemy. Initially proposed by Lincoln in 1953 on the basis of previous studies at M.I.T., the development of this system has been a major activity of the Laboratory in the intervening years.

This is but a sampling of the many developments coming out of our large industrial and government-sponsored research laboratories.

Corporation, Faculty, and Administration

With deep sorrow I must record the passing of two distinguished members of the Corporation, both of whom gave the Institute long years of counsel and service: Dr. Gerard Swope '96 and Dr. Willis R. Whitney '90, both Emeritus Life Members.

Several changes have affected the membership of the Corporation during the past year. We look forward with pleasure to long and pleasant associations with the following men, some of whom will be new to the Corporation's rolls: General James H. Doolittle '24, Vice President of Shell Oil Company; Clarence D. Howe '07, Chancellor of Dalhousie University and Canadian Minister of Defense Production from 1951 to 1957; and George M. Humphrey, Chairman of the Executive Committee of the National Steel Corporation and Secretary of the Treasury from 1953 to 1957, have been elected Life

Members of the Corporation. Cecil H. Green '23, Chairman of the Board of Geophysical Service, Inc., and Clarence H. Linder, Vice President of General Electric Company, have been appointed Special Term Members. The Alumni Association has elected three of their number to Alumni Term Membership: Donald W. Douglas '14, Chairman of the Board of Douglas Aircraft Company; Robert C. Gunness '34, Executive Vice President of the Standard Oil Company of Indiana; and Gilbert M. Roddy '31, President of Boston Manufacturers Mutual Insurance Company and Mutual Boiler and Machinery Insurance Company. John J. Wilson '29, Director of Minneapolis-Honeywell Regulator Company, also joins the Corporation as the new President of the Alumni Association.

Expiration of term membership has cost us the association of Dr. Theodore P. Ferris, Rector of Trinity Church in Boston; and Edwin D. Ryer '20, Director of Barbour-Stockwell Company.

I should like to pay special tribute to the highly effective services rendered by members of the Corporation throughout the year. Some two-thirds of the active membership attended each of the four regular meetings. In addition, twenty of the twenty-six Visiting Committees under their direction met to discuss and examine the affairs of the several academic and service departments. The wisdom and counsel of these men have provided a superb measure of trustee responsibility in both guiding and stimulating the many activities of the Institute.

It is with regret that I report the death of two members of the faculty during the year: Professor William A. Wilson of the Department of Mechanical Engineering and Assistant Professor Stuart Edgerly of the Department of Humanities.

Five members of the faculty reached the Institute's mandatory retirement age at the end of the past academic year: Professor George C. Manning and Associate Professor Evers Burtner of the Department of Naval Architecture and Marine Engineering; and Professor Leicester F. Hamilton, Professor Avery A. Morton, and Professor Walter C. Schumb of the Department of Chemistry. We shall miss these colleagues in the years ahead, although, happily, several of them will remain with us as Lecturers.

Among the honors which have come to members of the faculty during the past year are the following: Membership in the National Academy of Sciences to Professors Thomas K. Sherwood (chemical engineering) and Martin Deutsch (physics); the Gold Medal of the American Society of Metals to Professor John Chipman (metallurgy); the Gold Medal of the American Petroleum Institute to Professor Warren K. Lewis (chemical engineering); the Holley Medal of the American Society of Mechanical Engineers to Professor Charles S. Draper (aeronautical engineering); the Kamerlingh Omnes Gold Medal of the Dutch Society for Refrigeration to Professor Samuel C. Collins (mechanical engineering); the John Jeppson Gold Medal of the American Ceramic Society to Professor W. David Kingery (metallurgy); the first Ruzicka Award in Chemistry to Professor George H. Büchi (chemistry). Professor Richard Filipowski of the Department of Architecture won the top award in sculpture at the Boston Arts Festival during the past summer. Many of our staff and faculty were honored by lectureships and travel grants, among them Gregory Tucker, Lecturer in Music, who received a Guggenheim grant to study and compose in Italy.

During the year several important administrative changes were made, including the appointment of Pro-

fessor Joseph H. Keenan to succeed Professor Jacob P. Den Hartog as Head of the Department of Mechanical Engineering. Professor Den Hartog will devote full time to teaching and research, as a member of the faculty.

At the end of the fall semester, Professor Ralph E. Freeman retired as head of the Department of Economics and Social Sciences after twenty-five years of service in that post. We are fortunate in having as his successor Professor Robert L. Bishop, an economist of distinction, who for the past ten years has been a member of the Department.

Professor Howard W. Johnson has been appointed Associate Dean of the School of Industrial Management to succeed Professor Douglass V. Brown, who had agreed to serve in this post on a short-term basis. Professor Johnson brings to his new position a wealth of experience gained in industry and as Director of the Executive Development Programs at M.I.T. since 1955.

I am particularly delighted to report also the appointment of Professor Howard R. Bartlett as the Master of Burton House, beginning with the fall semester. This is the first step in a plan by which all dormitories will have resident masters and tutors for the guidance and counseling of students. In addition, various members of our faculty will be invited to participate as nonresident associates in student affairs in the dormitories. We are delighted to have Professor Bartlett, who has been a member of the Department of Humanities since 1929, as leader in this new program.

The M.I.T. Community

One of the most important developments at the Institute in recent years has been the growing breadth and depth of activities that enrich its daily life. M.I.T. truly is a

stimulating academic community in which to live and to work, with a host of exciting experiences which are shared by students and staff alike.

During the past twelve months, visitors came from every continent, not only to contribute to our many professional activities but also to observe and to learn. Among our visitors I list, almost at random, a few of the distinguished men who have been our colleagues, seminar speakers, and guest lecturers: Professor Howard W. Emmons of Harvard University as the Jerome Clarke Hunsaker Professor of Aeronautical Engineering; Dr. Arthur Kantrovitz, Director of AVCO Research Laboratory, as Visiting Institute Professor and Fellow of the School for Advanced Study; Dr. Armand Borel of the Technische Hochschule in Zurich, Switzerland, as Visiting Professor of Mathematics; Dr. Derek H. R. Barton as the Arthur D. Little Visiting Professor of Chemistry; Dr. Yngve Larsson of Stockholm, Sweden, as Visiting Lecturer in City Planning under a grant of the Robert D. Kohn Fund; Lewis Mumford as Albert Farwell Bemis Visiting Professor of Architecture; Dr. Pierre Aigrain, Professor of Physics at the École Normal Supérieure in Paris, as the Edwin S. Webster Professor of Electrical Engineering; and Dr. Leo Szilard of the University of Chicago as the Arthur D. Little Memorial Lecturer.

This past fall marked the initiation of the Karl Taylor Compton Lectureship, established in honor of the former President and Chairman of the Institute. We were extraordinarily honored that Dr. Niels Bohr, Nobel Laureate and Head of the Institute of Theoretical Physics at the University of Copenhagen, was the first holder of the Compton Lectureship. In a memorable series of six lectures, Dr. Bohr summarized philosophical conclusions reached through his long studies in physics.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Dr. Bohr generously made himself available to students and faculty alike during his month of residence on the campus, providing for our entire community a warm friendship with one of the great minds of all times.

". . . a warm friendship with one of the great minds of all time."

In addition, more than six hundred other guests representing foreign and domestic governments and industries have received the hospitality of the Institute during the past year. These many visitors continue a tradition of interchange which is at the heart of all professional advance.

As usual, it has been the Institute's pleasure to entertain a number of professional conferences and meetings. We are particularly fortunate in having both Kresge Auditorium and the Endicott House available for such purposes. Last fall the Department of Electrical Engineering conducted a one-week Curriculum Workshop under the joint sponsorship of the National Science Foundation, the General Electric Company, and the

PHILIP LIEBERMAN '57

Westinghouse Corporation. Over one hundred sister educational institutions sent delegates to study, criticize, and evaluate new methods of teaching electrical engineering pioneered by members of our faculty. In November, the Industrial Relations Section celebrated its twentieth anniversary with a conference for over two hundred distinguished guests, including the Honorable James P. Mitchell, Secretary of Labor. Last winter the Biophysical Society convened its second national meeting at the Institute with some five hundred attendants to hear two hundred technical papers. A two-day symposium for New England newspapermen, under the joint sponsorship of Harvard University and M.I.T., was planned to provide an up-to-date background for science reporting.

PHILIP LIEBERMAN '57

DAVID W. BAKER '61

The Honorable James P. Mitchell (above), Secretary of Labor, was principal speaker at the 1957 conference marking the twentieth anniversary of our Industrial Relations Section.

Thanks in large measure to the superb facilities provided by Kresge Auditorium and the Chapel, the Institute has enjoyed a rich and varied cultural program during the past twelve months. Professional events have included a concert by the Boston Symphony Orchestra; the Juilliard String Quartet; the Pauk Quartet of Budapest; and a piano concert by Professor Ernst Levy. In a special chamber music concert, a group of musicians from the Boston Symphony Orchestra presented "Façade," with poems by Edith Sitwell and music by William Walton.

A mainstay of our musical life continues to be the excellent programs offered by student groups, including the Concert Band, the Brass Choir, the Symphony Orchestra, and the Choral Society. The latter performed *The Messiah* in its original form and in the spring sang *The Transfiguration Cantata* of Alan Hovhaness, with the composer conducting. Fritz Buechtger, prominent German twelve-tone composer, also directed the Choral Society in the first American performance of his *Resurrection According to St. Matthew.* During the summer the Society made a European tour which included performances at the American Pavilion in Brussels, at Paris, and at a number of cities in West Germany.

Student interest and activity in dramatics continue to grow. The productions by the student Dramashop this year included Shakespeare's *Richard II* and E. E. Cummings' satirical comedy, *Him.* The final evening of the year presented three original one-act plays written and directed by our undergraduates. In addition, the Celebrity Series brought to the campus outstanding personalities and events of the theatre. This year's highlight was the presentation of *Othello* by the Canadian Players of Stratford.

As usual, the Museum Committee, under the imaginative direction of Professor Herbert L. Beckwith of the Department of Architecture, brought a number of distinguished exhibitions to the galleries of the Institute. Besides the regular pedagogical shows, the series included an exhibition of nineteen portraits by the great German expressionist, Max Beckmann; a handsome collection of modern European glass design; and a special showing of photographs by Gjon Mili '27 on M.I.T. subjects, some of which are reproduced elsewhere in this report.

A STATISTICAL ABSTRACT

In 1957–58 the student body numbered 6,179, as compared with 6,000 in 1956–57. We estimate that enrollment this fall will be about 6,200. Veterans numbered about 6 per cent of the total enrollment as compared with 8 per cent the year before. In 1957–58, 21 per cent of our students were married, an increase of 3 per cent over the previous year. One hundred and twenty-two women were enrolled, fifty-nine of whom were graduate students.

Enrollment in the graduate school was 2,515. There were 140 officers from the United States armed services enrolled for advanced degrees.

Students enrolled at M.I.T. during 1957–58 held degrees from 484 other colleges and universities, 297 American and 187 foreign. Total foreign student population was 732, representing about 12 per cent of the total student body. These were citizens of sixty-eight different countries.

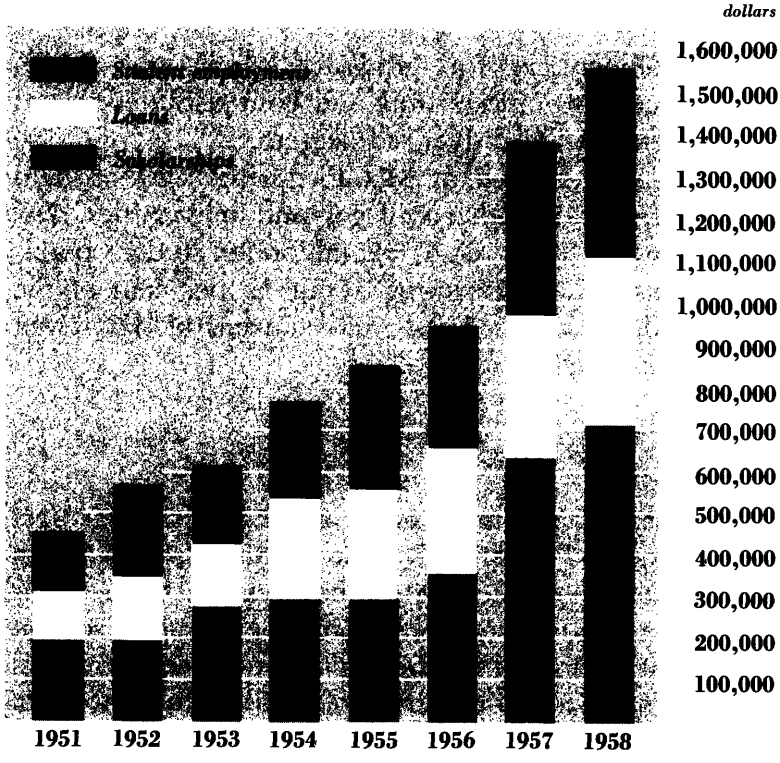
Student Aid

Total financial assistance given to M.I.T. students last year amounted to slightly more than $2,400,000, an increase of 15 per cent over the previous year. This increment was due to the cumulative effect of several important factors, including gifts and bequests from alumni and friends and the use of Institute funds to meet special demands.

Financial assistance to undergraduates totaled nearly $1,600,000, bettering by some $200,000 the recorded help for the previous year. Specifically, $710,530 was granted in scholarships; $397,087 in loans; and $482,000 earned in part-time employment around the campus.

At the same time, financial support to our graduate students showed only a slight increase over the record amount given in 1956–57. In all, the Institute awarded 206 fellowships totaling $385,988 and 93 scholarships valued at $126,987. Loan funds assisted 203 students to its amount of $113,112. Including staff awards for

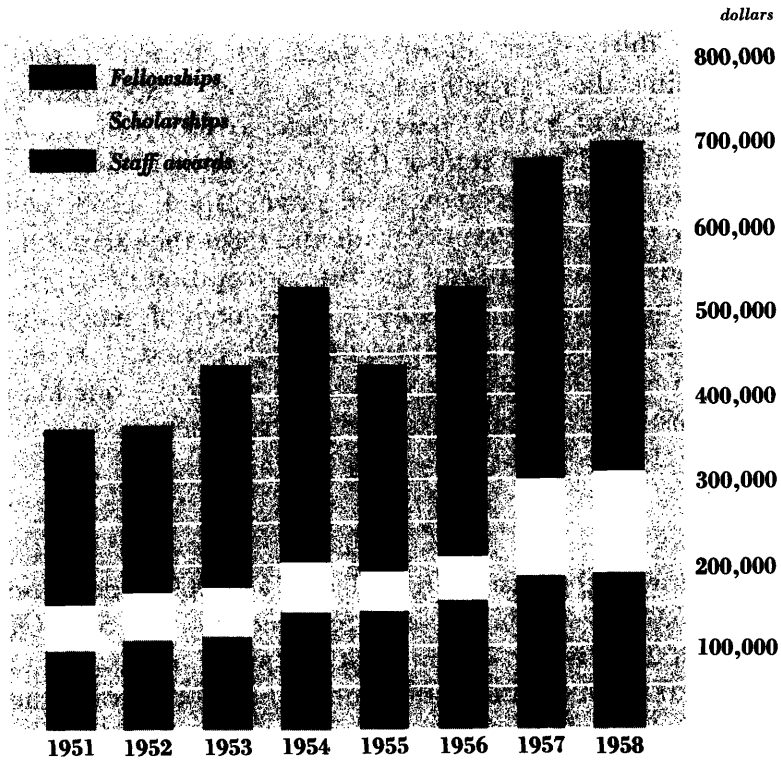
FINANCIAL AID TO UNDERGRADUATE STUDENTS



teaching and research, grants last year totaled $813,839.

It is gratifying to note that at the close of the fiscal year (June 30, 1958) the capital of the undergraduate scholarship funds totaled $5,425,000, an increase of almost $400,000 or 8 per cent over a year ago. This growth resulted from some twenty bequests and gifts including new capital funds from Evert W. Freeman '20, Humphrey M. Haley '04, Bancroft Hill '11, William E. Stevens '98, Archer E. Wheeler '95, George H. Rand, and Gustaf R. Lindberg. Additional gifts to previously established permanent funds were made by Paul W. Litchfield '96 and John J. Wilson '29.

FINANCIAL AID TO GRADUATE STUDENTS



During the past decade, the total of our endowment for scholarships has doubled and so has apparently kept pace with changes in tuition. But because of increases in the size of the undergraduate body, the incremental gain in both capital and income has not kept up with demands for assistance. At the present time we are assisting through scholarship aid only 22 per cent of our undergraduates, a percentage relatively low compared to other ranking educational institutions. Our need for augmented scholarship endowment funds is urgent.

The concern for scholarship aid should not overshadow the substantial help made available by our loan fund program, which is one of the most successful and probably the largest administered by any educational institution. Each year, increasing demands are made upon our loan resources. Last year, for the first time in nearly thirty years of operation, we loaned a total exceeding the half-million dollar mark. Specifically, loans totaling $510,919 were made to 662 individuals representing 13 per cent of the entire student body.

Administrative changes effective July 1, 1958, will serve to strengthen the program and meet the increasing demands by accelerating the rate of rotation of capital funds and insuring the complete repayment of maximum amount loaned within a twenty-year period. At the same time — for the first time in its history — our loan fund becomes available to entering freshmen.

Gifts

Gifts during the past year totaled $7,732,000, a decrease of $766,000 from the amount received in 1956–57. Of this total, gifts for endowment purposes amounted to $1,138,000, including substantial bequests from the estates of Frank Hanchett and Hazel Hanchett Harvey

for the Walter R. Hanchett Fund, and a sum of $145,000 from Archer E. Wheeler for a scholarship fund.

The Donner Foundation of Philadelphia generously awarded the Institute a grant of $500,000 to establish an endowed professorship in natural science. Dr. Claude E. Shannon of the Departments of Electrical Engineering and Mathematics has been appointed the first holder of the Donner Chair of Science.

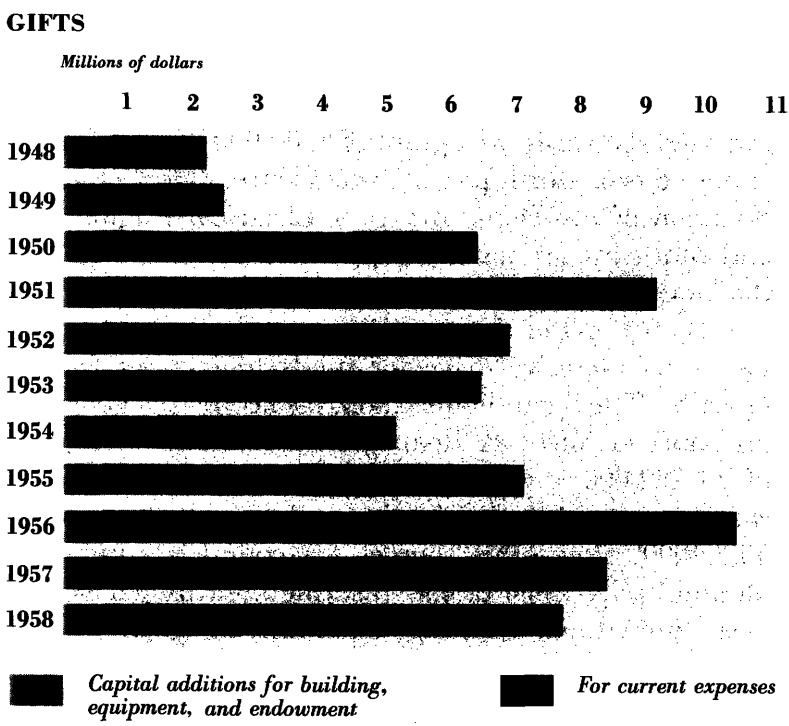
By the end of the academic year the Institute completed its intensive drive for funds to increase faculty salaries. The Sloan Foundation, backed by the generous assistance of Alfred P. Sloan, Jr. '95, had offered a grant of $1,250,000 towards a $5,000,000 fund for faculty salaries, provided the Institute obtain the remaining $3,750,000 from other sources. A countless number of alumni and friends of the Institute contributed generously to the fund, enabling us to reach the goal.

Alumni were directly responsible for gifts to the Institute of $2,452,000 during the past year. Over thirteen thousand individuals contributed $445,194 to the Alumni Fund for further designation by its Fund Board.

Corporate support of the Industrial Liaison Program totaled $1,188,000, as given by ninety different companies. It is very heartening to receive such generous support in spite of the generally unfavorable economic outlook that has prevailed throughout the past few months.

Finances

During 1957–58 the Institute's academic expenses, not including funds expended on sponsored research, amounted to $20,905,000, approximately 7 per cent more than the preceding fiscal year. This increase resulted primarily



from the improved salary and wage structure for faculty and other employees of the Institute.

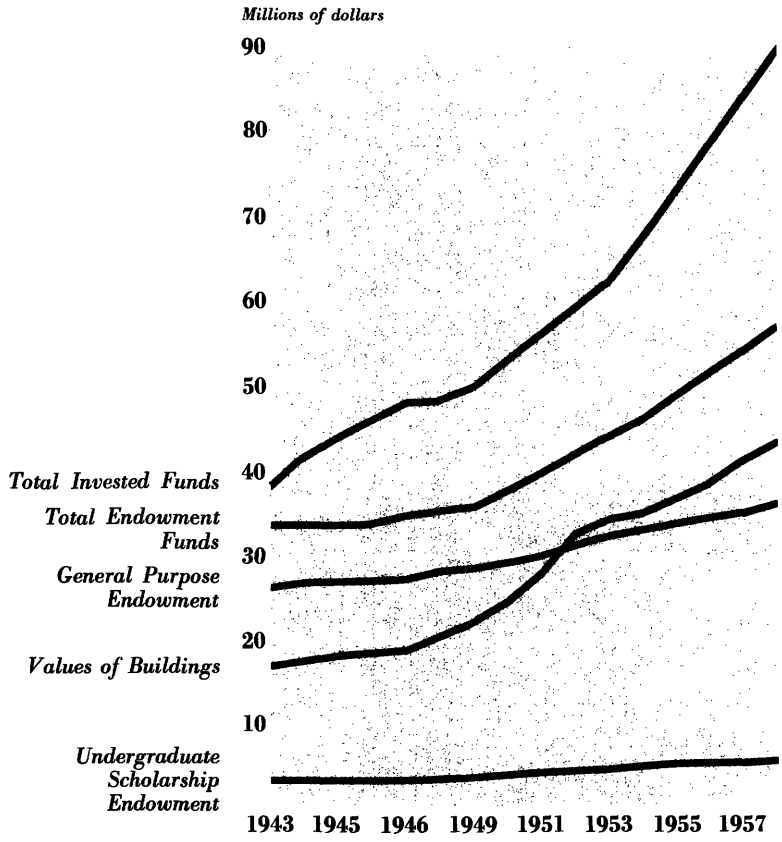
Sponsored research represented an expenditure of $54,344,000, an increase of 12 per cent over the fiscal year 1956–57. Many of these projects are clearly integrated with the teaching programs of the academic departments, particularly at the graduate level. A substantial portion of the Institute's general, administrative, and plant operating expense consists of indirect costs stemming from the sponsored research program. Such costs, however, are reimbursed by allowance received under contracts for the various projects.

The Institute's investments have a total book value of $89,267,000 and a market value of $132,150,000, as of

June 30. Educational plant assets stand at $43,251,000, about 4.7 per cent greater than a year ago.

The rate of income earned in 1957–58 on the funds sharing in the general investments was 6.2 per cent on the average book value, compared with 6.14 per cent the preceding year. Of this, 5.5 per cent was allocated to the funds. The total income on the general and special investments was $4,548,000, as compared to $4,263,000 in 1956–57.

THE GROWTH OF M.I.T.'S FUNDS AND PLANT



After long and careful consideration, we have increased the tuition for all students from $1,100 to $1,300 per academic year, beginning with the fall semester of 1958. This step was necessitated by the steadily rising costs of operation. Even at the new rate of tuition, the student will pay considerably less than half the actual cost of his education. To alleviate the immediate impact of the tuition change, substantial increase in scholarship and loan assistance has been provided. It is our firm intent that no student presently enrolled should find it necessary to leave for financial reasons related to the tuition increase.

IN CONCLUSION

In presenting this report, I speak not only for myself but also for my many associates and colleagues, for this is a record of their ideas and accomplishments. Our most priceless assets are embodied not in brick and mortar; rather, they lie in the many individuals who form this common enterprise that is M.I.T. I am particularly grateful for the splendid manner in which the Corporation, the faculty, and the student and alumni bodies rally together, as they have this year, with enthusiasm and loyalty to maintain the driving force and ever-increasing excellence of our institution.

J. A. STRATTON

PERSONNEL CHANGES TO JULY 1, 1958

CORPORATION

Deaths

Gerard Swope, EMERITUS LIFE MEMBER
Willis R. Whitney, EMERITUS LIFE MEMBER

Term Expirations

Theodore P. Ferris, SPECIAL TERM MEMBER
James H. Doolittle, ALUMNI TERM MEMBER
Clarence D. Howe, ALUMNI TERM MEMBER
Edwin D. Ryer, ALUMNI TERM MEMBER
Gilbert M. Roddy, PRESIDENT OF THE ALUMNI ASSOCIATION

Appointments

George M. Humphrey, LIFE MEMBER
James H. Doolittle, LIFE MEMBER
Clarence D. Howe, LIFE MEMBER
Cecil H. Green, SPECIAL TERM MEMBER
Clarence H. Linder, SPECIAL TERM MEMBER
Donald W. Douglas, ALUMNI TERM MEMBER
Robert C. Gunness, ALUMNI TERM MEMBER
Gilbert M. Roddy, ALUMNI TERM MEMBER
John J. Wilson, PRESIDENT OF THE ALUMNI ASSOCIATION

FACULTY

Deaths

Charles B. Breed, PROFESSOR EMERITUS IN CIVIL ENGINEERING
William H. Lawrence, PROFESSOR EMERITUS IN ARCHITECTURE
Waldo V. Lyon, PROFESSOR EMERITUS IN ELECTRICAL ENGINEERING
William A. Wilson, PROFESSOR IN MECHANICAL ENGINEERING
Stuart Edgerly, ASSISTANT PROFESSOR IN HUMANITIES

Retirements (WITH TITLE PROFESSOR EMERITUS)

Leicester F. Hamilton, PROFESSOR IN CHEMISTRY*
George C. Manning, PROFESSOR IN NAVAL ARCHITECTURE
Avery A. Morton, PROFESSOR IN CHEMISTRY
Walter C. Schumb, PROFESSOR IN CHEMISTRY*
Evers Burtner, ASSOCIATE PROFESSOR IN NAVAL ARCHITECTURE*

** Will continue as Lecturer in 1958–59*

Resignations

Karl W. Deutsch, PROFESSOR IN HUMANITIES

Clair N. Sawyer, PROFESSOR IN CIVIL ENGINEERING

Carl W. Wagner, PROFESSOR IN METALLURGY

Archibald W. Adkins, ASSOCIATE PROFESSOR IN MECHANICAL ENGINEERING

Leo L. Beranek, ASSOCIATE PROFESSOR IN ELECTRICAL ENGINEERING *

Clark Goodman, ASSOCIATE PROFESSOR IN PHYSICS

Thomas F. Jones, ASSOCIATE PROFESSOR IN ELECTRICAL ENGINEERING

Alexander Kusko, ASSOCIATE PROFESSOR IN ELECTRICAL ENGINEERING *

William K. Linvill, ASSOCIATE PROFESSOR IN ELECTRICAL ENGINEERING

Gordon J. F. MacDonald, ASSOCIATE PROFESSOR IN GEOLOGY

E. Eugene Allmendinger, ASSISTANT PROFESSOR IN NAVAL ARCHITECTURE

J. Perry Barger, ASSISTANT PROFESSOR IN CHEMICAL ENGINEERING

William H. Ceckler, ASSISTANT PROFESSOR IN CHEMICAL ENGINEERING

Amelio M. d'Arcangelo, ASSISTANT PROFESSOR IN NAVAL ARCHITECTURE

Martin Dyck, ASSISTANT PROFESSOR IN MODERN LANGUAGES

Joseph D. Everingham, ASSISTANT PROFESSOR IN HUMANITIES *

Robert B. Fetter, ASSISTANT PROFESSOR IN INDUSTRIAL MANAGEMENT

Thomas P. Goodman, ASSISTANT PROFESSOR IN MECHANICAL ENGINEERING

Ingo Ingenohl, ASSISTANT PROFESSOR IN INDUSTRIAL MANAGEMENT

Andrew B. Jack, ASSISTANT PROFESSOR IN INDUSTRIAL MANAGEMENT

James D. Koerner, ASSISTANT PROFESSOR IN HUMANITIES

Robert A. Lauderdale, Jr., ASSISTANT PROFESSOR IN CIVIL ENGINEERING

Norman H. Meyers, ASSISTANT PROFESSOR IN ELECTRICAL ENGINEERING

Henry M. Morgan, ASSISTANT PROFESSOR IN MECHANICAL ENGINEERING

Frederick W. Nesline, Jr., ASSISTANT PROFESSOR IN ELECTRICAL ENGINEERING

* *Changed to Lecturer*

Capt. Jack A. Obermeyer, PROFESSOR IN NAVAL ARCHITECTURE
Stylianos D. Pezaris, ASSISTANT PROFESSOR IN ELECTRICAL ENGINEERING
Warner R. Schilling, ASSISTANT PROFESSOR IN ECONOMICS
David A. Stevenson, ASSISTANT PROFESSOR IN METALLURGY
Arnold R. Weber, ASSISTANT PROFESSOR IN ECONOMICS
Morton G. Wurtele, ASSISTANT PROFESSOR IN METEOROLOGY
Victor H. Yngve, ASSISTANT PROFESSOR IN MODERN LANGUAGES*

Promotions

Professor Manson Benedict, TO HEAD OF THE DEPARTMENT OF NUCLEAR ENGINEERING
Professor Robert L. Bishop, TO HEAD OF THE DEPARTMENT OF ECONOMICS AND SOCIAL SCIENCE
Associate Professor Howard W. Johnson, TO ASSOCIATE DEAN OF THE SCHOOL OF INDUSTRIAL MANAGEMENT
Professor Joseph H. Keenan, TO HEAD OF THE DEPARTMENT OF MECHANICAL ENGINEERING
Professor Claude E. Shannon, TO DONNER PROFESSOR OF SCIENCE

TO PROFESSOR:

E. Cary Brown, ECONOMICS
George H. Büchi, CHEMISTRY
Stephen H. Crandall, MECHANICAL ENGINEERING
David Durand, INDUSTRIAL MANAGEMENT
Francis L. Friedman, PHYSICS
David H. Frisch, PHYSICS
Myle J. Holley, Jr., CIVIL ENGINEERING
John W. Irvine, Jr., CHEMISTRY
Kenkichi Iwasawa, MATHEMATICS
Roy Lamson, HUMANITIES
Daniel Lerner, ECONOMICS
Ithiel deS. Pool, ECONOMICS
Robert M. Solow, ECONOMICS
C. Gardner Swain, CHEMISTRY
Theos J. Thompson, NUCLEAR ENGINEERING
David C. White, ELECTRICAL ENGINEERING

* ***Changed to Research Associate***

TO ASSOCIATE PROFESSOR:

Clyde M. Adams, Jr., METALLURGY
Albert Bush-Brown, ARCHITECTURE
David O. Caldwell, PHYSICS
Alfred D. Chandler, HUMANITIES
Noam A. Chomsky, MODERN LANGUAGES
Melville Clark, Jr., NUCLEAR ENGINEERING
Morton Finston, AERONAUTICAL ENGINEERING
Frederick D. Greene, CHEMISTRY
Hermann A. Haus, ELECTRICAL ENGINEERING
John G. King, PHYSICS
William L. Letwin, INDUSTRIAL MANAGEMENT
Robert W. Mann, MECHANICAL ENGINEERING
Ross E. McKinney, CIVIL ENGINEERING
Erik L. Mollö-Christensen, AERONAUTICAL ENGINEERING
Jurgen K. Moser, MATHEMATICS
Robert C. Reid, CHEMICAL ENGINEERING
Isadore M. Singer, MATHEMATICS
Leon Trilling, AERONAUTICAL ENGINEERING
John S. Waugh, CHEMISTRY

TO ASSISTANT PROFESSOR:

Albert K. Ando, ECONOMICS
Victor L. Andrews, INDUSTRIAL MANAGEMENT
Dudley A. Buck, ELECTRICAL ENGINEERING
John C. Chato, MECHANICAL ENGINEERING
Edward A. Crocker, ATHLETICS
Charles M. Gray, HUMANITIES
Elias P. Gyftopoulos, ELECTRICAL ENGINEERING
Imre Halasz, ARCHITECTURE
Laurence C. Hoagland, MECHANICAL ENGINEERING
Ronald A. Howard, ELECTRICAL ENGINEERING
Harry Hughes, GEOLOGY
Ralph C. James, Jr., ECONOMICS
Paul R. Johannessen, ELECTRICAL ENGINEERING
Theodore R. Madden, GEOLOGY
Arthur P. Mattuck, MATHEMATICS
Charles W. Merriam, III, ELECTRICAL ENGINEERING
Charles R. Niehaus, HUMANITIES

Albert H. Nuttall, ELECTRICAL ENGINEERING
Irwin A. Pless, PHYSICS
Norman C. Rasmussen, NUCLEAR ENGINEERING
Herbert H. Richardson, MECHANICAL ENGINEERING
Rolf P. Scharenberg, PHYSICS
Joseph L. Smith, Jr., MECHANICAL ENGINEERING
Bernard P. Spring, ARCHITECTURE
James M. Symons, CIVIL ENGINEERING
Seth P. Tillman, ECONOMICS
David R. Whitehouse, ELECTRICAL ENGINEERING
William A. Youngblood, ELECTRICAL ENGINEERING
Zenon S. Zannetos, INDUSTRIAL MANAGEMENT

Appointments

VISITING

Paul F. Chenea, WEBSTER PROFESSOR IN ELECTRICAL ENGINEERING
Frederick S. Dainton, ARTHUR D. LITTLE PROFESSOR IN CHEMISTRY
Erik H. Erikson, PROFESSOR IN ECONOMICS
John C. Fisher, III, PROFESSOR OF ENGINEERING
Guy C. Hirsch, PROFESSOR IN MATHEMATICS
Laurel J. Lewis, PROFESSOR IN ELECTRICAL ENGINEERING
Salvador E. Luria, PROFESSOR IN BIOLOGY
Nathaniel Rochester, PROFESSOR IN ELECTRICAL ENGINEERING
Robert H. Strotz, PROFESSOR IN ECONOMICS
George P. Sutton, HUNSAKER PROFESSOR IN AERONAUTICAL ENGINEERING
Herbert Freeman, ASSOCIATE PROFESSOR IN ELECTRICAL ENGINEERING
Vernon M. Ingram, ASSOCIATE PROFESSOR IN BIOLOGY
David S. Wood, ASSOCIATE PROFESSOR IN MECHANICAL ENGINEERING

PROFESSORS

Capt. Edward S. Arentzen, NAVAL ARCHITECTURE
Evsey D. Domar, ECONOMICS
Donald G. Marquis, INDUSTRIAL MANAGEMENT*

ASSOCIATE PROFESSORS

Daniel M. Holland, INDUSTRIAL MANAGEMENT
Alexander Rich, BIOLOGY
David J. Rose, NUCLEAR ENGINEERING

* *To start in 1959.*

ASSISTANT PROFESSORS

George E. Backus, MATHEMATICS
Jere H. Brophy, METALLURGY
Secor D. Browne, MODERN LANGUAGES
David M. Green, ECONOMICS
Martin Greenberger, INDUSTRIAL MANAGEMENT
Philip G. Hill, MECHANICAL ENGINEERING
Allan S. Hoffman, CHEMICAL ENGINEERING
William D. Jackson, ELECTRICAL ENGINEERING
Richard C. Jeffrey, ELECTRICAL ENGINEERING
Kenneth A. Johnson, PHYSICS
David H. Klipstein, CHEMICAL ENGINEERING
Thomas M. Lodahl, INDUSTRIAL MANAGEMENT
Arthur L. Loeb, ELECTRICAL ENGINEERING
John McCarthy, ELECTRICAL ENGINEERING
Charles M. Mohr, CHEMICAL ENGINEERING
Franklin P. Peterson, MATHEMATICS
Yasutoshi Senoo, MECHANICAL ENGINEERING
Walter R. Thorson, CHEMISTRY
George O. Totten, ECONOMICS

Changes of Appointment

Jacob P. den Hartog, TO PROFESSOR IN MECHANICAL ENGINEERING
Ralph E. Freeman, TO PROFESSOR IN ECONOMICS

Changes in Air, Military and Naval Science

APPOINTMENTS

Col. Frederic H. Fairchild, PROFESSOR IN AIR SCIENCE AND HEAD OF THE DEPARTMENT
Capt. Robert C. Shoemaker, ASSISTANT PROFESSOR IN AIR SCIENCE

PROMOTIONS

Capt. John M. Mays, TO ASSOCIATE PROFESSOR IN MILITARY SCIENCE
Capt. Edward P. Stefanik, TO ASSOCIATE PROFESSOR IN MILITARY SCIENCE

RESIGNATIONS

Col. Harmon Lampley, PROFESSOR IN AIR SCIENCE AND HEAD OF THE DEPARTMENT
Lt. Col. Donald S. Bowman, ASSOCIATE PROFESSOR IN MILITARY SCIENCE
Major Warren Rogers, ASSOCIATE PROFESSOR IN MILITARY SCIENCE
Capt. Harry J. Crook, Jr., ASSISTANT PROFESSOR IN AIR SCIENCE
Capt. Peter Hexner, ASSISTANT PROFESSOR IN MILITARY SCIENCE

ADMINISTRATION

Appointments

D. Hugh Darden, EXECUTIVE SECRETARY OF THE EDUCATIONAL COUNCIL AND ASSISTANT DIRECTOR OF ADMISSIONS
Winston R. Hindle, Jr., INDUSTRIAL LIAISON OFFICER
Malcolm D. Rivkin, PLANNING OFFICER
George D. Wood, Jr., ASSISTANT DIRECTOR OF PUBLIC RELATIONS

Leave of Absence

Robert M. Briber, ADMINISTRATIVE ASSISTANT TO THE PRESIDENT

Changes of Appointment

Carl T. Carey, Jr., TO ASSISTANT BURSAR
William Mackintosh, TO ASSISTANT TO THE TREASURER
R. Colin Maclaurin, TO ASSISTANT TO THE CHANCELLOR
Walter L. Milne, TO ADMINISTRATIVE ASSISTANT TO THE PRESIDENT

Resignation

David A. Dudley, ASSOCIATE DIRECTOR OF ADMISSIONS

School of Architecture and Planning

The philosophy of education of our School depends in part upon the type of students we are able to attract. The entrance standards of the Institute are of necessity based on aptitudes which may not be the most suitable for the architectural or planning professions. Furthermore, a natural inclination towards these professions is difficult to detect in the student's earliest years.

For this reason our School would welcome the establishment of a Junior Division, which would allow a two-year testing period, during which a young person could become more sure of his true vocation or make a change into other more congenial disciplines without loss of prestige. This system would also have the advantage of allowing transfer students to come into our School in a more orderly manner and have the Institute requirements more nearly tailored to their professional needs. The number of transfer students has been steadily growing; they have given excellent account of themselves, although they have been handicapped by standards designed more for engineers and scientists than for architects.

This system of Junior and Senior Divisions would have the added advantage of allowing for a better organized curriculum leading to a more desirable master's degree and even to a Ph.D. degree in architecture; it would also permit more favorable conditions for the reestablishment of undergraduate courses leading to the city planning degrees.

Looking towards greater effectiveness, our School feels the need for a summer campus where instruction in practice and materials may be possible, in a way that would be in character with the original Institute motto of "mens et manus." We believe that students need to supplement theory with experiments in structures, with knowledge of materials and techniques — a kind of instruction which is now sorely lacking in almost all schools because it takes away precious time from other more pressing intellectual efforts.

This summer program could be alternated with guided visits to important architectural or planning works in this country or abroad, thus imparting greater life and motivation to the educational program.

All of this of course would require an increase in the budget as well as more space. Even now, existing programs are gravely limited by lack of space, a condition which will inevitably become more acute in the near future.

Teaching Program — Architecture

Following faculty approval of the Department of Architecture's proposal for Field 10 — Visual Arts — as an elective sequence in the humanities, the new subjects were offered during 1957–58. The subjects in history and criticism of the arts under Professor Albert Bush-Brown were already in being as part of the curriculum in architecture, and all that was required was to broaden somewhat the objectives and to arrange to accommodate a larger number of students.

However, the subjects involving studio work in drawing and painting, under Professor Robert O. Preusser, were not only entirely new but in their nature required a departure from the lecture-conference-homework format that has been standard in the humanities at M.I.T. A minimum of six studio hours per week imposed scheduling difficulties. In the first term twenty students, representing fifteen departments, enrolled in Visual Design and were able to continue, while ten others had to withdraw because they were unable to meet the schedule. The second-term subject required the first term as prerequisite, and the enrollment shrank to nine. Consideration is being given to offering the beginning course in both terms in order to equalize teaching loads.

The Department is proud of this innovation and feels that its contribution to the general education of scientists and engineers will be valuable. Creative work by the first students in Field 10 was exhibited in April in the Hayden Library, thus associating this activity with the center of the humanities and museum programs.

In the spring of 1958, the Committee on Curricula approved a further addition to this sequence — The Architecture of Cities. This will be a lecture course in civic design, in which Joseph Hudnut (already on our staff as Lecturer for the freshman elective, Structure

of the City) will describe and interpret the cities of the Western world as communal works of art.

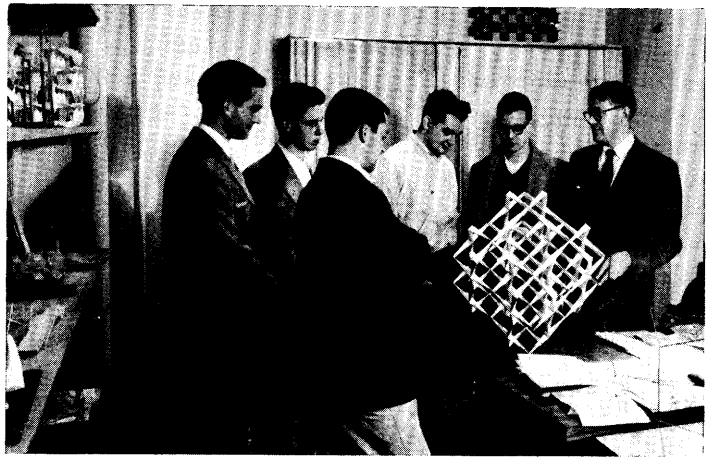
Carrying out earlier curricular plans, Professors Gyorgy Kepes and Preusser this year inaugurated a new subject for fifth-year students — Light and Color. Systematic studio experiments were carried out to show the extraordinary potentials of these intangible elements in design, while a series of guest lecturers conveyed a sense of the meaning of light and color from the points of view of their own disciplines.

Advanced students in the Department benefited greatly by the temporary lectureship of Giulio Pizzetti of Torino, whose course in structural mechanics was designed for both architects and engineers.

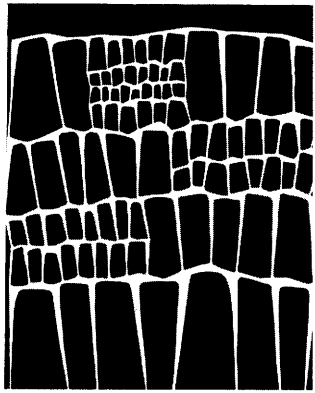
Progress was made toward formulation of research objectives in a proposed Structural Testing Laboratory. It is proposed to develop refined methods of manipulating scale models as an aid in the analysis of stress distributions in three-dimensional structures, complementing or at times replacing analysis by mathematical techniques. It is now generally agreed that architecture has been impoverished through disuse of vault structures which accurately express the channeling of the loads. In former times, tradition and intuition were a sufficient guide for the designer. Modern industrial economy, however, requires very precise prediction of structural behavior, so that redundant elements and quantities can be eliminated in the design stage. Elaborate mathematical procedures have been or can be developed to embrace any form; but their application is often cumbersome, and freedom to conceive organic structural solutions is thereby inhibited.

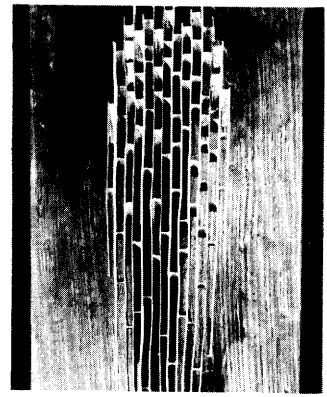
High development of the science of applied mechanics has been a factor in the increasing difficulty of mutual understanding between architect and engineer. We believe that since scale models are superior to mathematical formulas in their ability to represent visual qualities, they will have more meaning for architects and may perhaps lead engineers to think more readily in three-dimensional forms.

Designers in Italy and in Spain have amply demonstrated the practical value of model study as an aid to structural design and have developed some of the necessary techniques. It is appropriate that we should take the lead in American exploitation of this field; M.I.T.'s skill in laboratory investigation should lead to important new developments.



These imaginative forms are products of students in Form and Design, a new second-year architecture subject developed on the theory that there are many areas of design where art, science, and technology are interdependent.





GORDON N. CONVERSE, STAFF PHOTOGRAPHER, THE CHRISTIAN SCIENCE MONITOR

Teaching Program — City and Regional Planning

Pressures for professional training in planning have again pushed enrollment in the graduate Course in City and Regional Planning to a new high, with 34 candidates for the M.C.P. degree and 5 special students (as of January 1, 1958). Drafting-room and classroom facilities have been strained beyond optimum capacity, and the ratio of students to faculty has risen beyond a desirable level.

The core curriculum of the M.C.P. program, the workshop (or "design") course of subjects, has been undergoing restudy for several years. Basic improvements in the way the subjects are taught, together with some shift in the materials emphasized, are gradually being put into effect. The objective of the changes is greater stress on aspects of the city as a whole, and less on the design of small elements, such as subdivisions.

In the spring of 1958, the Institute approved the offering of the Ph.D. degree in city and regional planning, a long-sought extension of the Department's teaching program.

The addition of a part-time Visiting Professor, Charles Abrams (distinguished housing expert, land economist, and public administrator), partly compensated for the transfer of some faculty teaching time to research. A half-time instructor was also added to the staff: Bernard Frieden, M.C.P. '57.

Dr. Yngve Larsson of Sweden, for many years a key member of the government of Stockholm and responsible for forming and applying much of its progressive planning policy, spent a part of the spring term in the Department. He was the first distinguished foreign visitor under the terms of the Robert D. Kohn Fund, the generous gift of Civic Films, Inc.

The Center for Urban and Regional Studies, as recommended by the "Burdell Committee" in 1956, was established this year; it is under the directorship of Professor Lloyd Rodwin, two-thirds of whose time was transferred from teaching to this new post. The year has been spent in formulating the Center's research objectives and policies, negotiating with foundations, and working out with the parallel center at Harvard a program for an integrated and interdisciplinary approach, jointly exploiting the rich resources of many other M.I.T. and Harvard departments.

The focus of the Center's research will be the physical environment of cities and regions, the forces that shape them, and the interrelations between urbanization and society. The key areas of interest will include the form and the structure of the city, transportation,

technology, controls, the planning process, the urban landscape, and the physical planning problems of developing countries.

The Rockefeller grant for research in the perceptual form of the city was extended, permitting the continuation of the work in this field by Professor Kevin Lynch, in collaboration with Professor Kepes of the Department of Architecture.

A strong Visiting Committee appointed for the Department in 1957 met again in 1958, supporting the Department's research and Ph.D. programs, and helping in critical discussion of curriculum revisions and new subject offerings that are under consideration.

Staff, Student, and Alumni Activities

The Third Annual Teachers' Seminar, sponsored by the Association of Collegiate Schools of Architecture, took place this spring in Nantucket. Professor Herbert L. Beckwith was active in organizing its two-week program, and Professor Bush-Brown was a contributor and will report the meeting for the professional press. Professor Bush-Brown also edited a much-appreciated issue of the *Journal of Architectural Education.*

Professor Marvin Goody continued his research program sponsored by the Monsanto Corporation and developed with his assistants a design for the structural use of plastics in school construction.

Solar House IV, of interest to several members of the staff engaged in Cabot Fund research on space heating with solar energy, was completed. It stands ready for occupancy and experimental heating operation.

Professor Richard Filipowski won the top award for sculpture at the Boston Arts Festival.

Marilyn Fraser '55 was appointed instructor in architectural design. Fred Koeper, on leave from the University of Minnesota to do graduate work in fine arts at Harvard, accepted a part-time temporary lectureship in history of architecture.

Julian Berla '23 of Berla and Abel in Washington, and Norman Fletcher of The Architects Collaborative in Cambridge served as visiting critics in fourth-year design. Reginald Knight, well-known architect, assisted with summer criticism of thesis projects.

Thanks to the generosity of The Rockefeller Foundation, the Department profited by the teaching activity of Imre Halasz, formerly a member of the faculty of the University of Budapest.

Mr. Halasz, teaching fourth-year design and laboring to adjust himself to the American environment, showed evidence of the European tradition for the strong cultural meaning of architecture, combined with skill in enlisting the interest of students. He now joins our staff on regular faculty appointment.

A series of five lectures on shell structures was given by Ervin Galantay, a graduate of the Swiss Federal Institute of Technology and now employed by I. M. Pei and Associates. Professor Mario Salvadori of Columbia University also gave a lecture on this subject.

An important international competition for the design of the Toronto City Hall has passed its first stage; eight architects from several countries have been invited and reimbursed for submittals, from among which the commission will be awarded. Two of the eight (I. M. Pei '40 and William Hayward '55) are alumni; a third, David Horne, is a graduate student in the Department.

During the fall terms of three successive years, Lewis Mumford is to conduct a seminar subject for graduate planners and architects, through his appointment as visiting Bemis Professor. The first of these subjects, Perspectives on City Development, was offered last September. Professor Mumford presented a reprise of the ideas in his book, *Culture of Cities*, which he published in 1938 and is currently revising. The class, limited in number to encourage fuller participation, discussed the problems of this rewriting in the light of city developments. His seminars and lectures were a stimulating supplement to the School's usual subject offerings.

This year one of our planning students, Henry S. Brinkers, was awarded one of the five two-year Graduate Fellowship Awards offered under the Sears-Roebuck Foundation's new program in aid of planning education. The Voorhees Walker Smith & Smith Research Fellowship was awarded to a second-year graduate student, Donald S. Appleyard, for research in the perceptual form of the city. Three of our graduating students received Fulbright awards for study abroad during the coming year: Peter L. Abeles (Israel), Bernard Brenner (Italy), and James A. Wedberg (Norway).

The planning students have greatly enriched their own educational opportunities by organizing weekly informal discussions with academic and civic figures in the Greater Boston community whose interests have a bearing on city planning, ranging from Dr. Norbert Wiener of M.I.T. to the chief of development of a department store.

Professor Frederick J. Adams has served as chairman of the American Institute of Planners committee on functional divisions,

Professor Roland B. Greeley as a member of the membership committee, and Professor Burnham Kelly as a member of the nominating committee. Professor Adams has been consulting on the preparation of a metropolitan plan for Bangkok, Thailand.

Professor Greeley continued as vice chairman of the Research Division of United Community Services of Metropolitan Boston and on the Greater Boston Census Tract Committee. He also participated in two Boston College Educators' Seminars on metropolitan planning, and he delivered papers at the Massachusetts Safety Conference and to the Connecticut Federation of Planning and Zoning Agencies.

Professor Kelly served as vice chairman of the Housing Association of Metropolitan Boston and participated in the *House and Home* Round Table on Building Codes.

Professor Rodwin served as visiting lecturer to the University of Minnesota and the University of Pennsylvania and presented a paper at the annual meeting of the Regional Science Association in Washington, in addition to governmental consulting work in Canada, Mexico, and Puerto Rico. He served with Professor John T. Howard on the Research Advisory Council of the Greater Boston Economic Study Committee.

Professor Howard also served on the Technical Advisory Committee on Planning of the Committee for Cambridge, the American Institute of Planners Committee on functional divisions, and the M.I.T. Long Range Planning Committee. He delivered papers at the annual meetings of the National Municipal League in Cleveland and the American Society of Newspaper Editors in Washington, and led seminars at the New England Economic Education Council Osgood Hill Conference and at a University of New Hampshire planning series.

Professor Lynch presented a paper at the annual national conference of the American Society of Planning Officials, in Washington.

Bernard Frieden participated in a panel discussion of metropolitan planning for the Massachusetts Chapter of Americans for Democratic Action.

In addition, members of the faculty spoke on various planning topics over several television and radio stations and to numerous civic and educational groups in the Boston region.

PIETRO BELLUSCHI

School of Engineering

The total enrollment in engineering for the year 1957–58 was 3,687, almost exactly the same as for the previous year. The undergraduate enrollment decreased by 126 students to 2,215; the graduate enrollment increased by 120 students to 1,472. The reduction in undergraduate enrollment was confined mainly to the freshmen and sophomores in civil and mechanical engineering. The national position of the School of Engineering in relation to degrees at the doctoral level is substantially the same as reported last year.

The placement situation in engineering, as far as M.I.T. is concerned, appears better than might have been expected from indications earlier in the year. As of June 30, approximately 95 per cent of the graduating class had been placed. The figure is higher for men with advanced degrees. The situation does not appear equally favorable for the nation as a whole, and there has been an unmistakable change of attitude both of industrial concerns and of the students themselves. The starting salaries have been somewhat higher than last year's, but the commitments have been made with much greater caution than in former years. The students have been quick in responding to the new circumstances. They have come to realize that it is now necessary to give serious effort to finding a satisfactory first job.

The national employment situation for engineers continues to show many contradictory aspects. There still appears to be a demand for recent graduates in certain of the less "glamorous" industries, but there are many engineers with some years of experience whose prospects are discouraging. There is some unemployment in these categories, but reliable statistics are not available. Some of these circumstances are probably temporary manifestations of the recession; others are likely to be long range in character and may indicate a degree of human obsolescence in a rapidly developing technology. They are aspects of some of the most fundamental

problems of rapid technological development, and they must receive serious attention in coming years.

Men of doctoral training continue to be in very high demand, lending support to the premise that an extended professional education for the right men represents the soundest safeguard against an uncertain future.

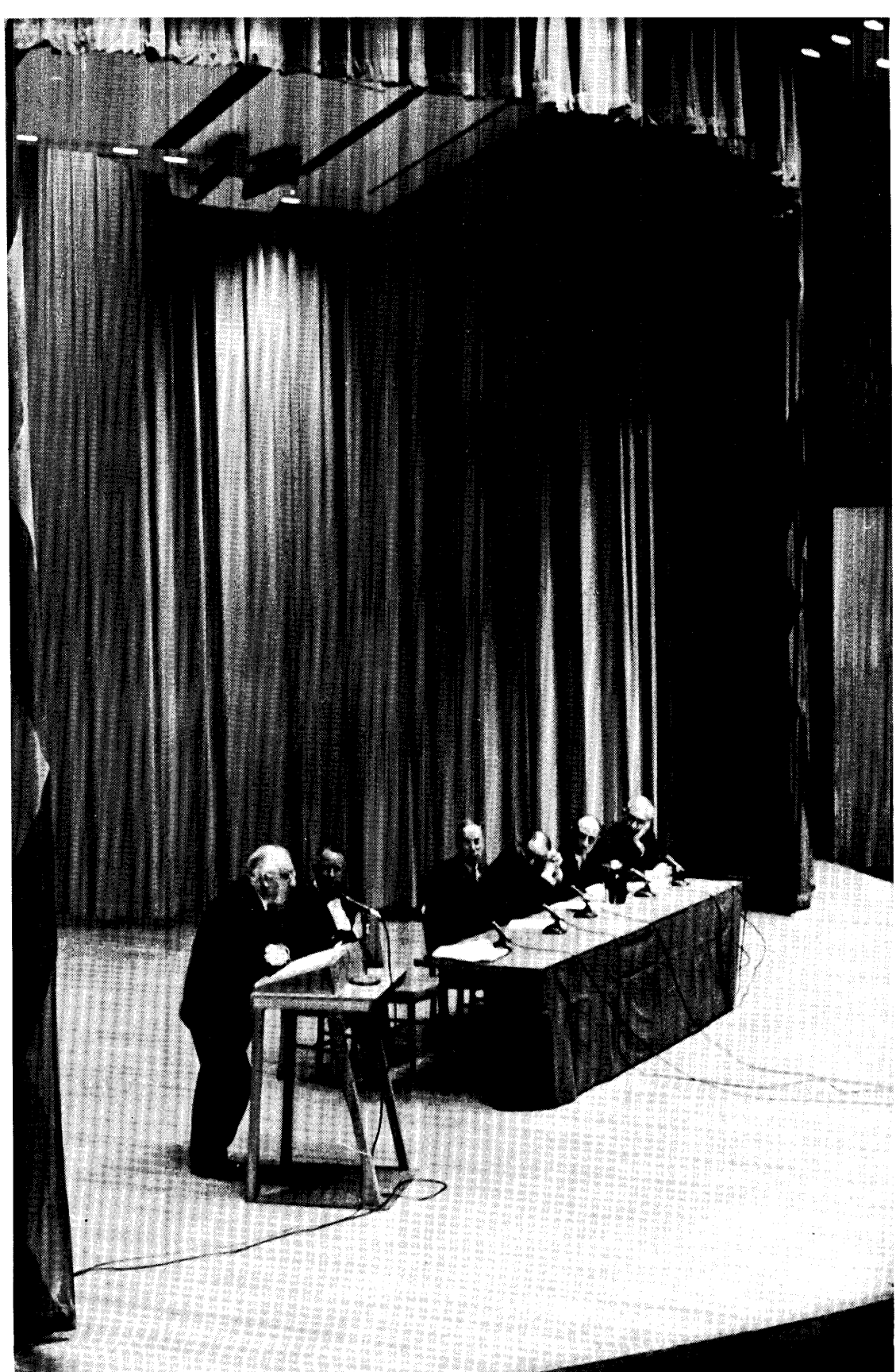
The Committee on Engineering Education

The academic year 1957–58 will be remembered as one of great importance to engineering education at M.I.T., not so much for what has actually been accomplished but for the change in attitude which world events have forced upon us. This was the year in which the nation first came to realize the extent of Soviet Russia's intellectual and material developments and to question the superiority of our own system. In this new setting, education is seen as an element of national strength and position — perhaps even as a means of survival. The intellectual potentialities of the nation's youth represent our most important national resource, and the development of this resource is no longer the sole concern of the individual or his community; it is a truly national problem. Perhaps time will also develop the deeper feeling that education has important values other than contributing to the nation's position as a world power. This is needed if we are to give education sustained support, irrespective of fluctuations in intensity of the cold war or domestic political developments.

Engineering education has had a heavy share of criticism. It is asserted that we permitted Russia to outstrip us, both in quantity and in quality. In the meantime, a change has taken place with respect to the shortage — characteristic of recent years — of engineers with a bachelor's degree. This is partly due to the rapid increase in the number of graduates since the low year of 1953–54 and partly to the temporary effects of the recession. The attitude of young men towards the engineering profession is thus likely to alter, since the powerful stimulus of a serious shortage of engineers with a bachelor's degree may not be present in the immediate future.

A much more real and more lasting shortage — that of men with training at the doctoral level — has not received the attention

The visit of Dr. Niels Bohr as Compton Lecturer during November, 1957, was the occasion for an unusual and distinguished seminar in engineering science.



it deserves. The number of doctoral degrees in engineering has remained stationary at about 600 per year since 1950–51; this is a very low number, considering that the requirements for engineering teachers alone for the next decade may be on the order of many thousands.

There is a growing realization that our country's system of engineering education is in need of a thorough overhaul. The patterns which evolved in response to the needs of the nineteenth century, and which served these needs well, may no longer be capable of effective response to the needs of the twentieth century.

This change of outlook with regard to engineering education has served to accelerate the process of self-searching which has been gathering way in the School of Engineering at M.I.T. during recent years. The Committee on Engineering Education was enlarged in the fall of 1957 to include seven members. Under the leadership of Professor Edwin R. Gilliland, this group has started a far-reaching review of our entire program. The interest and participation in the Committee's work on the part of the entire engineering staff is very encouraging. This year, there were two meetings of the entire faculty of the School of Engineering at which topics presented by the Committee had constructive discussion.

In its first progress report, the Committee has outlined the results of its work during the past two years and its stand on some of these problems. The Committee sympathetically endorses the undergraduate program at M.I.T. but concludes that many reforms are needed.

It recommends serious attempts at experimentation in education, and much of its future work will concentrate on such ideas as the use of the tutorial system; the enrichment of undergraduate education by research; and better opportunities for highly endowed students, particularly through the introduction of greater flexibility of programs. The Committee also emphasizes the importance of maintaining the strength of the staff and recommends a more extended system of sabbatical leaves of absence. It believes that unless the standards of admission are raised during the next few years, consideration should be given to reducing the number of freshmen admitted to M.I.T. The Committee has initiated a thorough study of the curricula in engineering and tentatively has concluded that no major shift of emphasis is desired at the present but that changes in the material presented are essential. Perhaps the most important object of study at the moment is the development of

the engineering sciences and their role in our educational program.

The Committee will need at least another year to complete the present phase of its work, which is to suggest directions for the future development of engineering education. A second phase, one of exploration and experimentation with staff and student groups, will follow. This work has already begun, and two conferences of educators and professional men have been organized. One is to study the role of the applied sciences in engineering education, under the leadership of Professor Ascher H. Shapiro and supported financially by the Carnegie Corporation of New York. The other will investigate education and research in the field of materials, under the leadership of Professor Morris Cohen. This has financial support from the Victoria Foundation.

The work of the Committee must involve imaginative attention to both the long-range problems of the future, on which immediate attack is not practical, and to the many other lesser problems on which immediate steps can be effective. Work in both areas will represent real progress. The coming years are certain to be fruitful.

Departmental Activities

In spite of the fact that the Committee on Engineering Education found a need for progress in educational methods, the reports from the heads of the departments indicate great activity at the departmental level; this has been a characteristic of the School of Engineering at M.I.T. for many years. All of the departments are actively studying the problems peculiar to their own fields, and some are making substantial progress in some of them. In the Department of Electrical Engineering, the first phase of the massive effort to create a new synthesis of this field, which has been under way for more than five years, is nearing its completion and is entering upon a period of consolidation. The results of this work — including the new five-year Course in Electrical Science and Engineering — are justly receiving national attention. The Civil and Chemical Engineering Departments have further demonstrated the possibility of acquainting engineering students with major problems of technology in their sophomore year. The Department of Metallurgy is continuing its study of a broad program in materials and is giving its students greater freedom to select their own programs, as is Chemical Engineering. The Aeronautical Engineering Department is responding with characteristic vigor to the challenge of the space age, and Naval Architecture is examining its role in a world of new

perspectives in transportation. The Department of Mechanical Engineering can point to a long period of steady developments, both in the engineering sciences and in technology. During the past year it has made a thorough search of its objectives, and it is now entering upon an epoch of intensive new developments.

The activities in nuclear engineering, which until now have been a part of the Department of Chemical Engineering, were organized during the year into a graduate Department of Nuclear Engineering under the leadership of Professor Manson Benedict. This gives full recognition to a field which has been growing steadily under his leadership and which represents a major expansion of effort by the Institute. While reactor technology and fission now dominate in the program, the new group is already active in fusion and thermonuclear reactions as well. The unfolding activities in this and in the related field of gas dynamics will bring together several of the departments of the School of Engineering — and of the School of Science as well. The Department is expanding as rapidly as our available resources permit, and it already represents one of the important centers in this field.

Personnel and Professional Activities

Only brief references can be made here to the many important personnel, program, and facility changes which have taken place or are under active planning.

Professor Jacob P. Den Hartog resigned as head of the Department of Mechanical Engineering at the close of the academic year, and Professor Joseph H. Keenan has been appointed to succeed him. Professor Den Hartog will continue to serve the Institute as Professor of Mechanical Engineering. During the years of his administration the Department has grown in stature and reputation, particularly in the quality of its staff.

The School of Engineering suffered a great loss during the year through the untimely death of Professor William A. Wilson of the Department of Mechanical Engineering. Professor Wilson possessed a rare combination of personal qualities, a devotion to teaching, and a mature industrial experience.

During the year Professor Carl Wilhelm Wagner resigned his position as Professor of Metallurgy to accept a post as head of the Max Planck Institute at Göttingen. Professor Wagner came to the United States as part of the transfer of German civilians by the

U. S. Army. His eminent position in physical chemistry eventually received full recognition, and his leaving represents a serious loss to the Institute.

Dr. Arthur Kantrowitz served during the year as Visiting Institute Professor and conducted a weekly seminar in gas dynamics which attracted much attention from all age groups of the staff. The seminar called attention to the better understanding of many phenomena in applied physics which will become necessary as this subject unfolds. A similar venture for next year in solid state science and technology has been under consideration, but no specific plans have been formulated as yet.

Dr. John C. Fisher of the General Electric Research Laboratory has been appointed Visiting Professor of Engineering. He will participate in seminars and research in those aspects of solid state physics which are of particular interest to the Mechanical Engineering and Metallurgy Departments.

The following honors have come to department heads in the School of Engineering: Professor Gordon S. Brown (Electrical Engineering) was appointed to the first J. I. Carroll Memorial Fellowship at the University of Sydney in New South Wales, Australia, and was in residence at the University of Sydney for a portion of the spring term. Professor Den Hartog (Mechanical Engineering) was chosen to deliver the Thomas Hawksley Lecture of the British Institution of Mechanical Engineers; he is the first non-Britisher to receive this honor. Professor John Chipman (Metallurgy) received the Gold Medal of the American Society for Metals, and Professor Charles S. Draper (Aeronautical Engineering) received the Holley Medal of the American Society of Mechanical Engineers. Professor John B. Wilbur (Civil and Sanitary Engineering) has been chosen as the educator member of a panel on engineering education that will highlight the silver anniversary celebration of Wayne State University.

During the spring term, the School of Engineering presented a materials colloquium on the mechanical behavior of materials, planned to bring faculty, staff, and students together to pool common interests and to advance the study of materials. The series opened with a lecture by Dr. Alan H. Cottrell, Deputy Head of the Metallurgy Division of the Atomic Energy Research Establishment, Harwell, England; it continued through the term with lectures by members of the Institute faculty. This colloquium was arranged by

a committee consisting of Professors Nicholas J. Grant (Chairman), Raymond L. Bisplinghoff, Albert G. H. Dietz, and Frank A. McClintock.

The Jerome C. Hunsaker Professorship in Aeronautical Engineering and the Webster Professorship in Electrical Engineering have continued to be held by distinguished members of the engineering profession and are discussed in more detail in the reports of the respective departments.

The most important addition to the facilities of the School is the nuclear reactor, which has already been put into limited operation and is expected to be ready for full use in the fall. The M.I.T. Reactor is the first to go critical in New England. Because of its unusual versatility, permitting more than seventy simultaneous experiments, it has received much attention both in the United States and abroad. It will be available for use in research by many of the departments at M.I.T. as well as by other industrial, educational, and medical organizations. The successful completion of this major undertaking reflects great credit on those members of the staff in nuclear engineering who have contributed to the project, particularly Professor Theos J. Thompson, who has been in charge.

An important change is taking place in the Naval Supersonic Laboratory; this facility is undergoing a gradual modification so that it can become a major factor in aerodynamic research related to missiles and the re-entry problem.

The Department of Aeronautical Engineering has made an imaginative proposal for the conversion of its facilities into a center for aeronautics and astronautics, with an appropriate change of name for the Department. This will not take place in the immediate future, but it does represent an example of the readjustment which will be demanded of us if we are to keep pace and to lead in our rapidly changing technological complex.

C. Richard Soderberg

AERONAUTICAL ENGINEERING

Aeronautical engineering experienced a very exciting year in 1957–58, and all the implications of important technical events are still far from clear. Sputnik and the American satellites have started a new era in the history of flight by man-made devices. Flight within the atmosphere has been well developed by the science of aeronautics.

The science of astronautics, which is now coming into being, will give the human race the same sort of power over flight in space outside the atmosphere. Because the problems of conception, design, construction, and operation of space vehicles fall into a pattern that is essentially the same as that for aircraft, the discipline of aeronautical engineering provides a firm foundation for the new field of astronautical engineering. At M.I.T., the Department of Aeronautical Engineering is acutely aware of this fact and is taking bold steps to meet the challenge.

New facilities for teaching and research, integrated into an M.I.T. Center for Aeronautics and Astronautics, are now being planned for a site adjoining the present Naval Supersonic Laboratory. Revisions of the educational plan toward the subjects of astronautics, already in progress before 1957–58, are being strongly accelerated. Additional faculty requirements to assure continued leadership in astronautics are being studied. Efforts are now under way to raise the funds that will be necessary to build, to staff, and to provide research support for the new M.I.T. Center for Aeronautics and Astronautics.

Educational objectives of the Aeronautical Engineering Department have become clearly defined as a result of many discussions among faculty members. Modifications in the curriculum are designed to treat both aeronautics and astronautics in terms of flight vehicles, without compartmentation of the two fields. This approach to education is possible in the limited time that is available only by a thoroughgoing revision of applied science, mathematics, and professional subjects, in which only the absolutely essential material is retained. The strong motivations of students who are interested in aeronautics and astronautics are easily exploited in the teaching of this necessarily concentrated material.

This year the undergraduate and graduate enrollments both remained substantially unchanged, at levels near the teaching capacity of the Department. The Cooperative Course decreased in numbers, although the group continues to draw interested students. The Honors Course, a five-year program leading to both bachelor's and master's degrees, showed increased activity with a total of thirty-one juniors, seniors, and graduate students, and nineteen social members. Several outstanding juniors were invited to join the group during the past year. This experiment, tried for the first time, appears to be successful. The Honors Course continues to serve its objective of encouraging qualified students to enter

graduate work with long-range coordinated programs. The weapons systems program operated with forty military students for the master's degree, including three from Canada and one from England. A number of civilian students also worked in this field for the master's or doctor's degree.

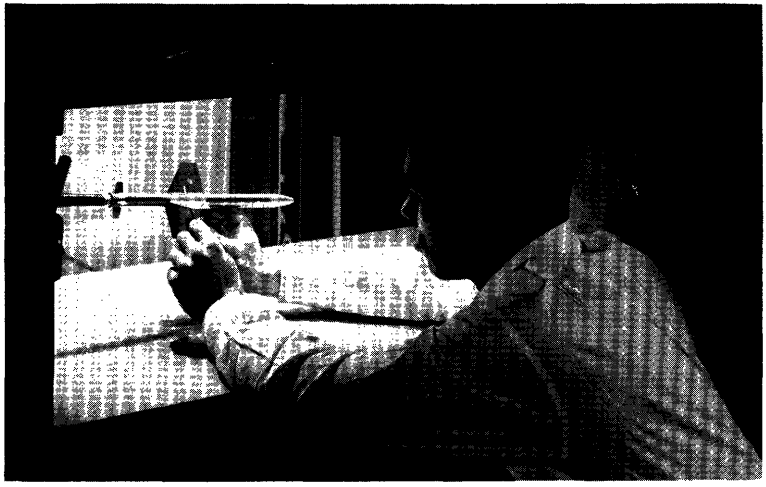
Educational Developments

During 1957–58, the staff re-examined the role of fluid mechanics for flight vehicles in the light of the growing importance of ballistic missiles and satellites. This review has led to changes in the basic aerodynamics subjects offered by the Department. These revisions will emphasize from the beginning that the aeronautical engineer's working fluid is a gas, any one of whose physical properties (compressibility, viscosity, heat conduction, etc.) can be neglected only under special conditions. The arrangement of topics to be presented in this area is still being discussed, but it is certain that an improved aerodynamics program is emerging from the studies now in progress. The advanced subjects in aerodynamics have also undergone re-examination. In particular, a new subject in the physics of high-speed, high-temperature gas flows and hypersonics was given during the past year to a group of advanced students from the Aeronautical, Mechanical, Electrical Engineering, and Physics Departments and to research engineers from local laboratories.

The past year has seen a major change in emphasis in the professional fields of aeroelasticity and structures. There have been significant alterations in the curriculum in the solid and structural mechanics subjects; the concepts of elasticity, plasticity, and statically indeterminate structures are now introduced in the initial subject in mechanics. The older, classical Strength of Materials has been upgraded to a second-year subject in Mechanical Properties of Materials which emphasizes the microscopic properties and behavior of solids. The regular undergraduate subjects in structures have been revised to cover more basic information in the fields of elasticity and plasticity, in order to provide a broad base in the fundamentals of solid and structural mechanics and prepare students for later specialization in any phase of aircraft, missile, or spacecraft construction. During the past year, the aeroelasticity subjects reflected the newer interests of hypersonic re-entry vehicles with severe aerodynamic heating; although no major changes have been made in curriculum, there has nevertheless been a gradual but firm change in emphasis.

The rotary wing subjects have been expended to include all types of vertical take-off and landing craft. Primary emphasis remains on the helicopter, which is at present the only operational VTOL configuration.

The airplane stability and control and missile aerodynamics part of the comprehensive senior project subject has been changed to include the generalized treatment of large- as well as small-disturbance dynamics. The relationships of the moving-axis flight vehicle system to a fixed-axis system have been increasingly stressed. As a special project during the past year, four models of student-designed missiles were constructed and tested in the blowdown



Student-designed missiles received wind tunnel tests supervised by the students themselves in the fourth-year program in airplane stability and control.

supersonic tunnel to show the students how well their aerodynamic estimates checked with reality. All members of the senior class were offered a four-place airplane flight in which stability and control properties of the airplane were demonstrated. These flights were highly successful and will be repeated in a way that closely ties experimental observations to the automatic control phase of the aircraft engineering subjects. The advanced project subject has now been developed so that it deals with the systematic reconciliation of conflicting requirements by analytical means in order to satisfy a given mission with an optimum vehicle, rather than with the analysis of a given aircraft or missile configuration.

The academic year 1957–58 was the fifth since servomechanisms and automatic control were included as subjects integrated in the regular undergraduate aeronautical engineering curriculum. Automatic control has been the subject matter for a full-term lecture course, for one-third of a laboratory course, and for one-half of a comprehensive project course. This arrangement proved to be so educationally successful and interesting to students that a basic sequence of control subjects extending over five terms, with two required and three elective subjects, is now offered. This sequence covers all phases of aeronautical and astronautical control problems. A special feature of the control subjects is that options are being offered in which small groups of students may work on projects rather than follow the usual classroom procedures.

New curricula in astronautics have been prepared in the field of guidance for space flight vehicles. This sequence includes a new subject on inertial guidance given during 1957–58. This is the first time in history that a subject of this kind has been presented. Largely because of the Department's inertial guidance work, groups of Air Force and Navy officers are expected to start the new astronautics curriculum next fall.

Propulsion, from the standpoint of engines suitable for use both inside and outside the atmosphere, has received special attention during 1957–58. Professor Howard W. Emmons, the Hunsaker Professor for the past year, devoted particular attention to the propulsion field; and George P. Sutton, a very distinguished rocket engineer who has accepted the Hunsaker Professorship for 1958–59, will give a special subject in rocket engines, in addition to leading seminar work. The aircraft propulsion subject has been altered to give more attention to rockets, and the jet propulsion engine subject has been changed in content and renamed "Rocket Engines."

Facilities and Research

The past year has been one of substantial achievement for the Naval Supersonic Laboratory. The supersonic wind tunnel has been ingeniously modified to extend our aerodynamic research into the elevated temperatures of missiles, rockets, and re-entry vehicles. A hypersonic tunnel with an eventual capacity of Mach 9 has been put into operation and used successfully in the lower hypersonic ranges. During the forthcoming year it is planned to extend the temperature range of both the supersonic and hypersonic facilities

to the vicinity of 2000°F. The supersonic wind tunnel is also being modified to achieve flows at extremely low pressures which will accurately simulate the great altitudes that missiles and satellite vehicles will be reaching in the near future. The research in infrared which has been conducted for several years has gained wide notice, including the recent efforts in tracking satellite vehicles. As a result, the Laboratory has become a center for advice and consultation in this area. Most significant, promising developments made by this infrared group will substantially increase the useful range of current missiles. The Laboratory has continued its pioneering work in the field of transpiration cooling and has begun fundamental studies and experimental investigations in the field of magnetohydrodynamics. The large digital computer at the Laboratory has been housed in new, modern quarters.

The Wright Brothers Wind Tunnel facility has emphasized educational activities rather than sponsored research during 1957–58, although some commercial work was necessary to fund theses, testing of the design group missile models, and similar unsponsored projects. Total hours of tunnel use decreased from 1,657 in 1956–57 to 935 in 1957–58, due mainly to the fact that the supersonic test work on the bluff bodies project was moved to the Naval Supersonic Laboratory.

The Aeroelastic and Structures Research Laboratory has operated at a slightly reduced level of activity as compared to previous years. The research activities have increasingly involved fundamental investigations associated with the forefront of very high speed flight. Hypersonic flutter and aerodynamic heating phenomena continue to dominate the program, although studies of shell structures, large structural deformations, plasticity, fatigue, and rotor-blade aeroelasticity also play prominent roles. Substantial changes in the nature of the research to be undertaken by the laboratory are in prospect for the next year.

The Aerophysics Research Group continued work in the fields of cruise control, satellites, missiles, stability and control, and aerodynamics.

The Gas Turbine Laboratory's support from General Electric, Westinghouse, Allison, and the Office of Naval Research continued during the past year. Support from the Curtiss-Wright Corporation was discontinued. With the reduced emphasis on turbojet engines for military aircraft, there is cause for alarm about the problem of future support for the activities of the Gas Turbine Laboratory. This work in the field of fluid machinery has surely

not been decreased in importance by recent events and will be continued as long as support can be found.

Instrumentation Laboratory activities increased during 1957–58, as a result of the Laboratory's being entrusted with development of the inertial guidance system for the Navy's Polaris missile and also with inertial guidance projects for Air Force missiles. Weapon and flight control projects for manned aircraft were either sharply cut back or terminated because of the general preoccupation with space projects and ballistic missiles. This trend away from aircraft is introducing several problems in rearrangement of laboratory personnel and facilities and will probably make it necessary to curtail activities in the near future.

CHARLES S. DRAPER

CHEMICAL ENGINEERING

A year ago we described a liberalization of the undergraduate program which would give students in chemical engineering considerable choice of elective subjects, chiefly in their junior and senior years. About one-third of our students used this increased freedom to take additional mathematics and physics, another third increased their time in economics and business subjects, and the remaining students selected a number of different areas. Although more faculty time is required for counseling, both the staff and the students favor the new curriculum and greater elective time.

In December, the Department sponsored a meeting at the Endicott House with a group of seven leading chemical engineering educators from other schools. The methods, plans, and problems in graduate chemical engineering education were compared, and everyone attending the meeting was enthusiastic about its value. As a result of these discussions, the Department is introducing several experiments in the handling of its graduate students.

Graduate Student Aid

An increasing number of our graduate students are interested in continuing for the doctor's degree. About one-third of all the graduate students in chemical engineering have now passed the major examinations for this degree and are engaged in, or ready to begin, full-time thesis work. We are no longer able to support all of these

doctorate candidates during their thesis programs by fellowships or research appointments. We need more financial support for the increased number of qualified men studying for doctor's degrees.

It has been decided that the Department should increase its program of advanced chemical engineering research by the addition of several postdoctorate research fellows, and plans are being made to obtain financial support for this work.

It is significant that 38 per cent of our graduate students do not have financial support from the Institute or from outside fellowships of which we have knowledge. About 10 per cent of the doctorate men are in the unsupported category.

School of Chemical Engineering Practice

The School of Chemical Engineering Practice is a very important part of the educational program in chemical engineering and has contributed substantially to the training of the graduates. During the past year we have made a critical study of the School in the light of the changes that have taken place since its establishment over thirty-five years ago, and we have concluded that its operations should be centralized in a single geographical location. Such a change would permit married students to live with their families during the semester in the School; would minimize the time now lost in traveling between stations and in completing the work at one station and beginning at another; would allow more flexibility in housing arrangements and station operations, should enrollment fluctuate from year to year; and would encourage more visits by M.I.T. staff members.

The study indicated that northern New Jersey would be a very suitable location for the centralized operation of the Practice School. Arrangements have therefore been made to open new stations in September, 1958, at the Bound Brook Plant of the American Cyanamid Company and at the Bayway Refinery of the Esso Standard Oil Company.

Nuclear Engineering

M.I.T.'s program of graduate instruction and research in nuclear engineering continues to expand. Enrollment of graduate students in this field reached a new high, and the first two men to receive the Doctor of Science degree in Nuclear Engineering have been graduated. The M.I.T. Research Reactor went critical in the summer of 1958 and is already supporting a substantial and varied load of research. The size of the nuclear engineering staff continues

to increase, to keep pace with the increased number of courses being offered.

Nuclear engineering was initiated at M.I.T. in 1951 in recognition of a new technological area of great potential significance in which M.I.T. should exercise educational leadership; the responsibility for organizing this venture was assigned to the Chemical Engineering Department. The program in this area has now achieved maturity, and the staff and student body have grown to a size which justifies establishment of a separate Department of Nuclear Engineering in the School of Engineering, as of July 1, 1958.

Professional and Personal Honors

During the past year several members of the staff received special recognition for their contributions, as follows:

Professor Warren K. Lewis received the American Petroleum Institute Gold Medal in November, 1957, in recognition of his distinguished achievements for the petroleum industry. In June, 1958, Professor Lewis was given the Founders Award of the American Institute of Chemical Engineers for his achievements in advancing chemical engineering.

In August, 1957, the American Society of Mechanical Engineers and the A.I.Ch.E. held a national conference on heat transfer, honoring Professor William H. McAdams.

Professor Harold C. Weber received a "Certificate of Achievement" for service with the Army Chemical Corps.

Professor Thomas K. Sherwood was elected a member of the National Academy of Sciences. Professor Sherwood was on leave of absence during the spring term to act as Visiting Professor in the Department of Chemical Engineering at the University of California, Berkeley.

Professor Robert C. Reid was appointed United Engineers and Constructors Preceptor.

WALTER G. WHITMAN

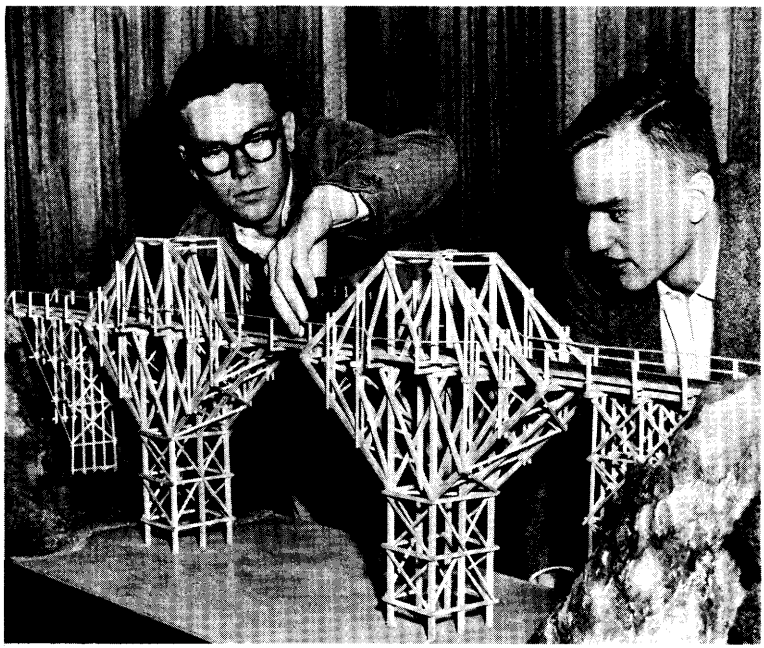
CIVIL AND SANITARY ENGINEERING

This year the Department graduated its first class under its new undergraduate curriculum, and a number of new fourth-year subjects were thus taught for the first time. In addition, there has been

substantial progress on research activities in many civil engineering fields.

Structural Division

For the Structural Division, these new course offerings included the four senior subjects of the curriculum's five-subject structures sequence. With such limited experience with the new sequence, we can appraise its merit only in a general and qualitative way. We sense among this year's seniors greater interest and enthusiasm, an improved appreciation for structural behavior, and a better perspective of the over-all structural design problem. It may be, however, that the less able students have not acquired as much facility with analytical methods as their predecessors. All things considered, the Structural Division is encouraged by its experience with the new curriculum and is confident that it can overcome any weaknesses by modifying its teaching techniques, probably by adapting some of the techniques used in the third-year structures course.



Inspired by the motion picture, two juniors in civil engineering built this model of the bridge over the River Kwai.

Our graduate structures program continues to operate very successfully. This year we offered for the first time a new graduate subject dealing with the application of numerical methods and digital and analog computers to structural engineering problems. We have also been studying possible revisions to our graduate structural program. We will complete a study of possible revisions in the graduate structural program next fall.

In the fall term of 1957, 44 of the 112 graduate students in civil engineering were majoring in structures. Of these, 28 were candidates for the master's degree, 2 for the civil engineer degree, and 14 for the doctor's degree. Of these same 44, 23 were full-time students, 19 were research assistants, and 2 were teaching assistants.

The volume of sponsored research being conducted by the Structures Division continues at a high level, with the eight projects under contract totaling $197,000. We continue to be concerned, however, about the predominance of military research in this total. Our ambitions are to emphasize two principal areas in our sponsored research program: the development of new structural forms, arrangements, and techniques; and the application of modern computers and computing techniques to structural analysis and design. Fortunately, our military program has contributed greatly to our work in the second of these areas.

Hydraulic Engineering and Hydrodynamics

Graduate instruction in hydraulic engineering has been strengthened by a reorganization of pertinent material into subjects on Hydrology and on Water Resources Development. Hydrology is a basic earth science of importance to several fields of interest, and its further development is essential to a rational water economy.

The research activities of the Hydrodynamics Laboratory are concerned with many aspects of water wave characteristics and of wave action on beaches and man-made structures. This interest has been greatly aided during the year by the presence of Dr. Fritz Ursell, a member of the Department of Mathematics of Cambridge University, England, as a Visiting Associate Professor. Other projects in our large wave channel were concerned with the direct measurement of transient shear exerted by shallow water waves, conducted by Professor Peter S. Eagleson, and the dynamic behavior of moored structures under wave action, carried out by Professor Donald R. F. Harleman.

In the general area of turbulence and diffusion, a study has been completed under Professor Harleman on the quantitative determination of diffusion coefficients in a channel with a homogeneous turbulent field. The motivation for this study came from pollution problems in reservoirs and tidal estuaries, but the implications pertain to several areas of modern technology.

The paper industry has been baffled by the peculiar behavior of paper pulp flow in the processes of paper production. A concerted experimental attack is therefore under way by Professors Arthur T. Ippen and James W. Daily to determine the properties of non-Newtonian viscous flows under laminar and turbulent conditions.

A basic study covering the flow conditions near rotating disks, completed by Professors Daily and Ronald E. Nece, is of interest for many types of machinery with respect to torque losses as well as to internal circulation patterns.

Soil Engineering Division

During the year, the Soil Engineering Division has given much study to its educational and research programs. Present programs have been reviewed and evaluated and future programs outlined. Grants from the Fundacion Creole and from the Sprague and Henwood Foundation will make possible renovation and re-equipment of the soils laboratories for student instruction and research. The planned development will result in more space and test equipment for both graduates and undergraduates.

The Division's research is directed toward a better understanding of the fundamentals of soil behavior, especially the shear strength of clay. Of particular importance are two sponsored projects on the effects of time on shear strength. One of these, sponsored by the Office of Naval Research, is concerned with the long-time strength of marine sediments; this strength is needed to determine the degree of stability of submarine slopes, both natural and man-made. Another project, sponsored by the Corps of Engineers, is designed to evaluate and explain the effects of rapid strain rates on the strength and deformation characteristics of soils. Such work is of immediate interest in protective construction for key defense facilities.

Building Engineering and Construction

New fourth-year subjects given this year for the first time included Building Construction, Advanced Materials, and Construction Man-

agement, all given by the Division of Building Engineering and Construction as part of the new undergraduate curriculum. Approximately half the senior class elected to take some or all of these subjects. The staff feel that by and large these new intensive subjects worked well and that the experience gained will help to indicate changes and improvements for next year.

The combined subject in Materials and Mechanics has had its second year of operation, and the best pattern for handling the combination of theory of strength of materials, discussion of engineering materials, and materials testing, is emerging. Plans are under way to provide greater flexibility and increased student responsibility in setting up testing procedures, in order to give the students greater insight into the problems of determining the properties of materials.

At the graduate level, plans are being laid to increase the calibre and extent of instruction in Construction Management, with increased attention to the broad aspects of labor policy, finance, and business law. Advanced work in construction and more fundamental work in materials are under study.

Plastics Research

Research in plastics has moved in two principal directions. Under the cooperative program with the Manufacturing Chemists Association, the long-range research into the relaxation behavior of a large number of polymers has continued. Programs sponsored by the National Science Foundation and the Owens-Corning Fiberglas Corporation seek to understand first the nature of the bond between resinous materials and fibrous reinforcement, and second, the behavior of reinforced plastics as it correlates with and deviates from the theory of elastic behavior of such materials.

The fundamental studies of adhesion have led to a treatment of materials difficult to bond, especially polyethylene, resulting in bonds in which the bond strength is greater than the strength of the polyethylene. Bonds are made to a variety of materials, such as glass and stainless steel.

Sanitary Engineering Division

The change in teaching personnel in the Sanitary Engineering Division during the past year has led to a reassignment and revaluation of the subjects presented in the undergraduate and graduate curricula. Extensive changes in subject content have been made to

place greater emphasis on the understanding and application of the physical, chemical, and biological sciences to the unit operations and processes of sanitary engineering. Laboratory subjects have been revised to make more effective use of the scientific principles learned, particularly in the processing of radioactive wastes and in the biochemical degradation of synthetic organic chemical wastes, two of the most significant problems in stream pollution control.

Active research has continued in the fields of air pollution control, radioactive tracer studies of corrosion control, the biochemical treatment of sewage, the subsoil disposal of domestic sewage, high-rate anaerobic digestion of organic wastes, the breakdown of synthetic detergents, and the treatment of radioactive wastes.

A new process has been developed for the fixation of fission product wastes in solid media. At the present time these highly radioactive wastes are stored as liquids in huge underground tanks. The new fixation process results in a molten glass which cools to a solid of great stability. A significant volume reduction has been obtained in the laboratory, and indications are that the process may be of real value in solving the complex problem of disposal of high-level wastes.

Experiments have also been conducted on zirconium-bearing wastes arising from the newer type of reactor fuels. Stainless steel in the wastes will also be subjected to similar processing, with different glass compositions called for in each case. Mixing of the wastes with granite also produced a glass, with even greater retention capacity for the cesium.

Transportation and Surveying

Over the years, the undergraduate work in transportation in this Department has been curtailed and condensed, largely through the elimination of design and practice exercises. Emphasis has turned toward the fundamentals, with increasing attention to the relation of transportation to other branches of civil engineering and to other professions. Unlike some phases of engineering, transportation engineering is not wholly a scientific or mathematical specialty. Rather, it is the application of the products of engineering and science to fulfill a particular function: the moving of people and goods. Our teaching, therefore, follows the application approach, drawing frequently upon real problems for illustrations of principles. Even

after many years of research and development, most phases of transportation engineering still lean heavily on experience. Possibilities for the application of science and mathematics are being investigated constantly. However, many factors of a social and political nature, which cannot be reduced to mathematical terms, are encountered.

The educational program of surveying instruction developed in recent years bears little resemblance to the older, well-established impressions of surveying. Broadly defined, it is concerned with the procurement, reduction, processing, and presentation of civil engineering data. The fundamental concepts and applied techniques of approaching measurement and data problems are equally applicable to surveying, traffic engineering, structural engineering, hydraulic engineering, and soils engineering. In the surveying program, each student is introduced to the fundamental principles of making physical measurements and to the problems of assembling engineering data. Particular attention is given to spatial measurements using surveying-type data primarily as a medium for presenting basic concepts. Each student is also introduced to the basic concepts of probability through the medium of error analysis theory. The important roles of photogrammetry, automation instrumentation, and electronic computers in facilitating the solution of civil engineering problems are emphasized.

Research in the Division of Transportation and Surveying encompasses a wide range of topics, including pavement technology, photogrammetry, computers, highway traffic, and economic studies. The work ties in closely with the academic program and gives opportunities for graduate assistantships and part-time employment for numerous students.

Two projects, both sponsored jointly by the Massachusetts Department of Public Works and the U. S. Bureau of Public Roads, are receiving nation-wide attention. In a study of new approaches to highway engineering through photogrammetry, automation instrumentation, and electronic computers, instrumentation has been developed for taking terrain data from an image model formed stereoscopically in a photogrammetric plotter. This information can be automatically plotted graphically, printed in tabular form, or stored on punched cards or tape for use in computers. The computations make possible the rapid solution of many otherwise tedious highway computations, such as earthwork calculations and horizontal and vertical alignment geometry. From the digital

terrain model, stored on tape or on cards, studies can be made automatically of alternate highway locations, and optimum locations may thus be determined. Technological advances from many branches and fields of engineering and science are being integrated in the research.

The study of the economic impact and traffic characteristics of Route 128 around Boston has also attracted wide interest among highway engineers, planners, and public officials. In brief, the purpose of this study is to determine the causes and effects of the industrial and residential development that has taken place along this highway since its reconstruction, and also to investigate the traffic generated and its effect upon travel patterns in the metropolitan area. Of concern also is the economic and social effect of the highway on adjacent communities.

JOHN B. WILBUR

ELECTRICAL ENGINEERING

The employment opportunities for electrical engineers from M.I.T. continued at a high level throughout the past year. By late spring the demand for current graduates was running ahead of the supply. Student interest in electrical engineering at the freshman and sophomore levels was substantially the same as for the past several years. Last October the total number of students majoring in all categories of electrical engineering totalled an all-time high of 1,337.

The number of graduate students registered in the Department has been increased slightly during the past few years but at no sacrifice in the quality of graduate work. There has been a deliberate attempt to increase the number of teaching assistants to help with the heavy undergraduate teaching load. The Department believes that a gradual expansion in graduate enrollment is advisable and that the proportion of graduate students working toward the doctorate should be increased — first, because of the clear need for more advanced graduates in the electrical field; second, because of M.I.T.'s unique position for providing training at the doctorate level; and third, because of the urgent need to increase the number of engineers trained at this level and hence qualified as future engineering teachers.

The Five-Year Curricula

The experience with the first group of students in the new Course in Electrical Science and Engineering (Course VI-B) was stimulating for both students and staff. The Course is offered for a selected group of students who, early in their careers, show promise of continuing to the doctorate and of becoming top-flight engineers. These students seek a strong basic background in preparation for graduate study; the curriculum in Course VI-B gives more than the usual emphasis to mathematics, physics, and the electrical science aspects of the core curriculum studies.

About twenty members of both the sophomore and junior classes in Course VI-B were handled in special sections in selected major subjects, under circumstances designed to motivate them to achievement in greater breadth and depth. In nearly every instance each junior was affiliated with a project or with the research of a member of the faculty on an individual basis, as a step toward expanding his experience and technique for uncovering new learning on his own initiative. The Department plans to continue the VI-B program at a level that represents about 10 per cent of the enrollment of each of its undergraduate classes.

Our Cooperative Course, VI-A, continues to provide selected industrially minded students with carefully coordinated experience in the plants of ten manufacturing, public utility, and research organizations. Professor Eugene W. Boehne, director of the program, has worked with plant officials to rearrange the practical experience, eliminating routine work and introducing assignments which stimulate the students' imaginative and developmental faculties. The industrial assignments have thus been kept in step with the subject matter and educational objectives which underlie the new electrical engineering curriculum. Examples of assigned work are: experimental evaluation of microwave propagation characteristics of helices, study of transient response of transistor-logic circuitry, laboratory studies of ferrite-core circuits in switching systems, nonlinear processing of communication signals, and investigation of ferroelectrics. In selected instances Course VI-A graduate students pursue thesis research in company laboratories, in order to have contact with unusual equipment and expert industrial personnel. This experience enriches both the students' educational experience and the industrial contacts of our faculty who supervise these theses.

Curriculum Workshop in Electrical Engineering

In response to widespread demand from sister institutions for detailed information about the content of our revised curriculum, the Department conducted a Curriculum Workshop from September 4 to 13, 1957. The program was supported in part by a grant from the National Science Foundation and in part by grants from the General Electric Company and Westinghouse Electric Corporation. The attendance comprised 108 faculty from 104 sister institutions. Members of the Department faculty and guests from certain sister institutions presented in some depth the technical content of classroom and laboratory instruction in circuit theory; electronic devices and circuits; electronic circuits and signals; fields, energy, forces; electromechanical energy conversion; energy transmission and radiation; and molecular engineering. The key objective was to answer the questions: "What should be taught, and how can it be unified?" The program was a new experience for all, for rarely can professors participate as a group in the presentation of a science-oriented core of modern electrical technology in sufficient depth and under circumstances that afford sufficient time to appraise its unity and evaluate its significance. Each participant was given a complete set — about two thousand pages — of our core curriculum notes, together with samples of home problems, quizzes, and laboratory exercises.

As a consequence of the interest aroused during the Workshop in finding new ways to introduce students to the broad problem of processing energy, the Westinghouse Electric Corporation agreed to engineer and produce in quantity the generalized machine developed by Professor David C. White and his colleagues. Furthermore, the Westinghouse Educational Foundation agreed to donate one of these machines to each institution represented at the Workshop. Professor White and his group are collaborating in designing and testing the production machine and in the preparation of a brief laboratory manual for students and teachers.

Curriculum Developments

The textbooks for all the core curriculum subjects of the junior and senior years, with the exception of the new subject in Molecular Engineering (6.08), are now in various stages of production with John Wiley and Sons, Inc., and are scheduled for publication during the 1958–59 academic year.

With the publication in April of Professor Samuel H. Caldwell's textbook, *Switching Circuits and Logical Design*, it becomes possible to economize on the student's time by substituting reading for much of the lecturing. Beginning with the 1958 Summer Session, the graduate subject will be compressed to a single term and coordinated with a group of subjects offered for students who are specializing in digital computers and data processing equipment. Beginning in the second term of 1958–59, a modified version of the subject will be offered as a senior elective open to students who do not meet graduate standards but need instruction in this highly modern area. Additional and novel equipment has been loaned by the Burroughs Corporation to support the increasing laboratory teaching load.

The group interested in teaching computer systems theory, serving as an *ad hoc* committee and including Professors Dean Arden, Edward Arthurs, Philip M. Lewis, and Alfred K. Susskind, and Dr. Frank M. Verzuh, have completed a major revision of the senior elective and graduate subjects in computation; four subjects will now be offered at the senior elective level and three at the graduate level.

Molecular Engineering and Materials

Because of the need to train teaching staff in molecular engineering, and in recognition of the major role of materials and the emphasis on the search for new materials in all of engineering, the Department is strengthening its total resources and level of teaching and research in this area.

The preliminary text and laboratory material for teaching the subject in Molecular Engineering, which will give major emphasis to materials encountered in electrical technology, is nearing completion. In September, 1958, it will be taught for the first time to all seniors in electrical engineering — about 200 students — as part of their core curriculum, and to several graduate students. Its aim will be to provide a view of the interaction between electromagnetic fields and matter which proceeds from fundamental physical principles. There will be considerable reliance on quantum-mechanical and statistical aspects of solid-state physics. The eventual goal is to obtain a simple representation or model for the bulk material which includes the dependence on time (frequency), temperature, field strength, and so forth. A similar approach will be

followed in treating the dielectric and conductive properties of matter. Thermal and mechanical properties, while not the main interest, will not be ignored. Laboratory exercises, a required part of the subject, will be designed to illustrate basic physical principles and to demonstrate how materials can be combined with circuitry to produce unconventional devices.

Several groups within the Department have federated to establish a Center for Modern Materials Research on an informal basis; the staff of Professor Arthur R. von Hippel's Laboratory for Insulation Research is collaborating with other members of the Department who are working in the areas of solid-state energy conversion, semiconductors, computer components, and new materials as related to pulse circuitry and radar. Joint seminars for faculty and graduate student staff have been conducted weekly. Dr. Pierre Aigrain, who, as Visiting Webster Professor in May, 1957, gave a series of lectures on Conduction Processes in Solids, returned for a short visit in the spring of 1958 and will be associated with this effort. This federation of the groups within the Department who are interested in materials will greatly aid Professor David J. Epstein, who is assigned the task of teaching molecular engineering to our senior students, by allowing him to draw, part time, upon the facilities and experience of many colleagues. The teaching load in molecular engineering will be a heavy one for several years, however, and for many reasons: the shortage of educators and engineers trained in molecular engineering, the large numbers of students seeking instruction, the lack of suitable texts and instructional laboratory aids, the slow growth in the level of on-campus research in this area, and the shortage of suitable research space all contribute to the problem.

Laboratory for Insulation Research

The concepts of modern materials research, as developed in the Laboratory for Insulation Research during the last decade, have become widely accepted outside the Institute. *Molecular Science and Molecular Engineering*, a book which grew out of the 1956 Special Summer Program, is in production. During the year, Dr. von Hippel gave lectures of one week's duration at the Ford Scientific Laboratories, at the Diamond Fuse Laboratories of the Department of the Army, and at the Bureau of Standards.

The work of the Laboratory for Insulation Research is broadly directed toward a deeper understanding of the electric and magnetic

properties of matter. Among its important activities are studies of the control of conduction, field emission, and electric breakdown in liquid and solid dielectrics as prerequisites for the realization of the "ultimate capacitor"; the development of accurate criteria and techniques for growing near-perfect single crystals; studies of individual electric and magnetic moments and of the coupling and spontaneous alignment of such moments, by a "dielectric spectroscopy" ranging from zero frequency to the far ultraviolet; the development of a magnetic resonance group and the application of its narrow-band spectroscopy to a variety of solid-state problems; studies on the formation of metallic and dielectric films and their interfaces; the preparation of ferroelectric and ferromagnetic ceramics from mixed-crystal systems and by high-pressure methods; and chemical and physical research bridging systematically between insulators and metals. Individual items of interest are the production of transparent ferromagnetics, the first definite proof of the existence of traveling excitons, and a quantitative measurement of their mobility and lifetime in cadmium sulphide.

Other Research in Materials

The role of the Laboratory for Insulation Research in the alliance formed with the energy conversion group, the computer components group, and the semiconductor circuitry group will be to guide the scientific research relative to materials, while the other groups will be concerned mainly with exploiting the basic knowledge in long-range projects involving new devices and systems and their evaluation.

ELECTRICAL ENERGY CONVERSION

Our work in electrical energy conversion is becoming increasingly concerned with new materials and new techniques. Professors White and Richard B. Adler and their associates are studying the direct thermal-to-electrical conversion in solids. Preparation and evaluation of binary compound semiconductors has been started, and studies of the thermoelectric properties of mixed solid solutions of compound semiconductors are being undertaken. Related problems being investigated concern the preparation of good thermal and electric junctions, diffusion of junction materials into semiconductors at high temperatures, and the design considerations of practical thermoelements. The mechanisms and kinetics of electrode reactions in fuel cells and studies of the photoconductive properties of the semiconductors being developed for thermoelectric converters are being explored at the thesis level.

Professor Herbert H. Woodson of the Energy Conversion Group is conducting research in the interaction of electromagnetic fields and conducting fluids; his work is closely allied with the microwave gas discharge group of the Research Laboratory of Electronics and with the interdepartmental group which has proposed a more comprehensive effort in plasma physics. The initial studies of the group on electromechanical conversion, under the guidance of Professors Alexander Kusko and Mahmoud Riaz, have led to an experimental model demonstrating two possibilities of a traveling-wave type electromechanical amplifier.

COMPUTER COMPONENTS

Illustrative of the fruitful interplay of materials and systems is the role of the departmental group interested broadly in computation. On the one hand they must maintain a high level of work in the field of molecular engineering, because component advances necessitate developments in materials and methods of fabrication, and on the other hand they must be concerned with the latest concepts for sophisticated data processing. At present these activities, sponsored by the Lincoln Laboratory and the Bureau of Ships, center around microsystem component research and computer system theory and problem solving. Microsystems research currently involves three distinct aspects. Professor Arthur L. Loeb is interested in the physics of the thin-film state and research in microsystems. During the fall and spring terms, he continued the series of seminars started in the spring of 1957 on quantum mechanics, with much interest shown by many Department graduate students and faculty. Professor Dudley Buck continues his interest in components and circuits (the cryotron) based on the magnetic destruction of superconductivity. Professors Ewan W. Fletcher and Norman H. Meyers are attempting to evolve workable and understandable techniques for ultimately realizing active and passive components to one micron dimensions. The physical equipment for the components research activity has been augmented by clean room facilities, an electron microscope, electron diffraction, air conditioning, two new evaporators, and much auxiliary laboratory equipment.

RADAR COMPONENTS

The program in advanced radar techniques, under the direction of Professor J. Francis Reintjes, is investigating the application of modern magnetic materials and semiconductor devices to pulse

circuitry and new-component research. In the latter area, extensive research is being conducted on the utilization of very thin single-layer films of appropriate materials as rectifier and storage devices and multilayer films as computing elements.

Center for Communication Sciences

The establishment in May of the M.I.T. Center for Communication Sciences is a matter of great import for the Department. This new Center is under the direction of a steering committee, with Professors Jerome B. Wiesner, Claude E. Shannon, Gordon S. Brown, Robert M. Fano, and Walter A. Rosenblith from Electrical Engineering. It has evolved out of work conducted in the Research Laboratory of Electronics as well as other departmental laboratories by many of the faculty and graduate students in electrical engineering.

The Center will provide an environment for the interaction of research interests of faculty and students from many sections of the Institute in the areas of human and machine communication systems, including research on speech, perception, vision, neural transmission, psychology, artificial intelligence, linguistics, machine translation, computation and data processing, information theory, and feedback control. It will permit us to accord greater prestige to scholars who are not specialists in conventional engineering or science fields and who otherwise would not seek to enter M.I.T. It will give us a stronger basis for seeking support in the broad research area involving the processing and transmission of information in man-made and living systems. Already a series of five seminars on linguistics has been offered by Dr. Roman Jakobson, Visiting Institute Professor, with discussion by Dr. Niels Bohr and Professors Robert M. Fano and Laszlo Tisza. Cooperative efforts with the Computer Group at the Lincoln Laboratory have resulted in a study in which a digital computer was used for the detection of patterns in brain waves. The Average Response Computer (ARC), built by Wesley A. Clark, Jr., and his associates at the Lincoln Laboratory, is on loan to the Center and opens the way for new experiments on evoked potentials in intact and awake humans.

As an aid to the many studies anticipated in the Center for Communication Sciences, the Lincoln Laboratory has made available its TX-O computer. Plans are under way to transfer the machine to Building 26 by late summer. This transistorized, high-speed machine will be a valuable research aid for groups within the Department investigating new concepts in computer technology, simulation of physical systems, and biocommunications problems.

Servomechanisms Laboratory

The digital instrumentation group in the Servomechanisms Laboratory completed development and evaluation of a novel digital camera which encodes light pulses directly into number form and eliminates the need for photographing objects. A one-week Special Summer Program in Analog-Digital Conversion Techniques was offered for the second successive year by the instrumentation group under the leadership of Professor Alfred K. Susskind; and a textbook, *Analog-Digital Conversion Techniques*, based upon the notes prepared for the Program, has been published by the Technology Press and John Wiley and Sons, Inc. The Computer Applications Group has developed a method of utilizing general-purpose computers as an aid to programming digitally controlled machine tools, and in collaboration with nineteen aircraft companies is evolving a commercially usable system.

During the year, the Servomechanisms Laboratory joined with the Chemical Engineering Department to initiate a research program in chemical process control. This program has as its objective the optimization of chemical processing systems through use of modern process design techniques, computers, and automatic-control devices and is under the direction of Professors George C. Newton and Leonard A. Gould of Electrical Engineering and Professor Harold S. Mickley of Chemical Engineering.

Graduate and senior student research continued on theoretical questions in the control area. New results have been obtained in sampled and nonlinear, adaptive control systems as well as in realizability problems of linear systems. New work is planned on quantization problems and the implications of information theory for control systems.

Stroboscopic Light Laboratory

The work of the Stroboscopic Light Laboratory, under the direction of Dr. Harold E. Edgerton, continues in the area of underseas photography. Equipment is now being developed with the support of the National Geographic Society to probe to the bottom of the deepest ocean. A push-button electronic-flash photographic system is to be installed on a special submarine that Captain Jacques Y. Cousteau is developing in France.

A project scheduled during the coming year is the development of an automatic motion picture camera for great depths. A special light-triggered camera, which the Laboratory developed for Professor George Clarke of Harvard University and the Woods

Hole Oceanographic Institute, was used in the Mediterranean on Cousteau's ship, working from Monaco as a base, for some very successful photographs of the ocean bottom.

High Voltage Research Laboratory

The High Voltage Research Laboratory, under the direction of Professor John G. Trump and with the collaboration of Professor William W. Buechner of the Department of Physics, has begun a broad investigation of electromagnetic means of producing high voltage d-c power for particle acceleration. Doctoral theses completed during the year advanced the understanding of instability and breakdown in high vacuum and showed new techniques for the production and use of fast negative ions. This work is relevant to a new multi-stage method of achieving high-energy monoenergetic ions for nuclear physics research, by first accelerating negative ions toward a positive electrode, converting them to positive ions by stripping, and then giving a second acceleration away from this electrode.

Physical and clinical studies with megavolt electrons and X-rays, supported by the Damon Runyon Memorial Fund, continued in Building 28, with the medical cooperation of Dr. Magnus I. Smedal and his associates of the Lahey Clinic in Boston. Over 100 patients with *lymphoma cutis* — a widespread superficial malignancy — have been treated with two- and three-million-volt electrons. They constitute the largest patient series with this difficulty so far treated at one institution. The generalized skin lesions of these patients have been systematically controlled by electron therapy over long periods, often after conventional forms of radiation had been extended to the limit.

Interesting methods have been developed during the year for protecting radiation-sensitive structures such as the eye or the spinal chord in situations where these are surrounded by tumor-invaded tissue. Several of the techniques of field-shaping and protection in megavolt X-ray therapy developed in this program are gaining wider acceptance. The investigations on the banking of irradiated bone, arteries, and other materials, conducted by Professor Trump and Kenneth A. Wright, with the support of the United States Public Health Service, has led to the development of an irradiation service for some thirty hospitals around the country.

Research Laboratory of Electronics

The Department sponsors the Research Laboratory of Electronics jointly with the Department of Physics. The report of this

laboratory is appended. Approximately 30 per cent of the research energies of the faculty and graduate students of the Electrical Engineering Department support the activities of this interdepartmental laboratory.

Staff Activities

During the year Professor Claude E. Shannon served as Fellow at the Center for Advanced Study in the Behavioral Sciences in Palo Alto, California, on leave from the Department. Last February he gave the Venuxem Lectures at Princeton University on Information Theory and its Applications. In the second term, Professor Peter Elias served as Visiting Professor at the University of California, Berkeley, on leave from the Department. During October, 1957, Professor Ernst A. Guillemin gave a series of lectures on Advanced Circuit Theory at the University of Washington in Seattle as Walker Ames Professor of Electrical Engineering. Professor Aigrain of Ecole Normale Superieure in Paris made a second visit to the Department as Visiting Webster Professor during the second term, to counsel students and staff in the area of materials; it is expected that he will spend, on the average, a month each year with us on this status. Dr. Paul F. Chenea, Associate Dean of Engineering and Professor of Engineering Science at Purdue University and a specialist in advanced dynamics, servomechanisms, vibration analysis, and theory of elasticity, has been appointed Visiting Webster Professor for the academic year 1958–59. Professor Kenneth A. Fegley served as Visiting Assistant Professor of Electrical Engineering for the academic year on leave from the Moore School of Electrical Engineering at the University of Pennsylvania.

GORDON S. BROWN

MECHANICAL ENGINEERING

During the year 1957–58, the Department was happy to receive some accolades for past accomplishments, continued its work vigorously as usual both in teaching and in research, and was more than ordinarily active in soul-searching discussions about its course in the future.

The honors bestowed were threefold: Professor Samuel C. Collins received the Kamerlingh Onnes Gold Medal for his trailblazing accomplishments in cryogenic engineering; this was in a ceremony in Leyden, Holland, where the first liquid helium was produced. Professor Milton C. Shaw was given the Gold Medal of the American Society of Tool Engineers for his contributions to

the engineering literature in metals cutting extending over a period of twelve years. The third honor was for the Department as a whole: an eminent alumnus of the class of 1911, Admiral Luis de Florez, established a pair of "prizes for ingenuity" to be awarded to the senior and junior undergraduate students who showed the greatest accomplishment in that direction. The prizes were awarded during a special dinner in May, at which the junior and senior classes and most of the faculty were present.

As in previous years, some of our faculty members were abroad for the year on exchanges — Professor James B. Reswick at Imperial College, London; Professor Miguel A. Santalo at the University of Cambridge, England; and Professor Robert R. Archer at the Technische Hochschule in Darmstadt, Germany. Their places were taken here by Professors Peter F. Blackman from London, Harry G. Rhoden from Cambridge, and Hans-Theo Woernle from Darmstadt. Professor Egon Orowan spent half of the year at the Geology Department of the California Institute of Technology, and in return we will welcome Professor David S. Wood from Pasadena here for the first semester of the coming year.

The Department continued to be the most active one in the Institute in its contribution to the Special Summer Program series. We shall offer eleven such courses in the summer of 1958; of these, three have lectures published in book form in advance: the Program on Thermodynamics, given by Professor Joseph H. Keenan; on Random Vibration, given by Professor Stephen H. Crandall; and on Strain Gage Techniques, given by Professor William M. Murray. All of these draw large and important audiences and are a notable factor in extending the reputation of the Institute throughout the nation.

Research in Mechanical Engineering

Research continued on a large scale throughout the year and is becoming one of the principal means of education of graduate students. A partial and necessarily incomplete narrative of these researches, which have given rise during the year to fifty-five published scientific and technical papers, three books, and thirteen Sc.D. theses, follows.

Professor Tau-Yi Toong has been working on theories of ignition and flame stabilization under a grant of the National Science Foundation and is conducting research on the interactions between burning fuel droplets under a grant of the Shell Oil Company.

Professor Frank A. McClintock, in his studies on the mechanism of fracture in metals, has made a theoretical analysis of the stress and strain fields around a crack and has succeeded in establishing criteria for failure from this theory which agree with experiments on the behavior of aluminum foil.

Professor Thomas P. Rona is working on the development of a magnetostrictive ring oscillator and on a bifilar inertia reference system with optical registration, both of his invention. He and Professor Crandall have embarked on research on random vibration processes, which recently have acquired great practical significance. They also have taken part in an Air Force development of a high-speed carriage (up to Mach 10) on a track of several miles length.

Professor J. Lowen Shearer and his servomechanism and control group continue researches on nonlinear control in hot gas servomechanisms, conversion of high-energy pneumatic power to mechanical power, the feasibility of high-temperature hydraulic servo valves, conduit dynamics, heat exchanger dynamics, and human operator characteristics.

Professor Robert W. Mann, with the group on machine design, has been working on the utilization of hot gas in auxiliary power supplies, unsteady flow in partial admission turbines, gear dynamics, and the use of photo memory devices in character recognition and fast data storage and retrieval systems.

Professor Keenan, in collaboration with Professor Emeritus Frederick G. Keyes of the Chemistry Department, is continuing his work on the properties of steam at high pressures and temperatures on a research committee grant of the American Society of Mechanical Engineers. This work carried him to an international conference in London in July, 1957, and will take him to Moscow in July, 1958.

Professors Joseph Kaye and George N. Hatsopoulos have concentrated on the development of devices which convert heat into electricity directly with no moving parts. One resulting device, which has been named the thermoelectron engine, is based on the phenomenon of thermionic emission. The basic research program involved the development of new materials and new methods for reducing the space charge which is present in devices of this kind. A thermodynamic analysis of thermionic converters has indicated that thermal efficiencies up to 35 per cent are attainable with presently known materials. An extensive experimental program is under way; efficiencies up to 13 per cent have been achieved, and

This so-called "thermoelectron engine" is a promising breakthrough in the development of devices to convert heat into electricity without moving parts.

experimental work aiming at higher thermal efficiencies and the development of practical units having a power output of from 10 to 1000 watts is being continued.

Professor James A. Fay is continuing with his investigation by means of shock tubes into phenomena at high temperatures. He is actively engaged in the development of an Institute program in magneto-fluid mechanics.

Professor Kenneth R. Wadleigh and his group in the Steam Power Laboratory have made a theoretical and experimental study of fluid dynamics of two-phase flows in vertical tubes, sponsored by the Babcock & Wilcox Company. They are also working on the influence of design parameters on the performance of high-speed, jet engine gear pumps; on the atomization of liquids in high-velocity gas streams; and on the flow, heat transfer, and friction characteristics of small positive displacement expansion engines.

Professor Shih-Ying Lee has been conducting research in the general field of automatic control, including the development of new concepts in servo valve design for pneumatic systems.

Professor Kaye and his group continued to work on fluid flow and heat transfer in an annulus with the inner cylinder rotating,

and on the effects of sound fields on natural convective heat transfer. They also constructed an inexpensive supersonic wind tunnel which has yielded excellent experimental results in the study of diffusion of a foreign gas in the laminar boundary layer of a supersonic stream moving at Mach 5.

Professors Ascher H. Shapiro and Osman K. Mawardi and their associates have started a program of research in the area of magnetohydrodynamics. This new and rapidly developing field is becoming of great importance to a number of problems, ranging from controlled nuclear fusion to propulsion devices to be used for space ships. Studies are being made on hydromagnetic shocks and waves, on the dynamics of hydromagnetic stability, on radiation from plasmas, and on the containment of plasmas by electromagnetic fields.

Professor Brandon G. Rightmire and his group have completed an analysis of the dynamic behavior of ball bearings and have worked on the development and testing of a kinetic interpretation of temperature and speed effects in boundary lubrication. Progress has been made on applying statistical and probability methods to problems of dry sliding, and a study of abrasive wear has been started.

Professor Milton C. Shaw and his group in the Metal Cutting Laboratory have made a fundamental investigation of the role of manganese sulfide in free machining steels. They have also studied the action of extreme boundary lubricants used to produce fine finishes, the relation between tool temperatures and tool wear, the characteristics of ceramic cutting tools, and the basic action involved in the spark and ultrasonic cutting operations.

Professor Warren M. Rohsenow and his collaborators in the Heat Transfer Laboratory have studied nucleation processes associated with boiling heat transfer at a solid surface, the nature of the two-phase flow regimes of boiling in forced convection flows, the heat transfer and pressure drop in noncircular tubes with both laminar and turbulent flows, the effect on heat transfer and drag of pulsating flow across a cylinder in an air stream, the nature of heat transfer resistance at metal-to-metal contacting interfaces, and the mass transfer and heat transfer effects in freezing out one component of a two-component gas mixture.

Professor Edward S. Taylor and his group in the Gas Turbine Laboratory have continued research on the theory of three-dimensional boundary layers to include the region close to the wall, on the

experimental verification and theories of the behavior of the laminar boundary layer in unsteady flow, and on the behavior of the flow around compressor blade tips and roots.

Professors Edward R. Schwarz and Stanley Backer of the Textile Division have completed two major programs of research and development on parachutes. The first is an experimental program evaluating the interaction between biaxial stress levels on parachute fabric and resistance to air flow. This has provided the basis for a continuing program under Air Force sponsorship on the theoretical and experimental behavior of parachute fabrics at high altitudes, such as are involved in satellite recovery. In the second program, a complete design was developed for a high-speed impact tensile tester for use on parachute components. This machine will be built at the Quartermaster Research Laboratories and will be capable of testing materials over range of 15 to 60 feet per second, with a maximum load capacity of 6,000 pounds. Other research programs in progress include the study of the mechanics of nonwoven materials and a study of nonwoven processes and yarn bulking processes. Finally, an operations research evaluation of the parachute service life problem is under way, with the cooperation of the Mathematics Department.

During the year a series of departmental faculty meetings of more than ordinary interest were held, during which educational policies, admissions procedures, and questions of curriculum were discussed at length.

JACOB P. DEN HARTOG

METALLURGY

In many areas of technology, future progress rests on the availability of improved materials of construction. Research in materials has become a most critical part of research and development programs in connection with high-speed flight. Not only is there a great need for metals of superior properties at elevated temperatures; there are also similar needs for nonmetallic materials, such as ceramics, cermets, plastics, elastomers, and substances of controlled electrical and magnetic properties.

Developments in Materials Technology

Many of the basic principles of chemistry and physics which metallurgists are accustomed to apply to metallic structures are also applicable to nonmetals. This fact, coupled with the already important activities of the Department in fields of minerals, ceramics, and such complex aggregates as cermets, suggests that serious consideration be given to broadening the Department's interests to include engineering materials in general.

A committee of the School of Engineering under the leadership of Professor Morris Cohen has studied and is prepared to recommend a graduate curriculum in materials technology which would be open to graduates of any engineering department and to others properly qualified. It would be a two-year curriculum leading to two degrees: Master of Science in Materials Technology, and Materials Engineer. These plans are of vital interest to the Department, and it is anticipated that a number of Course III graduates would seize the opportunity to broaden their knowledge of materials in general.

In connection with the undergraduate program, the sophomore subject offered to metallurgists and to students of other engineering departments, formerly called Engineering Metals, has been renamed Engineering Materials, and the content has been broadened to include nonmetallic materials. Instruction is based upon the structure, properties, and processing of materials, and the basic principles are applied alike to metals and nonmetals.

The revised curriculum in Metallurgy, with its wide choice of elective subjects in the junior and senior years, offers any undergraduate student the opportunity, both inside and outside the Department, for special instruction in specific types of materials, as well as in design courses in which the selection of materials is vital. Thus a student in Course III can secure broad preparation for a career in materials engineering.

The undergraduate and graduate enrollments of the Department remain at essentially a constant level, the latter being limited by laboratory space available for research.

Research in Metallurgy

A number of research programs have attained fruition during the year. The method of fluorescent X-ray analysis is constantly finding new applications and is becoming increasingly effective as a tool for metallurgical research. A microbeam analyser which provides a rapid and quantitative chemical analysis of an area of a metallic

specimen about one micron in diameter (about 2 billionths of a square inch) has been constructed by Professors John T. Norton and Robert E. Ogilvie. By this means it is possible to identify tiny inclusions in metals and to study concentration gradients from grain to grain as well as within individual grains. The unit has proved to be of tremendous value in the study of diffusion and offers new approaches to the determination of phase diagrams; it promises to become one of our most useful research techniques.

Research in the Corrosion Laboratory under the direction of Professor Herbert H. Uhlig has led to an explanation of the passive film on metals which is so important in preventing corrosion. Potential measurements have yielded that the passive film on iron produced by chromates, nitrites, molybdates, tungstates, and similar passivators is related in properties to the passive film on stainless steels, nickel, or chromium. In all instances, the passive film has been shown to consist of adsorbed oxygen.

It has been known for some years that unusual properties could be conferred upon aluminum by a method of fabrication in which powdered aluminum and very finely divided aluminum oxide are thoroughly mixed and subjected to mechanical working as by extrusion. Professor Nicholas J. Grant has shown that unusual properties can also be obtained in copper and nickel when similarly blended with aluminum oxide in finely divided form. The technique is of special interest for high-temperature applications, since the usual recrystallization of the metal is prevented. The strength of copper at temperatures of 450° to 550°C can be greatly enhanced without large impairment of its electrical conductivity. Similar techniques are being applied to the more refractory metals with promising results for high-temperature application.

Personnel and Professional Activities

A number of awards have come to members of the Department during the year. In December, *Chemical Engineering* presented to the Richards Mineral Engineering Laboratory, through Professor Antoine M. Gaudin, an award for chemical engineering achievement "for meritorious contribution to the extractive metallurgy of the atomic age."

Professor Howard F. Taylor and R. Guy Powell received the Gustav Lilliquist Award of the Steel Founders Society of America for the best technical paper of 1958.

Professor Frederick H. Norton delivered the honorary lecture and was made an honorary member of the British Ceramic Society "in recognition of his outstanding services to the science of ceramics."

Professor W. David Kingery was the first recipient of the John Jeppson Gold Medal of the American Ceramic Society "in recognition of his contributions to the understanding of heat transfer through ceramics and his measurements of basic thermal conductivity values."

Professor Morris Cohen delivered the Burgess Memorial Lecture of the Washington Chapter of the American Society for Metals. He also served as chairman of the first Karl Taylor Compton Lectureship Committee, which was responsible for bringing Professor Niels Bohr to the Institute for a series of six lectures on The Philosophical Lesson of Atomic Physics.

Professors Chipman and Grant were invited to attend a seminar in Moscow and spent three weeks in the Soviet Union, visiting research laboratories and teaching institutes of metallurgy and installations of the steel industry. Professor Cohen went on a similar mission, along with nine other metallurgists from various parts of this country. These three representatives brought back first-hand information on Russian progress, especially in the field of metallurgy, and since their return they have been in demand as lecturers for various organizations.

JOHN CHIPMAN

NAVAL ARCHITECTURE AND MARINE ENGINEERING

The Department of Naval Architecture and Marine Engineering has continued to prosper in a year of greatly expanding technical activity in the field. During the year, 13 bachelor's, 26 master's, and 24 engineering degrees were granted by the Department. This year a second student completed the five-year Course XIII-B, Shipping and Shipbuilding Management. No student, however, is enrolled at the present time in the undergraduate year of this Course, and the demand of the marine industry for persons with this educational background is not being met. In fact, we cannot meet the demand for our graduates with bachelor's or master's degrees in any curriculum.

Of the 13 recipients of the bachelor's degree in 1957–58, 5 are foreign nationals. Of the 28 recipients of advanced degrees, 25 are naval students and 3 are civilians. Of the latter, only one is a citizen of this country. (It should be noted that the naval students concerned receive the master's and engineering degrees simultaneously.)

The Department continues its important role in the training of naval officers.

The Class of 1961 in Naval Construction and Engineering, Course XIII-A, is composed of 15 U.S. Navy officers, 6 U.S. Coast Guard officers, and 3 foreign naval officers, making a total of 24 new students. In June, 1958, 6 Brazilian naval officers, who will have completed the equivalent of the first year of the Course XIII-A curriculum at the Escola Politecnica of the University of São Paulo, will join the Class of 1960.

Personnel Changes

Professors George C. Manning and Evers Burtner retired from the Institute at the end of the academic year. Professor Manning will continue his activities at the University of São Paulo, Brazil, for at least another year. Professor Burtner will continue to serve as Emeritus Lecturer, part time. Assistant Professor Amelio M. D'Arcangelo will join the faculty of Virginia Polytechnic Institute next year, and Assistant Professor E. Eugene Allmendinger will join the faculty of the University of New Hampshire.

At the beginning of the year, Professor Philip Mandel accepted a three-year appointment, and Justin E. Kerwin was named an instructor.

Captain Jack A. Obermeyer, U.S.N., will be relieved of his duties at the Institute by the Department of the Navy at the end of the academic year 1957–58. His successor will be Captain Edward S. Arentzen, U.S.N.

Professor Kemal Kafali of the University of Istanbul, Turkey, has been a Guest of the Institute since October, 1957. He will work in this Department for another year.

Educational Program

A detailed review of the curriculum in Naval Construction and Engineering resulted in a number of changes and in the reduction of the number of specialties from five to four, as follows: hull design and construction; marine electrical engineering; ship propulsion engineering; and nuclear engineering. All specialties now have a common group of subjects for their first academic term.

As a result of a thorough study of the undergraduate curriculum, the sophomore year will now be identical to the new sophomore curriculum for Mechanical Engineering.

For the second year, the Department has joined with the Department of Architecture in a common project giving opportunity to a group of architectural graduate students to work on the design of a ship, placing special emphasis on new ideas and solutions to the ship's accommodation problem. There is no doubt that this common project is an effective and stimulating educational device for both departments.

In the Hart Nautical Museum, various exhibits of ship models and plans were arranged. A short-term loan of whaling prints and Benjamin Russell paintings was made to the Old Dartmouth (New Bedford) Museum.

Research and Technical Activities

The Propeller Tunnel, in addition to its normal instructional use, has been extensively used in research projects dealing with inertia effects, propeller stress, and hydrodynamic force influences. Independent research by Professor Kafali was on the subject of multiple rudder effectiveness as affected by propeller-rudder configuration. The tunnel is part of a comparative testing program initiated by the International Towing Tank Conference.

The Ship Model Towing Tank continued its activities in instruction and in thesis work as well as in research, which was mainly in the seakeeping behavior of ships. The tank was represented at the International Symposium on the Behavior of Ships in a Seaway in Wageningen, The Netherlands, and at the International Towing Tank Conference in Madrid, Spain. Several contributions were made by the director, Professor Martin A. Abkowitz. Facilities of the Computation Center are being used in connection with calculations for sponsored research projects. The facilities of the towing tank have been augmented by the purchase of a four-channel electronic recorder. The operation of this installation is still seriously limited by the lack of any full-time employee, and the type of research which can be carried out is still seriously restricted by the lack of a monorail towing carriage.

The equipment of the Ship Structures Laboratory has been significantly augmented by the purchase of a very fine polariscope with a unique light source. The first phase testing has been completed in a project on the buckling of wide plates sponsored by the

Society of Naval Architects and Marine Engineers. The second phase can be undertaken this summer. Unsponsored research has continued on beams of short, deep proportions with stiffened and unstiffened webs. The hydraulic testing frame has given very satisfactory service, and the test results are gratifying.

This summer the Department will again offer a two-week Special Summer Program in the Stability and Control of Ship Motion.

The Department's brochure has been well received. A first edition of 1,500 copies was distributed, and a second and revised edition of 2,000 copies is in the process of distribution; we hope that it will aid materially in attracting young men to the profession.

LAURENS TROOST

RESEARCH LABORATORY OF ELECTRONICS

The past year marked the completion of twelve years of operation for the Research Laboratory of Electronics. Early in the year some of the research activities were moved to new quarters in the Karl Taylor Compton Laboratories. These two events prompted an appraisal of past performance and a critical evaluation of future goals.

The major objectives that prompted the founding of the Laboratory twelve years ago are still valid. These objectives are as follows:

1. To establish an environment in which basic research can flourish.
2. To provide improved facilities for graduate education in the broad field of electronics.

In addition, the sponsors wished to maintain close liaison between the military services and the frontiers of electronic science and engineering. The military services were also interested in establishing a laboratory from which competent help could be drawn at critical times. The application of basic research in communication theory to military problems during the Korean War is an excellent example of the manner in which this goal has been met.

The success with which the two major objectives have been met is a matter of record. Significant contributions have been made in a variety of existing fields, and pioneering work has been done in

a number of new ones. A partial list of the areas of interest includes physical electronics, microwave gas discharges, microwave spectroscopy, nuclear magnetic resonance, microwave electronics, atomic beams, statistical communication theory, processing and transmission of information, machine translation, communications biophysics, neurophysiology, network synthesis, nonlinear circuit theory, radar and missile guidance studies, and frequency modulation. Work in these diverse fields has resulted in approximately four hundred technical reports and about six hundred theses. The roster of the Laboratory's alumni includes some nine hundred names, many of which are important in academic, industrial, and government circles.

Much of the strength of the Research Laboratory of Electronics has been the result of the interplay between different technical disciplines. One of the most striking examples is in the area of statistical communication theory and the closely related work on processing and transmission of information. These mathematical principles have had a profound influence on the research in speech analysis and synthesis, linguistics, machine translation, biophysics, and neurophysiology. Conversely, these diverse areas of research have provided stimuli for further work on communication theory.

During the past year, the Institute established the Center for Communication Sciences for the purpose of giving greater recognition to the broad area of research involving the processing and transmission of information in man-made and living systems. This Center is to be associated with the Research Laboratory of Electronics, where research of this character has evolved during the past twelve years. This new Center will provide a mechanism for increasing the emphasis on human communication systems, including speech, perception, vision, neural transmission, psychology, artificial intelligence, and linguistics.

Work in the physical sciences will continue to be of major importance in the Research Laboratory of Electronics. This research includes fundamental physics, investigation of electronic devices, circuits and systems. Here again, technical interplay is important. For example, Professors Malcom W. P. Strandberg and Robert L. Kyhl at R.L.E., along with others at various laboratories, have succeeded in amplifying microwave signals by means of atomic energy transitions in the quantum-mechanical amplifier or "maser." Such amplifiers have great potential value in radar and communication systems, since they are very sensitive. Professors William P.

Allis and Sanborn C. Brown have made theoretical and experimental progress in the understanding of high-density ionized plasmas. An engineering development led by James W. Graham and Rosario S. Badessa resulted in a precise instrument for measuring the cyclotron resonance of ions in a plasma. Professor Jerrold R.

This "magnetic bottle" is used in the study of plasmas — electrical discharges in gases — related to problems in the control of thermonuclear reactions.

Zacharias has continued his work with cesium frequency standards for use in speed-of-light measurements, gravitational red shift measurements, and elsewhere. Professor Lan J. Chu has completed his formulation of macroscopic electrodynamics, which encompasses the interaction of fields and materials. Professors Hermann A. Haus and Louis D. Smullin have extended their work on noise in electron beams. The Statistical Communication Theory Group headed by Professor Yuk-Wing Lee has transcribed a series of lectures given by Professor Norbert Wiener for publication by the Technology Press. This book will be one of a series of research reports published to provide wider circulation of significant research results.

The availability of the I.B.M. 704 computer has had a profound influence on the trend of a number of research projects. One example is an investigation of the problems of processing picture

information. Instead of constructing large amounts of experimental apparatus, William A. Youngblood carried out his experiments by programming them on the computer. Increased computer facilities for experimental work will be available when the TX-O computer is in operation. This transistorized unit was built by Lincoln Laboratory and is being made available to the Electrical Engineering Department and R.L.E. for use in computer research activities.

During this past year thirteen doctor's theses were completed in the Research Laboratory of Electronics. In addition, the Laboratory sponsored numerous master's and bachelor's theses.

The technical staff during the past year has included 53 members of the faculty, 12 instructors, 8 research associates, 111 research assistants, 6 teaching assistants, and 5 industrial fellows. Total personnel including nonstaff and hourly employees averaged about 360 during the year.

JEROME B. WIESNER

HENRY J. ZIMMERMAN

School of Humanities and Social Studies

If asked to select the most important events in this School during the past academic year, I would recall that the faculty had approved the offering of a Ph.D. degree in political science; that the first seniors had been graduated from the new Course XXI; that Professor Ralph E. Freeman had retired as head of the Department of Economics and Social Science and had been succeeded by Professor Robert L. Bishop; that The Ford Foundation had made a substantial grant, $750,000, to support a four-year research and training program on problems of Indian economic growth to be carried out by the Center for International Studies in cooperation with several leading research organizations in India; that the Choral Society had been invited for the second year to sing in Europe and had accepted; that considerable strides had been made both in how Russian is taught at the Institute and in the numbers who elect to study it; that The Carnegie Corporation of New York had made a new grant of $100,000 for the general purposes of the School, to succeed the one of several years ago which had run out; and that the Special Advisory Committee to the School of Humanities and Social Studies had made its final report.

Each of these, except the Special Advisory Committee, will be discussed elsewhere in the text below; so it is appropriate to say a word here about that Committee. In my report of a year ago I commented on the establishment of the Committee and its distinguished composition, made up as it was of Carlos Baker, Kenneth Boulding, Bruce Catton, Robert Merton, Henri Peyre, Paul Weiss, and Harold Lasswell, the latter acting as chairman. Each member was a well-known and distinguished specialist, and among them they covered the fields in which this School operates; most of them were

attached to distinguished universities whose different experiences might offer valuable suggestions to us. The Committee came into being because I thought we needed a hard look at proposals from the Department of Modern Languages to install subjects in linguistics as a permissible option in satisfying our humanities requirements; also, I felt that this look would be more penetrating if it included an examination of all our other offerings in the upperclass electives, field by field. As the quality of the Committee and its interest became apparent, it was obvious that they should be invited to make any comments they thought wise about the School, and their final report took advantage of this wider interpretation of the mission. In the end, the report discussed the idea of a technological university; conditions at M.I.T. in the humanities and social sciences as regards morale, space, salaries, and library; the problem of recruitment and retention of staff; the details of our various upperclass sequences, including their virtues and their faults and recommendations for change; and finally, proposed fields for potential exploration and consolidation. The report was, in my opinion, brilliantly successful. Since it concerned itself with internal questions, it has seemed best to use it internally, and I do not propose to summarize it here. The report has been of great use to many of us in the School, and we must express our gratitude to the members of the Committee, who gave it so much time and thought, and to the Carnegie Corporation, from whose general grant we financed its cost.

Undergraduate Program

The Core Curriculum

Professor Howard R. Bartlett reports, with respect to the required subjects for underclassmen in the first two years, that only minor changes have been made in content but that a series of departmental staff meetings has resulted in proposals for major changes, particularly in the subject taught to second-semester freshmen. There is no unanimity as to the revisions that should be made, he says; but they should nonetheless be undertaken if only to create a greater feeling of involvement among the newer members of the staff, whose teaching is likely to be largely in the core subjects. The problem is chiefly one of maintaining enthusiasm for the objectives of the core rather than one of remedying any serious defects in what we are now doing.

With this, I would heartily agree. There is no collection of eight periods which are the indispensably right ones to study; there are few if any individual human documents which can be awarded such indispensability. It has long been my view that the core curriculum is weak in omitting consideration of the Palestinian Hebraic society and of the Roman imperium in favor of what seems to me an overemphasis on twentieth-century thought. But my colleagues have not agreed, and in the long run this difference is not an important one. The important thing is that people who are teaching a broad subject of this sort have enthusiasm for its details. This enthusiasm is more easily kept alive when the teachers participate intimately in the planning. So we should always be revising our core, and from time to time drastically, despite the fact that (unlike physics) the knowledge of these ancient civilizations and even the interpretations of the knowledge are not changing at a rapid rate.

Upperclass Electives

You will recall that all M.I.T. juniors and seniors are required to elect a group of subjects in the humanities or social studies, normally in a single field. The distribution of these elections changes slightly from year to year and is interesting to follow. The table below shows the number of students who were registered in a subject for one semester during the 1957–58 academic year:

Economics	1,206
History and philosophy	755
Literature	703
Psychology	519
Political Science	378
Music	292
Industrial relations	242
Fine arts	149
Foreign literature and linguistics	112
Total	**4,356**

This total represents a net increase over last year of 366. There was a slight and not significant decrease of 25 in all social science subjects and a large and significant increase in the humanities subjects of 242. But it is easy to overinterpret the figures. There is, for example, a built-in registration in elementary economics, occasioned by the fact that most of the engineering departments at M.I.T. require one term of economics. The changes in the psychology curriculum made it impossible to accommodate all

those students who wished to elect it during this year. Certain restrictions are necessary in some of the specific courses in literature and philosophy. Many of the registrations are now affected by required subjects in humanities or social studies occasioned by the syllabi of Courses XIV and XXI, our own majors.

However, one fact should be noted. This year there were 854 juniors and 883 seniors at M.I.T. If each of these had elected the minimum requirement of two subjects, the total election would have been 3,474 subjects. The difference therefore between the actual total of 4,356 and the theoretically required total of 3,474 is the substantial quantity of 882. This figure is well in excess of all the additional registration that might be induced by the requirements of Courses XIV and XXI, and it suggests to me that there is a considerable and continuing trend for M.I.T. students to elect more subjects in the social studies and the humanities than are required for their degrees. This is naturally encouraging to us, and it suggests that it may now be timely to analyze more carefully the extent of this trend and to see what subjects profit most from student enthusiasms beyond the call of duty.

Among the upperclass electives, three deserve special mention this year.

In the first place, the faculty approved linguistics as a new field of upperclass concentration in the humanities, following recommendations by the Special Advisory Committee previously mentioned. Linguistics, the science of language, has been taught at M.I.T. since 1950. For a time, a single subject, Social Linguistics, was offered; in 1955–56 two subjects were offered — Linguistic Structure, and Language and Society. This year a third subject, Problems of Phonology, was approved to round out a sequence. We are fortunate to have in the Department of Modern Languages two outstanding young linguists, Associate Professors Morris Halle and Noam Chomsky; and we have been privileged also that Dr. Roman Jakobson, no doubt the world's leading figure in linguistics, has been Visiting Institute Professor. I might also remark that growing undergraduate enrollments created the demand for this new field of concentration, and this is of course particularly healthy.

Secondly, aided by the strength implicit in the new Ph.D. degree in political science, by increased participation in teaching by members of the Center for International Studies, and by a grant from the Maurice and Laura Falk Foundation of Pittsburgh,

reported last year, extensive revisions were made and additions incorporated in the undergraduate offerings. Graduate courses in national security, military technology, and public administration contributed to the undergraduate courses. As a feature of the senior seminar in international relations, a "foreign policy game" method of instruction was initiated, in which students assumed the roles of foreign ministers of the major powers under carefully designed situations and conditions. The use of the game method brought observers from the RAND Corporation and inquiries from other universities.

Under the Falk grant, Assistant Professor Robert C. Wood made brilliant progress with another subject, which I wish might be reported even more fully here. Briefly, in the introductory undergraduate course, field project assignments were used as another way of providing students with direct contact with the political world. Public policy issues of immediate interest in the Boston metropolitan region were selected, each directly related to technological advances, and students were put in touch with the participants in these controversies under special arrangements. Sometimes by interviews and sometimes by direct working associations, the undergraduates studied the interaction of politics and technology at first hand and reported their findings and experiences in case form.

All in all, the Political Science Section has clearly come of age. Its offerings deserve more attention and registration, not only in the upperclass electives but also in the political science option of Course XIV and at the graduate level. There are some unique opportunities for studies in these areas at M.I.T., induced both by the activities and influence of the political science staff in world affairs and by the fact that politics today is heavily influenced by technology, which can be ignored only at peril.

Indeed I wonder, as I often have, why engineering educators at the national and accrediting level, at the departmental level, and even here at M.I.T., continue to regard economics as the single subject in the social sciences — and indeed as almost the only subject in the "humanistic-social" stem — which every engineer needs to encounter. I do not ask this question with any disdain for economics, which of course tries to analyze one of the foundations of our society — and a very important one indeed. But economics cannot account for the political man or the psychological man or even the sociological man, and I continue to wonder why engineering educators do not choose to follow the example of scientific

educators. Then, if there were any specific requirements in the upperclass electives at all, they would be for a stated number of units of social science and not specifically for economics. I believe all hands, certainly the professors of economics and most of all the engineering students, would profit from this greater freedom.

The third major change occurred in the psychology curriculum, on which Associate Professor Roger W. Brown and Assistant Professors John A. Swets and Davis H. Howes worked with very good results. Six new subjects were offered for the first time, so that nine are now available to the undergraduate. The introductory course, after extensive renovation, was made a prerequisite for the others. The general concept of the program is to cover the entire range of psychology in the first course and then, at a more advanced level, to span the same subject matter through eight specialized subjects. Thus a student who elects psychology as his field of concentration in humanities receives a broad picture of the whole field and makes an intensive study of two major topics; in special cases he might even make three intensive studies. The cornerstone of the new program obviously is the introductory course. The whole staff participated in getting it under way, and help was also obtained from psychologists in the School of Industrial Management, each lecturing on his special field and on the subjects he taught in the advanced courses. A great deal of attention was paid to the integration of material presented by this variety of instructors. A little may remain to be done to smooth out the rough spots, but the basic organization has proved highly satisfactory and is to be continued without change next year. A major need now is for a laboratory which will permit extensive use of demonstration equipment to supplement lectures; equally essential is the problem of long-time staffing with people who enjoy this rather strictly undergraduate teaching program and who will at the same time add distinction to the research activities of the Institute. I am sure that psychology will continue to be among the most popular electives in the social sciences and that psychological research, at least of certain kinds, will be logically central to other research activities at M.I.T. Thus I have no doubt that in the end there will be a psychology option in the undergraduate majors of Course XIV and little doubt either that a Ph.D. in psychology is inevitable. The question is, how soon; and the difficult problem is to get over the hump. The psychologists may look with some comfort to the fact that political science, after years of steady work, mostly at the under-

graduate level, bloomed rapidly when the conditions were just right. There is nothing in principle that inhibits a comparable development of psychology here; but we have not managed to strike quite the right strings yet, and I can think of no more urgent piece of unfinished business in this School.

Growth of Language Study

It is no national secret that the extent and quality of understanding of modern foreign languages among the American people is dangerously low and that substantial advantages are being conceded to other peoples, including the people of the Soviet Union, by our apathy in this regard. We have witnessed a disastrous cycle of events, in which a preponderance of colleges and universities have abandoned not only the entrance requirement of competence in a modern language but even the requirement of such competence for attaining the first degree; even where the requirement remains, it is less than minimal; for there is a critical point in the comprehension of any alien language below which retention and use will disappear and above which the probabilities of retention and use are maximized. There is also little national understanding of which languages are now critical for Americans. The World Wars reduced the study of German severely; apparent commercial advantages in some localities have perhaps overemphasized the study of Spanish; the study of French is dominant, and although no one admires this language more than I or would be more prone to praise its enormous literature and its cultural advantages, there is surely a serious question for debate whether Russian or Arabic or Urdu or Chinese may not be more important for many Americans today. Finally, the universities practice the ultimate absurdity when, having abandoned the pretense of a requirement for the first degree, they turn around and require competence in two foreign languages for the doctorates!

I think we must lay the blame on the easing of requirements at the college level, for this has reduced the number of college faculty, has reduced the number of Americans who wanted to make language competence a life work, and most of all has removed almost all the pressures on the primary and secondary school curricula, where the beginning of language competence is most easily achieved. I regret that M.I.T. must share this guilt with its sister institutions; and I wish that we might restore the requirement of competence for entrance or even for graduation, as the Visiting Committee on Modern Languages has several times recommended. But though

we may seek this end, no one university nor even a few universities are likely to change the national picture very much. Meanwhile I can report, with more pleasure, smaller developments on our own campus. Let me speak here of the growth in the study of Russian and secondly of the change of emphasis in instructional methods.

Professor William N. Locke reports that Russian has been offered at M.I.T. for twenty years, at first informally and without credit. In 1943 two elementary subjects were offered for credit and gained an enrollment of forty-five students. In 1950 two intermediate subjects were added, and one student elected the second year. In 1946 we added Scientific Russian for graduate students, with an enrollment of thirty-three. From the forty-five enrollees of 1942 there was a quick decline until 1945, when the enrollment of nineteen in 1944 jumped to 110. Again attrition set in, dropping to a low of fifty in 1951; but since then the trend has been steadily upward, amounting to 107 in 1956 and 217 in 1957–58. We can hope that this trend will continue, as we believe it to be related to a national need.

The faculty's interest in Russian became so keen this spring that we made a special appropriation to allow the addition of four part-time Russian teachers solely for faculty instruction. One hundred and fifty graduate and postgraduate students began Scientific Russian in February. Of these, forty-five were faculty and staff members. A dozen others enrolled in an intensive special course in speaking and reading Russian. Starting in June, another group composed principally of aeronautical engineers will work on Russian throughout the summer with Assistant Professor Secor D. Browne. Indications are that undergraduate interest in Russian will increase next year, and the Department staff is being developed with this in view. Already inquiries are being received about Russian literature in Russian; and as the number who have gained competence in Russian increases, we shall certainly have to open opportunities in literature.

In accordance with the more advanced ideas about language instruction elsewhere, M.I.T. has this year begun to shift emphasis away from the grammar and the translation of foreign languages, providing a much larger place for the spoken language in the elementary years. Since language is first a means of communication between living peoples, this is a sensible measure. The written language is independent of and in a sense a crystallized form of the spoken language. Spoken language is a living organism in constant

flux, and the written language trails behind, with a considerable time lag. Thus the spoken language may be the most reliable day-to-day mirror of the thinking of a contemporary people. Of course, full competence must in the end involve skill in writing and reading as well as skill in speaking and listening, but there has been a reversal in judgment as to which set of skills comes first.

The new emphasis on the spoken form of French, German, and Russian has made a noticeable improvement in the interest of the students. Moreover, as students enter the literature subjects, we are able to demand exclusive use of the foreign language in lectures and discussions, thus rapidly building the individual's competence and confidence.

M.I.T. needs more facilities for practice in speaking foreign languages. We have plans for a language practice room, where students can record selections in the language they are studying, but we do not yet have the money for the necessary equipment. Space has been set aside, and part of the funds have been promised by a generous alumnus who has been a consistent supporter of this School, so there is hope that next year we shall be able to provide this facility which has proved elsewhere to have great value.

Magnetic recording equipment allows one to listen over and over again to foreign sentences, to record one's imitation, and to listen to the model and the copy. By repeated recording and playing back, form and content may be studied separately, even perfected separately. Special tape-recording equipment for this method of language teaching has been designed by Professor Locke and Associate Professor Thomas F. Jones, Jr., of the Department of Electrical Engineering, and is being developed with the assistance of a local firm. A grant is being sought to complete this development and to supplement the gift already mentioned. In this work and in a series of evaluative studies to be made on the equipment and its applications, M.I.T.'s Department of Modern Languages is cooperating with Purdue University.

The Undergraduate Majors

The School of Humanities now has two full-fledged undergraduate majors. Course XIV, the older, has been going for some time with an economics major, and an option in political science was recently added. The psychologists suggest with some force that they are almost ready to propose a third option, in psychology. Course XXI operates in the Department of Humanities, and at Commencement

this year the first degrees were awarded in this new Course. Three were in Humanities and Engineering, eight in Humanities and Science. Among the graduates were a recipient of a Rhodes Scholarship and a winner of a Woodrow Wilson Fellowship. No placement problems were encountered; most of the graduates were continuing with graduate work, and the remaining few found positions without any direct assistance from the Department. Nine seniors were graduated in Course XIV.

Course XIV was considerably modified two years ago; the political science option was adopted then, and the first graduates emerged this year. So far, only a minority of Course XIV students are electing the option in political science; at the end of the spring term it was the choice of four out of fourteen juniors and three out of seventeen sophomores.

Peak enrollments in Course XIV occurred in the immediate postwar period, shortly after the program was organized. There was then a decline to the low points in the period 1952–55, with some recovery in the last few years. Typically, there is an increase in Course XIV enrollments in each class as it progresses from sophomore to junior to senior. This suggests, as is not surprising, that few students come to M.I.T. with the preconceived notion of majoring in Economics (or Politics) and Engineering (or Science). Some then elect Course XIV because their appetites have been whetted by one or more of the introductory subjects in the Department; but others, it must be admitted, turn to Course XIV not because they love economics or political science more but because they have come to love science and engineering less. Of the latter group, some are in actual or incipient academic difficulty, and this has persuaded the Department that it must be especially vigilant in maintaining the standards that its students must meet. Course XIV probably has a greater mortality rate than most other departments, despite the generally upward trend of its enrollment of the members of any given class. Everything in this statement about Course XIV could also be said of Course XXI; yet it is our intention that these Courses shall be among the most testing (and rewarding) in the Institute, and we have no desire simply to make it easier for some students to get a degree. Indeed, this we must discourage by every means in our power.

The most effective means is, of course, to have an even larger cadre than we have now of absolutely topflight enrollees in these Courses. This poses a continuing problem for both Departments of

convincing M.I.T. undergraduates (and perhaps even more of convincing potential applicants for admission to M.I.T.) of the constructive career opportunities of a combined study of social science or the humanities with engineering or science. To work on this aspect of the problem and to explore ways and means of improving the substance and attractiveness of Course XIV, the Department of Economics has established a committee consisting of Professor Harold A. Freeman and Assistant Professors Francis M. Bator, Abraham J. Siegel, and Robert C. Wood, with Professor E. Cary Brown as chairman. The Department of Humanities has a corresponding committee in being.

Graduate Program

All the graduate degree work in the School continues to be carried on in the Department of Economics and Social Science. However, we have an increasing number of graduate subjects in other fields, notably in the history of science and in modern languages. The expansion of our competence and interest in linguistics has aroused graduate interest among our own students and elsewhere as well. Several applications for graduate study leading to an advanced degree have been received. One has been accepted, although under the present circumstances the degree will have to be without specification of field. The Department of Modern Languages hopes that it can work toward graduate degrees in linguistics for unusually well-qualified students, for M.I.T. probably has unequalled opportunities for combining concepts of mathematics, physics, and electrical engineering with work in linguistics.

But the major graduate effort remains in the Department of Economics and Social Science, and the largest number of graduate students continues to be in economics. This number reached an all-time peak during the past two years. From September, 1957, to June, 1958, the Department recommended eleven Ph.D. and five S.M. degrees, the maximum number of graduate degrees in any single year in its whole history. The current level of numbers is about what the Department wishes to maintain in the future. In each of the last two years an unusually high acceptance rate among admitted applicants gave the Department about thirty first-year graduate students, which was somewhat more than is appropriate. To prevent a repetition of swollen admissions, the number admitted for next year was deliberately fewer, so there will be only about twenty first-year graduate students.

The graduate program in economics, including that in industrial relations, seems to be in good shape. It has been some time, however, since any changes have been made in the program. As a result, the Department feels that a review of practices and procedures will be constructive and has appointed a committee on possible revisions, consisting of Professors Evsey D. Domar, Charles P. Kindleberger, Charles A. Myers, and Robert M. Solow (chairman).

The graduate program in political science, under the direction of Professor Norman J. Padelford, is brand new. Focusing on the political problems which arise from changes in science and technology, it offers instruction in six fields and provides unusual opportunities for interdisciplinary study within the behavioral sciences, in combination with study in the sciences and engineering. Maintaining close ties with M.I.T.'s established research centers in International Studies, Urban and Regional Studies, and Communication Sciences, it aims at providing each graduate student with concrete experience in the political process. With such a combination of advanced instruction, professional research, and direct field experience, the program looks forward to supplying industry, government, and universities with people well equipped to deal realistically with problems of public policy — people who are capable of interpreting the significance of scientific advances to political institutions and processes. As science and technology continue to provide both opportunities and problems for the political process, an understanding of that process becomes of increasing importance, and not only for M.I.T. graduates. It is appropriate that the center for mature scholarship arising here is concerned with those opportunities and issues which call for the established M.I.T. tradition of essential unity among the sciences and the humanities.

The faculty available for the graduate students in this program includes the many eminent people who are permanent professors in various M.I.T. departments, together with a distinguished group of mature visitors who work in the various research centers at M.I.T. Certainly the ideas and the personnel for this new venture have been well considered and are mature; the most immediate problem for those who are supporting it will not be intellectual but financial, for we must find a way to put the fiscal foundation on as solid a basis as has already been erected for the intellectual foundation.

Before the inauguration of this new Ph.D. program in political science, the international communications program had entered the second year of graduate work in its special field. The core group

of five carefully selected scholarship students completed their courses satisfactorily and in several cases produced distinguished research papers in connection with a seminar on international communications research. A number of students from other departments and from Harvard and Radcliffe were permitted to register in these courses.

The possible relation between graduate work in political science and graduate work in international communications demands a word. The new doctoral program in political science significantly enlarges the contribution which the Center for International Studies makes to graduate teaching both in this School and in the School of Industrial Management. Those on the Center staff who are also members of the Political Science Section have helped to plan the new graduate program, and considerable thought has been given to the concrete ways in which the talents of specific Center members might be utilized. An important part of the graduate program in political science has been the program in international communications. Of the dozen or so students enrolled for next fall in the political science program, about half were specifically attracted by the possibilities of work on international communications and will be centrally affiliated with the communications program. The quality of the students taking this program has steadily improved, and the group enrolled for next year is very promising; the opportunity which now exists to work towards a Ph.D. degree in political science should markedly increase the attractiveness of the communications program for superior students.

However, some administrative problems concerning the communications program will have to be faced next year. One arises from the fact that the Ford Foundation grant which has supported fellowships in this program will be exhausted after present commitments have been met; additional funds will have to be found, if the high quality of the students is to be maintained. The other issue is a more general but related one. What should be the relationship between this specific program in international communications and the political science graduate program as a whole? To what extent should the former attempt to retain its identity, recruiting its own students and raising its scholarship funds as in the past, and to what extent should it tend to become one specialization within the Political Science Section?

In any case, the urgency of the need for vastly expanded funds in support of the graduate work in political science is evident.

Graduate instruction is expensive. It costs the time of high-salaried members of the faculty; in these days it requires generous fellowship and scholarship funds for the graduate students. The costs of this new venture cannot be supported out of previously committed general Institute funds; and the obligation of all of us who are convinced that our kinds of study in political science belong at M.I.T. is perfectly clear.

Special Centers

There are two powerful centers in the School of Humanities which now have been with us so long that we can assess their importance to our entire academic effort — and the assessment shows that they are vitally important. These are the Industrial Relations Section, just celebrating its twentieth year, and the Center for International Studies, about to enter its eighth year. Each publishes its own extensive report which is available to all who seek it, and this spares me the otherwise impossible obligation of recording their achievements on many fronts of research and of action. Insofar as comments on the actions of individuals are concerned, I shall put these all together in a section dealing with some of my colleagues in the School; the main lines of research are indicated both in their own reports and in the appended publications lists.

Here, then, I may mention only one or two highlights. The Industrial Relations Section held its Twentieth Anniversary Conference in November, 1957, with over 200 distinguished guests from industry, labor, government, and education. Speakers included George W. Brooks, Director of Research and Education for the International Brotherhood of Pulp, Sulphite and Paper Mill Workers; Frederick H. Harbison, Director of the Industrial Relations Section of Princeton University; Clark Kerr, President of the University of California; Leland Hazard, Vice President and General Counsel of the Pittsburgh Plate Glass Company; and the Honorable James P. Mitchell, Secretary of Labor. The papers were published and are available.

The Section ran a number of other conferences for labor and management groups and for visiting foreign teams from Japan and France.

The "incident process," which has been developed by Professor Paul Pigors as an alternative to the case method in management training, has continued to attract national and international interest.

Over eight hundred companies are using this method in their supervisory and management training programs, and Professor Pigors presented the method at management seminars run by the American Management Association in New York and at the conference held in England last summer by the European Productivity Agency for European teachers of business management.

Professor Max F. Millikan's interesting annual report for the Center for International Studies sums up the Center's activities for this year better than I can properly do here. No single event stands out to mark the year. The Center has pushed ahead on all fronts — in research, in publication, in educational activities, and in efforts to communicate the results of its thinking to citizens and officials concerned with the conduct of world affairs.

The Center's contribution in all these directions can most readily be measured by its most tangible product, the published works. The year has witnessed roughly a dozen books by Center members on a great variety of topics — problems and prospects of underdeveloped parts of the world, other questions of economic development, the role of nuclear power in Italy, the social structure of Japanese factories, discussions of aspects of Communist societies, the difficulties which people in one culture have in understanding the people of another. Also published this year was the first book in a series concerned with America's response to the challenge of international affairs, a detailed analysis of the organization and operation of the Department of Defense. All of these titles are listed in the summary of publications; one or two I shall mention later in other contexts.

I have already spoken of the contribution that the Center has made to graduate work in political science. There has been a clear and even more important trend over the past several years towards more general and extensive participation by Center members in the Institute's graduate and undergraduate teaching programs, both within and without this School, and the Center has already made contributions of this sort to the School of Industrial Management and the School of Architecture and Planning. As a result, more than 80 per cent of the Center's senior research staff participated in the academic program. The number of Center members actually engaged in teaching at any given time will of course vary somewhat from year to year, according to the needs of the various departments and the composition of the Center staff. The important thing, according to Professor Millikan (and I agree), is that integration of

the Center staff into the teaching program has been accepted in principle and in practice and that a sound basis has been established for continued cooperation with the academic departments most directly concerned.

It is perfectly clear that the Center has established itself as an important institutional and national resource. It has been clear for several years that the short-term project grants on which the Center was founded and upon which it has been too dependent would eventually have to be supplemented by financing of a more stable, longer-term character. Substantial support which can be counted upon for a number of years into the future is necessary for two chief reasons; first, it would enable the Center more easily to attract first-rate men by holding out a better hope of a permanent career; second, it would provide the necessary flexibility to perform certain kinds of educational, research, and public service functions for which short-term grants are both difficult to obtain and inefficient. Proposals have therefore been prepared requesting support over a twenty-five-year period to supplement the project grants which are now the Center's chief source of support.

Staff Changes

At the end of the first semester, early in 1958, Professor Ralph E. Freeman retired as head of the Department of Economics and Social Science after twenty-five years of service in that capacity. This quarter of a century embraced the most far-reaching changes in the Department's history. In 1933, when Professor Freeman assumed his post, the Department offered little more than two semesters of introductory economics. Under his leadership, the present extensive Ph.D. program in industrial economics was inaugurated in 1940 and developed to its present size and prestige in the years since the end of World War II. Shortly after the war, the undergraduate Course XIV was established. The postwar period has seen a great expansion in the Department's contributions to the Institute's program of humanities and social sciences — notably in the fields of industrial relations, political science, and psychology, as well as in economics. In short, the years of Professor Freeman's headship have brought a transformation from a small service department to one that offers a substantial amount of professional training on both the undergraduate and graduate levels, as well as a far broader and richer diet of social science for all the students at the Institute.

Professor Freeman and his advisers have also had a fine taste for quality. The expansions of the Department's teaching activities have been accompanied by a notable increase in both the size and the scholarly quality of its staff. In economics, especially, it has become one of the leading departments in the nation, due to the quality of its instruction and the excellence of the research and creative activities of its staff. All this has happened in a happy environment, in which Professor Freeman has been as beloved by the faculty of his Department as he was by his dean and the other administrative officers of the Institute.

Fortunately, Professor Freeman will continue as an active member of the Department following his leave of absence during the past semester. The unanimous choice of the senior members of the Department for the man to succeed him as Department head — a choice confirmed by the advice of a distinguished committee of outsiders — was Professor Robert L. Bishop, an economist of distinction and a man who has already demonstrated rare administrative talent.

It is good to be able to report three distinguished additions, two to the permanent staff and one as a visitor. Professor Roy W. Lamson, who was with us this year as Visiting Professor of Literature on leave of absence from Williams College, has agreed to join the faculty permanently and will add great wisdom and strength to our fine group in literature. In addition to being a popular and exacting teacher and a specialist in the literature of the English Renaissance, Professor Lamson is a military historian of repute, serving among other things as the official historian of SHAPE. Evsey D. Domar, formerly of Johns Hopkins University, has also accepted a full professorship. Professor Domar has an outstanding reputation in the economics of national income, business cycles, and fiscal and monetary policy. He is especially known for a notable contribution to the theory of sustained economic growth; and he is also a specialist in comparative social and economic systems with special reference to Soviet economics. Dr. Erik H. Erikson has been appointed Visiting Professor and will offer two courses next year: Personality, Society and Politics, and Identity and Ideology. These courses will provide students in communications and related programs with training in clinical and case studies. Dr. Erikson was formerly a professor of psychology in the School of Medicine at the University of Pittsburgh and will continue to be a part-time senior staff member of the Austen Riggs Center at Stockbridge.

There are seldom gains without losses. The Political Science Section has been hard hit by the departure of Assistant Professor Warner R. Schilling, who was lured back to Columbia University where he had previously studied and taught. Undergraduates and faculty members will especially regret the departure of Professor Karl W. Deutsch, who after years of successful accomplishment at M.I.T. resigned to accept the offer of a Sterling Professorship at Yale University.

Finally, the Department of Humanities lost one of its best-liked and most faithful members when Assistant Professor Stuart Edgerly had a fatal heart attack in his classroom.

Staff Travel

A modern and lively university faculty is peripatetic, and few men now remain in the ivory tower from year to year. Week ends in Baghdad or Geneva have become a matter of routine for members of the Center for International Studies, and so many others of our staff now visit from Washington to Tokyo that a list of simple comings and goings would be long, meaningless, and dull. Here again I must be selective.

A year's leave of absence was enjoyed by Professors Ithiel D. Pool and Robert M. Solow of the Department of Economics, both of whom spent the year at the Center for Advanced Study in the Behavioral Sciences at Palo Alto, California. Associate Professor Morris A. Adelman was on leave for the primary purpose of finishing his book on the A and P antitrust case. Gregory Tucker, Lecturer in Music, had a year's leave of absence while he enjoyed a Guggenheim grant which permitted him to study and compose, principally in Italy.

Professor Howard R. Bartlett had leave for the first term to discharge an interesting assignment in India, where he was one of a dozen American educators working with Indian universities on the general education project sponsored cooperatively by the Ministry of Education of the Government of India and the International Educational Exchange Service of the United States Department of State.

Professor Myers visited India in January and February on the invitation of the Overseas Development Division of The Ford Foundation to review proposals for research in industrial relations and

industrial management at several Indian universities and institutes. As a result of this trip, he has been asked by the Foundation to supervise a continuing three-year program of research and training in these fields in India.

Giorgio D. de Santillana, Professor of the History of Philosophy and Science, spent some of the spring months in Italy doing research under a Guggenheim Fellowship. Professor Padelford took advantage of a spring trip to Scandinavia to study and report on the Scandinavian view of the United Nations. Assistant Professor Swets was invited to spend the summer carrying on his psychological research at the Phillips Research Laboratories in Eindhoven, Netherlands; Associate Professor Halle was invited to teach a summer course on informational theory at the International School of Physics in Varenna, Italy; Associate Professor William F. Bottiglia received a grant from the American Philosophical Society to spend the summer in Geneva working on the unpublished papers of Voltaire.

Turning to the Center for International Studies, Professor Everett E. Hagen spent several months in Colombia carrying out a program of interviews; Drs. Clifford J. and Hildred S. Geertz struggled to carry out their research on local urban leadership in Indonesia, despite the double-barreled ravages of tropical disease and civil war. Professor Paul N. Rosenstein-Rodan gave a series of lectures in Polish universities, under the auspices of The Ford Foundation, and subsequently spent a few months in Italy in research on Italian economic problems; Harold R. Isaacs spent part of last summer in Great Britain talking with specialists on African affairs; Professors Millikan and Daniel Lerner went to Europe for a few weeks, primarily to attend a conference on Franco-American relationships sponsored by the World Peace Foundation; Dr. Lincoln Bloomfield left in June for a round of conferences in Europe in connection with his research on the United Nations; Arthur L. Singer, Jr. has left for two months in India to make administrative arrangements for the arrival in the autumn of a new team of economists; Associate Professor Lucien W. Pye has gone to Burma, where he will remain for the next eight months carrying out the first phase of his research on Burmese politics.

With all this coming and going, the needs of the students continued to be fully and richly served, and the virtue of the experiences in subsequent teaching can hardly be overestimated.

Visitors and Guests

Absences bring guests, and distinguished absences bring distinguished guests. Again they were legion, and only a few can be mentioned. In the Department of Economics three full-time visiting professors were in attendance: Professor Hendrik S. Houthakker of Stanford University replaced Professor Solow; Professor William H. Miernyk of Northeastern University filled gaps in the Industrial Relations Section; W. Phillips Davison, research scientist in the Social Science Division of the RAND Corporation, replaced Professor Pool. Alan H. Williams was also here for the entire year in the status of Visiting Lecturer; he came from the University of Exeter. Additional visiting lecturers in this Department for the spring term only were William H. Scott of Liverpool University and Kermit Gordon of Williams College.

In the Department of Humanities, Professor Lamson of Williams College and Hans Meyerhoff, Professor of Philosophy at the University of California (Los Angeles) were Visiting Professors; Professor Robert S. Cohen of Boston University served as part-time lecturer in the history and philosophy of science; and Professor Edward Rosen of the City College of New York came as Visiting Professor in the History of Science during the absence of Professor de Santillana.

In the Department of Modern Languages, for the last three months of the spring term, Dr. Martin Kloster Jensen, Reader in Phonetics and Head of the Department of Phonetics at the University of Bergen, Norway, was a Guest of the Institute.

The number of such distinguished guests has also mounted past the point where they can all be usefully counted. Among the Guests of the Institute who were attached to the Industrial Relations Section were Professor Tadatoshi Uchida, labor economist from Gakushuin University in Tokyo; Dr. Theodore J. Steenbergen, Assistant Director of the Institute of American Studies, University of Amsterdam; and Wendell D. Macdonald, on leave as Regional Director of the United States Bureau of Labor Statistics. The Center for International Studies was honored by visits from many distinguished Indians and arranged a week's program for a group of African civil servants studying development problems under the sponsorship of the United Nations. Several foreign scholars stopped in the Center for longer periods; in addition to a number of foreign graduate students, there were several postdoctoral scholars including Dr. Isamu Miyazaki and Professor Yoichi Itagaki from Japan,

Dr. Nejat Bengul and Dr. Besim Ustunel from Turkey, and Dr. Kosta Filip Mihailovic from Yugoslavia.

Distinguished visiting lecturers have become too numerous to mention. Here, in addition to those already cited in other contexts, I might select Professor Philip Taft of Brown University; Professor Edgar Dunsdorf of the University of Melbourne; Professor William Gomberg of Washington University; Professor J. R. Hicks of Oxford University; Professor B. S. Keirstead of the University of Toronto; Professor A. P. Lerner of Roosevelt College and Johns Hopkins University; Professor Franco Modigliani of Carnegie Institute of Technology and Harvard University; Professor K. N. Raj of Johns Hopkins University; Professor L. G. Reynolds of Yale University; Professor H. A. Simon of Carnegie Institute of Technology; Dr. Jacob Bronowski, Director of Research of the National Coal Board of Great Britain; Roger Jones, Assistant Director of the Bureau of the Budget; the Honorable Hubert Humphrey, Senator from Minnesota; and Sir Leslie Munro, Ambassador to the United States from New Zealand and President of the United Nations General Assembly.

Meetings and Conferences

Like visitors, too many meetings — too many, not too many for our good, but too many to be accorded justice. I have already referred to the meetings of the Industrial Relations Section. Distinguished among other meetings were the six formal lectures of the new Hayden Colloquium on common problems of the arts and sciences, directed by Professor Lerner. The theme of this year's Colloquium was "Evidence and Inference" — in fields of history, psychology, physics, biology, sociology, and the law; the lectures were presented by M. Raymond Aron, Professor Martin Deutsch, Dr. Erik H. Erikson, and Professors Henry M. Hart, Jr., Paul Lazarsfeld, and Walter A. Rosenblith. These lectures will be published simultaneously in the fall by *Daedalus*, the journal of the American Academy of Arts and Sciences, and by the Technology Press.

For the Industrial Liaison Office, members of the Center for International Studies contributed to a full day's program on problems and prospects for overseas investment. Papers were presented by Professors Wilfred Malenbaum, Benjamin H. Higgins, Walt W. Rostow, Rosenstein-Rodan, Millikan, and by Arnold Rivkin. Professor Robert R. Rathbone of the Department of Humanities conducted a Special Summer Program on Editing Technical Reports,

designed specifically for the supervisors of technical projects who had had little or no training in the art of editing; sixty-eight people attended the five-day session, about half from industry and half from government. Professor Rathbone was assisted by Associate Professor Lynwood S. Bryant, and Assistant Professor James D. Koerner, and visiting special lecturers. Professor Rostow's four-day conference on American society held at Endicott House was reported last year. The papers, prepared by Abraham Kaplan, George F. Kennan, Clyde Kluckhohn, Henry A. Murray, J. Robert Oppenheimer, and Professor Rostow have, with the exception of Oppenheimer's paper which had been earlier reproduced in *Foreign Affairs*, appeared in foreshortened form in a special issue of *Daedalus*. They will be published in full, together with prepared commentaries on the papers and a summary essay by the editor, Professor Elting E. Morison, under the title *The American Style: Essays in Value and Performance*.

Professional Activities, Publications, and Research

It can now be taken for granted that almost every member of the staff of this School is engaged in serious research and publication. There is little to be gained in reporting on work in progress, while work that has been completed is best evidenced by the publication lists appearing elsewhere. Here let me note only a handful of the publications that for one reason or another are of unusual interest. These would include Alexander Korol's *Soviet Education for Science and Technology;* Isaacs' *Scratches on Our Minds;* Professor Pigors' *The Incident Process*, Series II; Professor Roger W. Brown's *Words and Things;* the volume on *Linear Programming* by Professors Samuelson and Solow, with Professor Robert Dorfman of Harvard University; Professor Kindleberger's *Economic Development;* and Professor Myers' *Labor Problems in the Industrialization of India*, which was also published in India under a different title.

An unusual research project now under way is of departmental scope — indeed, interdepartmental. Professor Ralph Freeman is editing a book on various facets of the postwar development of the American economy, in connection with Professor Rostow's American studies project. Contributors from the Department of Economics will include Professors Adelman, Bator, Bishop, Cary Brown, Ralph Freeman, Kindleberger, Myers, Samuelson, Siegel, and Solow; they

will be joined by Associate Professor Alfred D. Chandler, Jr., of the Department of Humanities and Professor Eli Shapiro of the School of Industrial Management.

Professor de Santillana won the $500 Sidney Hillman Foundation Prize Award for his article in *The Reporter*, "Galileo and J. Robert Oppenheimer"; the judges were Lewis Gannett, Eric Sevareid, and William L. Shirer.

Staff Activities

Again I must select only a few typical examples, not necessarily the most important. Professor Rostow testified on the Soviet economic offensive in underdeveloped areas, and Mr. Korol testified on Soviet scientific and engineering education, both before the United States Senate Foreign Relations Committee. Testimony before various legislative committees was given on economic matters by Professors Samuelson, Kindleberger, and Hendrik S. Houthakker. Many of the staff, including Messrs. Padelford, Bator, Hagen, Rostow, Bloomfield, Richard S. Eckhaus, and Pye, lectured at various national academies for training mid-career civilian and military officers. Professor Millikan was a sponsor and Professor Rostow a member of the Executive Committee of the Committee for International Economic Growth. Several members of the communications program participated in the preparation of materials to be used by the International Exchange Service of the State Department in orienting Fulbright scholars going to India. Many have served on study groups of the American Council on Foreign Relations, including Professors Malenbaum, Lerner, W. Phillips Davison and Lamson, and Dr. Bloomfield. Professor Lamson was also a member of the discussion group on The Strategic Bases of the United States; this included members of the Gaither Committee, the Rockefeller Brothers Committee, and military and diplomatic personnel.

Members of the staff continue to hold office in many learned societies and committees of those societies. Among the more recent of such activities, Professor Carvel Collins has served on a committee of twenty-five college professors chosen across the nation to study methods of improving teaching in the United States from kindergarten through graduate school. This committee was financed by The Ford Foundation and directed by the Modern Language Association. Professor Collins continues to be a director of the New England College English Association. Associate Professor John B. Rae participated in the founding of the Society for the History of

Technology and is a member of its executive and nominating committees. He was also elected a member of the advisory board of the *Business History Review*. Associate Professor Thomas H. D. Mahoney completed his term as President of the American Catholic Historical Association. Associate Professor Alfred D. Chandler, Jr., has continued to serve on the editorial board of the *Business History Review* and as a consultant to Alfred P. Sloan, Jr., on his *General Motors Story*. He is also a member of the executive committee of the Humanistic-Social Division of the American Society for Engineering Education. Assistant Professor Norman N. Holland has conducted a weekly program on *The Film Critic* on Station WGBH-TV and FM.

As for my own outside activities, I continue to be a Trustee of Mount Holyoke College, a member of the Advisory Board of the United States Merchant Marine Academy, a member of the Visiting Committee to the Harvard Graduate School of Design, and a consultant to the Graham Foundation. During the year I have become Consulting Editor of *The Architectural Record*, a member of the Board of Trustees of the Boston Museum of Fine Arts, and a member of the Commission on Instruction and Evaluation of the American Council on Education.

Extracurricular Activities

All the main elements of our music program continued with unabated excellence, whether offered by the Concert Band, the Brass Choir, the Symphony Orchestra, or the Choral Society. They make news every year, but the news has now become familiar. The band properly plays only compositions which were originally scored for band. The orchestra gave six concerts, and four different students performed concerti with remarkable skill. Albert Wray '58 played the Sibelius Violin Concerto in D minor, Karl Kornacker '58 played the Boccherini Cello Concerto, Gerald Litton '60 played the Liszt Piano Concerto in E flat, and Robert Geopfert, G, played the Rachmaninoff Piano Concerto Number 2. The Glee Club sang at a number of women's colleges and notably combined with the Vassar College Glee Club in Kresge Auditorium in a program including excerpts from Randall Thompson's *Peaceable Kingdom* for mixed voices *a capella*.

The Choral Society, under the direction of Professor Klaus Liepmann, performed *The Messiah* in the original form in celebration of its tenth anniversary. In April they sang the *Transfiguration*

Cantata of Alan Hovhaness, with the composer conducting. Fritz Buechtger, prominent German twelve-tone composer, conducted the first American performance of his *Resurrection According to St. Matthew*, sung in German. In a concert for the summer session, the Choral Society sang contemporary works by Copland, Finney, and Ives. The successes of their 1956 summer's tour in Germany resulted in a return invitation, including performances at the American Pavilion in Brussels.

The M.I.T. Humanities Series now numbers 807 subscribers, showing a steady gain every year; this year, from 100 to 400 extra tickets were sold for programs by the Boston Symphony Orchestra, the Curtis String Quartet, the Juilliard String Quartet, and Professor Ernst Levy of the Humanities Department. In a special chamber music concert a group of musicians from the Boston Symphony Orchestra, conducted by Professor Liepmann, presented the world première of the *Concertino* by Gregory Tucker and Walton's *Facade*. Mr. Tucker, in Italy on leave from M.I.T., flew back to participate as piano soloist. The organs in the Chapel and Kresge Auditorium were, as usual, played by many guest artists as well as in weekly noon recitals by M.I.T. organist David Johnson.

Many of the more unusual events in the M.I.T. musical season are recorded, and these records are normally obtainable; inquiries as to sources will be answered by Professor Liepmann. Professor Levy has completed his series of Beethoven's late piano sonatas, with recordings of Opus 90 and Opus 101, and has commenced recording the Haydn sonatas. André Marchal's notable concerts on the Kresge and Chapel organs have been recorded also.

The Dramashop, under the direction of Joseph D. Everingham, shows further progress. As before, the Workshop evenings drew capacity crowds. The final evening of the year presented three original one-act plays, all written by M.I.T. undergraduates, selected from twelve which had been submitted. The year began with an exhibition of costumes and masks from a new donation of a theatrical wardrobe of over 300 costumes and accessories, presented by the Theater on the Green at Wellesley. About seventy-five freshmen joined the Dramashop lists. In November, the Dramashop sponsored the Canadian Players of Stratford in *Othello*, for an audience that was sold out weeks in advance. Its most ambitious student production to date was Shakespeare's *Richard II*, which used a cast of thirty student actors and played for four nights. The major production of the spring was E. E. Cummings' satirical comedy *Him*,

with a cast of thirty-four playing sixty-five speaking parts. It was set and costumed in the decor of the 1920's and employed musical comedy and expressionistic theatrical techniques to achieve a swift pace and vivid production. Received with enthusiastic applause, *Him* required an extra Saturday afternoon matinee to accommodate those who could not get into the four originally scheduled performances.

Debating continues to have a strong appeal for a small group of students. Out of a squad of twenty-six debaters, seventeen were able to participate in twenty-five tournaments. The team won about 60 per cent of its debates, which is satisfactory to all concerned.

Under the steady and imaginative direction of Professor Herbert L. Beckwith of the School of Architecture, ten exhibitions were shown in the New Gallery of the Charles Hayden Memorial Library and five in the lobby of Building Seven. In addition to our regular pedagogical shows, there were exhibits of painting, photography, glass design, and textiles. Perhaps the two most successful were a showing of portraits by Max Beckmann, loaned by the Catherine Viviano Gallery of New York and a number of individual owners, and an exhibition of photographs by Gjon Mili '29. The photographs covered a variety of subjects, and the heart of the collection was made in connection with the *Life* magazine story on M.I.T. Following the exhibition, these photographs were given to the Institute.

The student Lecture Series Committee continues to run its affairs so well that I respond only when asked for advice or help. We can be proud of the discretion and consideration with which this student group operates on behalf of the whole Institute community.

Finances

Various projects of the School or of individuals on the staff have continued to be generously supported by grants from foundations and individuals. One or two have been mentioned in the foregoing text, and all appear duly in the Treasurer's Report. Here let me mention only one that came with particular gratification. A number of years ago the Carnegie Corporation of New York made a grant of $150,000 to be used for general purposes of development in the School of Humanities. This is not the place to recount what a vital role this not enormous sum of "freedom money" has played in

the development of the School — in the core curriculum, the fine arts program, the growth of political science, important changes in staff and orientation, and in many other experiments. In almost every success, other funds and other people ultimately played a part, and sometimes the larger part. But the value of the seed corn has been incontestable. Last year I reported that this money would soon be gone. This year we had to report to the Carnegie Corporation that this was so, and at the same time we asked if we had not earned confidence in what we were doing, while pointing out that much remained to be done. The response was a new grant of $100,000, which again I say will have meaning far greater than the six digits of its dollars. It is an affirmation by this foundation not only of its confidence in what we may try to do but also of the role of humanities and social sciences in a serious technological institution and perhaps of the role of the technological institution in advancing the humanities and the social sciences.

Unsolved Problems

Our troubles are not big, but they must be solved. We have to find permanent support for the Center for International Studies; we have to find a way to underwrite the important and growing graduate work in political science; we have to find space and funds for an instructional and probably a research laboratory in psychology; and beyond that, the long-range prospects of space for the entire effort of the School remain undetermined and I believe threatening until we do have a long-range and accepted plan; we should encourage further work in linguistics; we ought to do more than we are doing internally and externally about the state of language study in America; we must begin a serious effort to consolidate and expand even to the graduate level our work in the history of science. But these are all problems that are within range of solution, and not the kind that lead to apathy or despair.

There is another long-range problem that I think our faculty must begin to face up to. We have enjoyed a favorable position with respect to salaries and teaching loads and the climate of life at M.I.T., wherein it has been possible for us to recruit an ever-better faculty and to keep an amazing number of the best, against the blandishments of the most famous American liberal arts universities. The very existence of a notable good faculty makes the seducers more avid; seducers are unimaginative and turn naturally

to the greenest pastures. We can expect their tempting songs to increase; and as the student bulge hits the universities, we can expect the individual pay-check inducements to increase, too. Try as the administration may to make the environment so favorable that no one will ever want to leave, the coming problem is not one that can be solved by the administration alone.

Above all, we here at M.I.T. (and throughout the United States) need to be perceptive and imaginative about ways in which the long arm of a great scholar and teacher can be lengthened, as the time is surely coming when every teaching arm is going to have to be lengthened. Whether this is by addition of technical devices, more imaginative programming, return of lecture methods which so many profess to abhor, or forcing the student to do more independent work, I do not know; but that drastic innovations are going to have to be made I am absolutely sure. Innovations will not be made by those who condemn the various ongoing experiments out of hand. I wish that I felt a surge in our own faculty to come to grips with this problem before it is upon us and may have become too big to grasp.

But anyway, as I wrote twelve months ago, it has been a good year.

JOHN E. BURCHARD

School of Industrial Management

The first earth satellite, circling a world already in crisis, emphasized for us all that the nation's continued existence as a world leader depends on our constant growth in science and engineering *and in management.* The role of an educational unit dedicated, as we are, to research and teaching in management becomes an especially critical one. The economic and political events of 1957–58 have served to stimulate the normal spirit of self-examination and experimentation that has been characteristic of our faculty. And, by and large, there has been a continued move toward improvement and increased effectiveness in many aspects of our programs.

In my report last year I described the School of Industrial Management in its fifth year of existence. My emphasis was on where the School stood after five years of building. I attempted to do this by describing the activities then taking place and the School's major divisions: undergraduate, graduate, and executive development.

In my report this year I propose to discuss developments in the School in terms of the fields of knowledge and inquiry which the faculty believes are most appropriate in preparing men for managerial responsibility at all stages of their careers. These areas, with appropriate adjustment, are represented in the curriculum of each program, whether for students about to enter industry or for those already in the world of action as are our Sloan Fellows and members of the Program for Senior Executives.

First, however, a word about the faculty and the students. The faculty continues to demonstrate competence and achievement of a high order in both teaching and research and in both theoretical and applied approaches to the problems of management. This is particularly characteristic of the younger and newer members of the staff. We continue to set standards that attract students with leadership potential as well as intellectual capacity to the several programs in the School. Our undergraduate and graduate students continue to be much sought-after even in an economy marked by recession. Our Sloan Fellowship Program and Program for Senior Executives are regarded by a substantial number of American corporations as the most important of their kind in the country. The constant stimulation provided by all these men, from the beginner in the undergraduate program to the corporate officer in the Senior Executive Program, interacting with our faculty, produces a climate of vigor and commitment that one writer has described as "an exposure to excellence." The best demonstration of this interaction is provided by our curriculum, which is the rationale that holds together the educational process of faculty and students.

I.

The curriculum of the School may be discussed under the following loosely descriptive headings.

The Quantitative Approaches and Analyses

A strong point of the School's approach to managerial education has always been in the measurement and quantitative analysis of management problems. I have said before that while management is an art, it is an art that is immensely and importantly influenced by the application of the methods of science to its many complex, interrelated elements. The emphasis in accounting at M.I.T., for example, has consistently been on measurement and analysis to give control and provide a means of giving direction to the enterprise. Our concern with accounting is distinctly managerial as opposed to professional. The stress and uses of statistics here also demonstrate our concept of quantification and measurement for purposes of control. This concept has reflected itself increasingly in our emphasis on mathematical methods in the analysis of operations.

Under this same heading, we may mention the new vistas for aid in decision-making which are promised by high-speed computers. In the field of industrial dynamics, which these new developments are beginning to open up, we see possibilities of major breakthroughs in a better understanding of the hidden interrelationships of production, marketing, and finance decisions. The work of Professor Jay W. Forrester and his associates in this promising area has been confined very largely to research, but we expect that these approaches will reflect themselves increasingly in our course offerings in the months and years ahead.

Under this general heading also may be included the studies of economic forecasting which have taken on great significance under the leadership of Professor Sidney S. Alexander.

The Social Sciences

Along with the emphasis placed on the quantitative analysis of the problems of management, there must be equal emphasis on understanding the role of man himself. The social sciences have made substantial contributions to our present knowledge of the modern man and the way he organizes with his fellow men to achieve his objectives. Business schools today tend to talk about the "behavioral sciences" as if the idea were a totally new one. Since the beginning of the School, however, we have had a deep commitment to the idea that the social sciences illuminate a vital part of the management problem. Our emphasis on the study of man sweeps across the entire field of organization analyses that are so basic to the process of management. A quick estimate of this emphasis is perhaps best provided by citing the names of such senior people as Professors Douglas M. McGregor, Douglass V. Brown, Charles A. Myers, Howard W. Johnson, and Paul Pigors, who with their associates guide our studies of "the human side of enterprise."

Included under this heading, too, are those disciplines having to do with the environment in which industry must thrive and progress. Here may be classified the studies in economics, so ably provided us by M.I.T.'s Department of Economics and Social Studies. But not only does understanding the environment involve studying the economy and its complex effects on the individual firm; it demands some understanding of the social and political world in which industry lives. Environment also involves a relationship to time — a knowledge of where we are on the curve from the past

to the future and the rate of change at our present point. To give this understanding of the dynamic nature of our American industry, we call on the study of history approached as a record of industrial innovation. In a sense, these areas deal with the history of ideas more than of technology. The principals here are Professors Elting E. Morison and William L. Letwin.

Finally, I include here also the environment created by man in the form of laws and institutions, about which every student of management must develop awareness and understanding.

The Study of Business Problem Areas

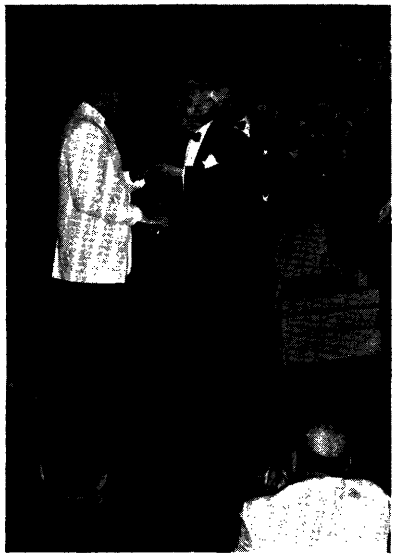
Always important in our School of Industrial Management has been the attack on practical problems which represent a complex mixture of several variables. These are traditionally represented under such headings as marketing, production, and finance. This functional area approach affords opportunity for applying theory to practical studies of problems now existing and constantly arising in a world of action.

Of special note is the School's unique approach to finance, under the leadership of Professor Eli Shapiro. Moving far beyond the traditional "money and banking" approach, the subject has become a major study of the dynamics of policy determinants, control, and direction in the corporate finance field; as such, it integrates the business problem areas.

Here also should be noted Professor Leo B. Moore's work in the field of the management of improvement. This has become a significant area of study, particularly for our younger students.

The Development of Character

And then there are the qualities characteristic of effective management which seem to be beyond the possibilities of formal educational efforts. How does one teach boldness and courage? How can we teach integrity, the first essential to successful management? As an approach, we count first on good selection of our raw material. And we hope that our students, who have the opportunity to rub shoulders with successful men in industry throughout the educational process, will recognize the importance of these qualities of character.



The Executive Development Programs have increasing stature and importance in the School. Above, our special concluding session for the Program for Senior Executives; below, a dinner-seminar for Sloan Fellows with Royal Weller, vice president for engineering at Stromberg-Carlson Company.

CHARLES F. LANGENHAGEN, JR.

After making many special studies in industrial plants in the Greater Boston area, graduate students in the School of Industrial Management entertained the managers of these industries and presented a filmed report of their findings.

DURLANDS PHOTO SERVICE

Dr. James R. Killian, Jr., president of M.I.T., has called management and technology "two of the richest outcroppings of our native resources."

II.

I want to turn now to a report of more traditional categories for reviewing the School's performance during the year.

Enrollment

The different divisions of the School showed the expected growth where our facilities and faculty permitted such growth. During the year, 83 undergraduates of the School received Bachelor of Science degrees — approximately 10 per cent of all bachelor's degrees awarded by M.I.T. This percentage is in line with the historical trend over many years. At the present time about half of those receiving their bachelor's degrees in the School are students who transfer during their third and fourth years from other institutions and from other departments at M.I.T. These are usually very desirable students who come with a strong motivation toward the field of management. As the School becomes better known in high schools and preparatory schools, we expect an increase in the number of freshmen who enter M.I.T. with the express purpose of registering in this School at the appropriate time.

The enrollment of graduate students during the year was up 14 per cent, to a total of 128; this includes the special students but not the Sloan Fellows, many of whom are also working for the master's degree. Applications for the graduate program for the 1958–59 academic year are up 30 per cent.

Increasing numbers of students enrolled in other departments at M.I.T. are studying in the School of Industrial Management at both the undergraduate and the graduate levels. In fact, this out-of-Course enrollment adds substantially to our teaching load.

The number of qualified applicants for the twelve-month Sloan Fellowship Program and for the two annual ten-week Senior Executive Programs far exceeds our ability to accommodate participants. We endeavor to limit the applications to numbers only reasonably in excess of the places available in order to keep disappointment to a minimum. Operating under this policy, we still obtained qualified applications well in excess of the places available — and this despite the unfavorable economic situation in the country in the past year.

The special programs offered in specific subjects by our staff during the summer of 1957 also attracted so many applications that

we necessarily limited the enrollment. I note this fact as an indication of the response of industry and various agencies of the government to the timeliness and importance of the subjects.

During the year an experimental executive development program was created to serve industry in the Boston area. Twenty-four members of middle management from twelve companies participated one full day each week for fifteen weeks. With no uncommitted staff time, this program was undertaken as an overload by individuals on the staff. The results were sufficiently successful so that the experiment will be conducted again; and we believe this course may well become part of our regular operations.

Staff Activities

It is inevitable that the personnel who comprise the faculty of this School should be called upon to assist companies in meeting some of their complex problems. Consulting in such cases, if it contributes to a staff member's professional stature and experience, is encouraged within the liberal limits established by M.I.T. policy.

But of even greater interest here are the calls made upon our staff for the public welfare, for advice to other educational institutions and to government agencies. Often these *pro bono publico* activities of our faculty members are at the expense of great personal effort and at some sacrifice to their research and professional development. The few activities which can be listed here can only begin to suggest the extent of the influence our faculty exerts in many directions.

Professor Brown is on the Research Advisory Board of the Committee for Economic Development.

Professor Billy E. Goetz was elected President of the Academy of Management.

Professor Houlder Hudgins was made a member of the World Trade Advisory Council of the U.S. Department of Commerce.

Professor McGregor was asked to serve with a select group to study the place of social sciences in business and management education and to report on such programs existing in our School.

Professor Morison delivered the principal address at the exercises commemorating the one hundredth anniversary of the birth of Theodore Roosevelt at the Library of Congress.

Professor Shapiro has acted as an adviser to the Ford Foundation program exploring the possibility of teaching mathematics for

management and discussing methods of improving the teaching and content of financial management in business education. He has also been an adviser to a similar study of business education undertaken by the Carnegie Foundation. He has been an adviser to the Dean of the School of Commerce, New York University, on matters of curriculum development and structure and to the President of Case Institute of Technology, reviewing the area of management training at Case.

Professor Johnson participated as a staff member in a one-week institute designed for directors and other administrators of the Internal Revenue Service.

Professor Moore received the S.E.S.-A.S.T.M. Award for outstanding contribution to literature of standards.

Professor Edward H. Bowman participated for the third year in a seminar in Advanced Logistics for Air Force career officers at the Air Materiel Command Institute of Technology.

Professor Gregory C. Chow testified before the Sub-committee of the U.S. Senate on Anti-trust and Monopoly on the probable effectiveness of the proposed excise tax reduction in increasing the sale of automobiles.

Professor Robert B. Fetter was Chairman of The Ford Foundation Conference on Research Needs in Production Management and, also under The Ford Foundation, was a seminar leader at Williams College in "New Developments in Teaching in Business Administration."

Professor Robert H. Gregory is Chairman of the American Accounting Association's Committee on Accounting Instruction in Electronic Data Processing.

Professor Edwin Kuh is Program Chairman for the winter meetings of the Econometric Society.

Professor Albert H. Rubenstein was reappointed for a three-year term as an Associate in the University Seminar on the Theory and Practice of Organization and Management at Columbia University.

Publications

In the academic world, the process of the inquiring mind satisfying its curiosity for new knowledge through research often produces publishable results. Publication sometimes follows such labors promptly, sometimes after the lapse of time. The complete list of

publications issued during the year under review is published elsewhere in this report. Here, however, it is appropriate to report highlights of the work now at or close to the publication point.

I want to call particular attention to the progress being made in preparing educational material in the field of management. Because this is a relatively new area, there is a great demand for textbooks and teaching material. To illustrate, the book *Analysis for Production Management*, by Professors Bowman and Fetter, has been translated into Japanese, Czechoslovakian, and French editions. Since its completion, the authors have collected a number of case studies which will soon be published under the title of *Studies in Manufacturing Analysis.*

Professor Shapiro and his coauthors have completely revised their book, *Money and Banking*, and have reissued it.

Professor Thomas M. Hill, with Professor Myron J. Gordon, is revising *Accounting: A Management Approach.*

Professor George F. Hadley is completing an intermediate textbook on linear, nonlinear, and dynamic programs; the book has already been scheduled for publication.

Research

Under the heading of research, but without reference to publication dates, I record that Professor McGregor and his colleagues are continuing their study of the records of a selected group of Sloan Fellows from each class in the years following the completion of their program at the Institute. This represents the first basic project in the evaluation of executive development in the country.

Professor Shapiro was the recipient of a Ford Foundation Faculty Research Fellowship and while on leave during the year devoted his research to the study of the nonfinancial corporation as a financial institution.

Professor Forrester and his group have pushed forward their studies in the field of industrial dynamics, making extensive use of the Computation Center's digital computer. The major article in the current (July–August, 1958) issue of the *Harvard Business Review* contains an initial review of their work.

Professor Hill and his associates continued their three-year hospital operations study for the U.S. Public Health Service.

Professor Edgar H. Schein's research under government sponsorship on the patterns of reactions of prisoners of war to various forms of pressure has proceeded to the publication of a number of papers and monographs and will eventually be put into book form.

Professor Letwin is continuing his research into the history of the antitrust laws.

Research and teaching are inextricably associated. Not only are most of our faculty members themselves engaged in some form of research; they are able to interest a good many students in research. During 1957–58, 46 graduate students received appointments as Research Assistants. These students are carrying on research of their own or are working with faculty on various projects, often as a result taking a longer time to obtain their master's degrees. We attach considerable significance to this rather large amount of work being done jointly by staff and students.

Staff Changes

It is a pleasure to record four faculty promotions. Dr. David Durand has been named to the rank of Professor and also has been appointed Chairman of the Undergraduate Committee of the School. Dr. Letwin has been promoted to the rank of Associate Professor, and Dr. Victor L. Andrews and Zenon S. Zannetos to that of Assistant Professors.

Professor Brown served his promised year as Associate Dean, and I record his contribution and faithfulness with gratitude.

On July 1, 1958, Professor Johnson, who has been the Director of our Executive Development Programs for the past three years, was appointed Associate Dean by the Executive Committee of the Corporation.

Professor Thomson M. Whitin's leave of absence was extended another year for his service with the U.S. Atomic Energy Commission. Both Professor Shapiro and Professor Whitin will return to their academic posts this fall.

New appointments include Dr. Daniel M. Holland as Associate Professor and Dr. Martin H. Greenberger and Dr. Thomas M. Lodahl as Assistant Professors.

John M. Wynne, a Sloan Fellow in 1955–56, has been appointed Director of the Executive Development Programs.

Alumni and Professional Relations

The School has yet no formal continuing program designed to acquaint the university world and industry with the activities taking place here. There is no regular communication with the alumni of the School. From time to time certain research material in the form of reprints has been given limited circulation. The newly formed Alumni Society of Graduate Students and the year-old Society of Sloan Fellows have both urged some continuing communication. The time is upon us when we must find the resources and develop programs aimed at creating a better understanding of the School's objectives and at encouraging closer relations between alumni and the Institute. To date, the Convocation held here in the spring of last year, commemorating the fifth year of the School's development, has been our most effective means of explaining the School's aims and programs to the outside world. The proceedings of this Convocation, published privately by the School, have had wide circulation, and a number of contributions have been reprinted in very large numbers.

Student Activities

It is to be expected that students in this School would be active in all manner of group activities on campus. Leadership qualities often assert themselves early in life, and it is not surprising to find that many of our undergraduates who seek management roles in the future are holding important positions in M.I.T.'s activities today. These undergraduate offices are indeed a laboratory for management. Three of the seven 1958 Compton Awards for outstanding undergraduate leadership went to undergraduates in the School.

The graduate students, through their Graduate Management Society, have undertaken a very helpful role in orienting new students before and on arrival. The activities of the Society contribute very substantially to the *esprit de corps* of the student body.

The Sloan Fellows and their wives develop for themselves a very meaningful social life which contributes enormously to the friendship bonds that always seem to characterize these groups. The wives play an important part in the success of the Sloan Program, and they organize many worthwhile activities — including some classroom work.

The twenty or more members of each Program for Senior Executives who live together at Endicott House for their ten weeks of study have time for little more in the way of extracurricular activities than seeing something of the Boston area. They do, however, end their period of study at M.I.T. with a three-day schedule to which their wives are invited and which serves to provide an interesting and pleasant closure to their stay with us.

And Always the Look Ahead

The School of Industrial Management, which the far-seeing industrial statesmanship and generous support of Alfred P. Sloan, Jr. launched in 1952, is no longer an infant. It has matured and established itself both at M.I.T. and in the eyes of the industrial world. We are, today, a going concern.

In the School's favored setting here at M.I.T., we see technology and management, two of the richest out-croppings of our native resources — to paraphrase the comments of President Killian at the School's Fifth Anniversary Convocation — aid and abet each other in enabling American capitalism to confound its detractors and adapt itself in a most remarkable way to fulfilling the changing needs of all our people.

"Management and technology," continued President Killian, "working in double harness, face an array of responsibilities in the United States today far beyond those directly concerned with our economy. To keep our environment humane . . . to provide adequately for fifty or more additional millions of people in the next twenty years, to provide us with the strength to deter war and keep peace, here are immense national tasks of the highest priority requiring all our skills and all our professions, tasks which particularly require boldness of management and administration coupled with an audacious and advancing technology."[1]

We are committed to our role in this partnership. Our advances thus far have opened new opportunities for the School and have awakened new needs. Our progress has encouraged us to raise our sights, to set for ourselves still higher standards. We see ways of doing our tasks better: preparing our students more

[1] *Adventure in Thought and Action,* The Fifth Anniversary Convocation of the School of Industrial Management, April 9, 1957, page 71.

effectively, searching new paths to the solution of management problems, serving industry better. But education for management is expensive education. As the School's efforts are successful and as our needs become known, I am convinced that the support necessary to carry on, to venture forth, to build for the great future needs of the country will become available to us.

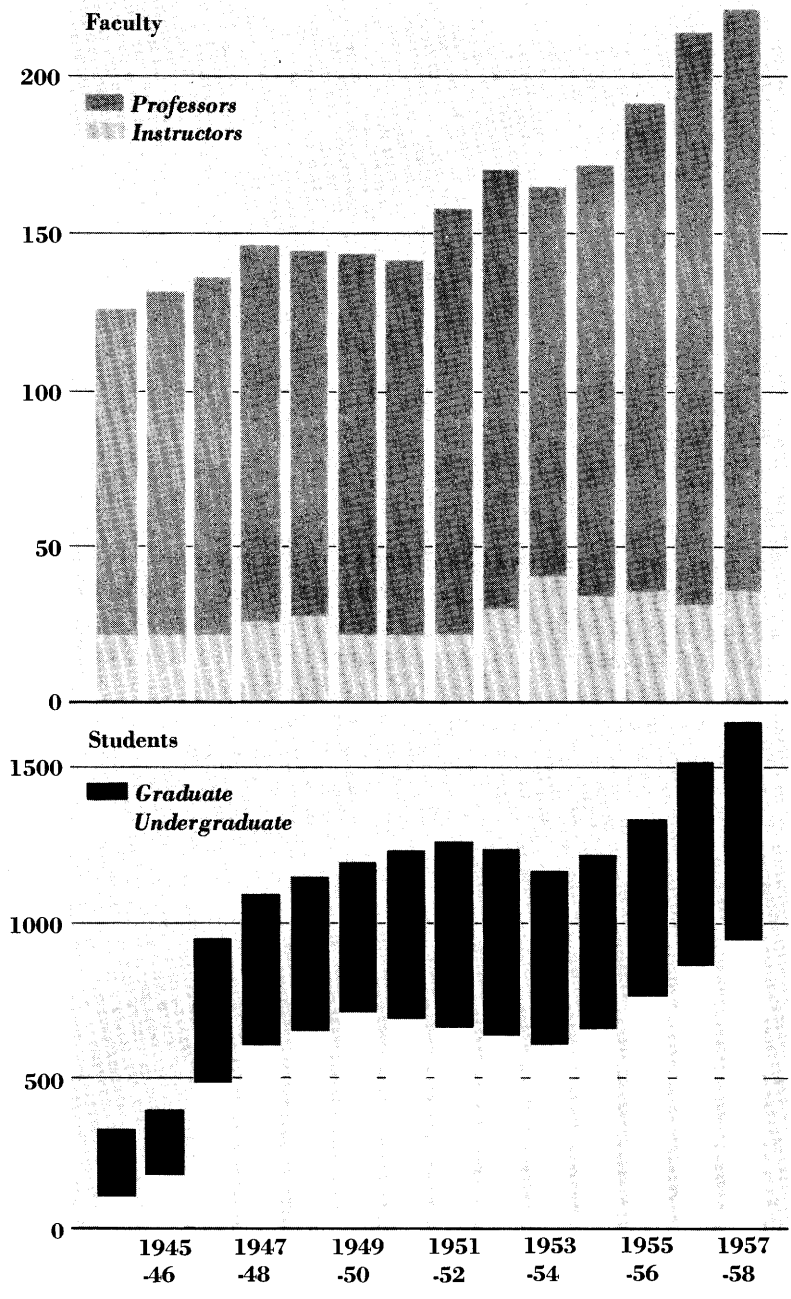
EDWARD PENNELL BROOKS

School of Science

The growth of the School of Science during the past year reflects the continued steady — though necessarily restrained — expansion of the Institute. The move into the Karl Taylor Compton Laboratories, which made available not only new laboratory space but also a magnificent new lecture hall and a considerable number of classrooms, has greatly eased the space problem of the Department of Physics and, to a lesser extent, that of other departments. Generally speaking, however, this problem still remains critical in many areas, for reasons illustrated in the following charts.

The first chart shows the recent growth of the student body and faculty of the School of Science. In the first postwar years, the number of science majors jumped from between three and four hundred to nearly a thousand. (A corresponding increase in the faculty is not apparent in the chart, which does not show the large number of staff members who were on leaves of absence during the war years.) Then followed a period of some years in which both student enrollment and faculty members remained more or less constant. However, around 1954 a new period of expansion appeared. Last year the School of Science contained more than 900 undergraduates and some 700 graduate students. Since 1944 the faculty has almost doubled, and now contains 231 members. Of this number 33 are instructors, while the remainder are of professorial rank.

GROWTH OF THE SCHOOL OF SCIENCE



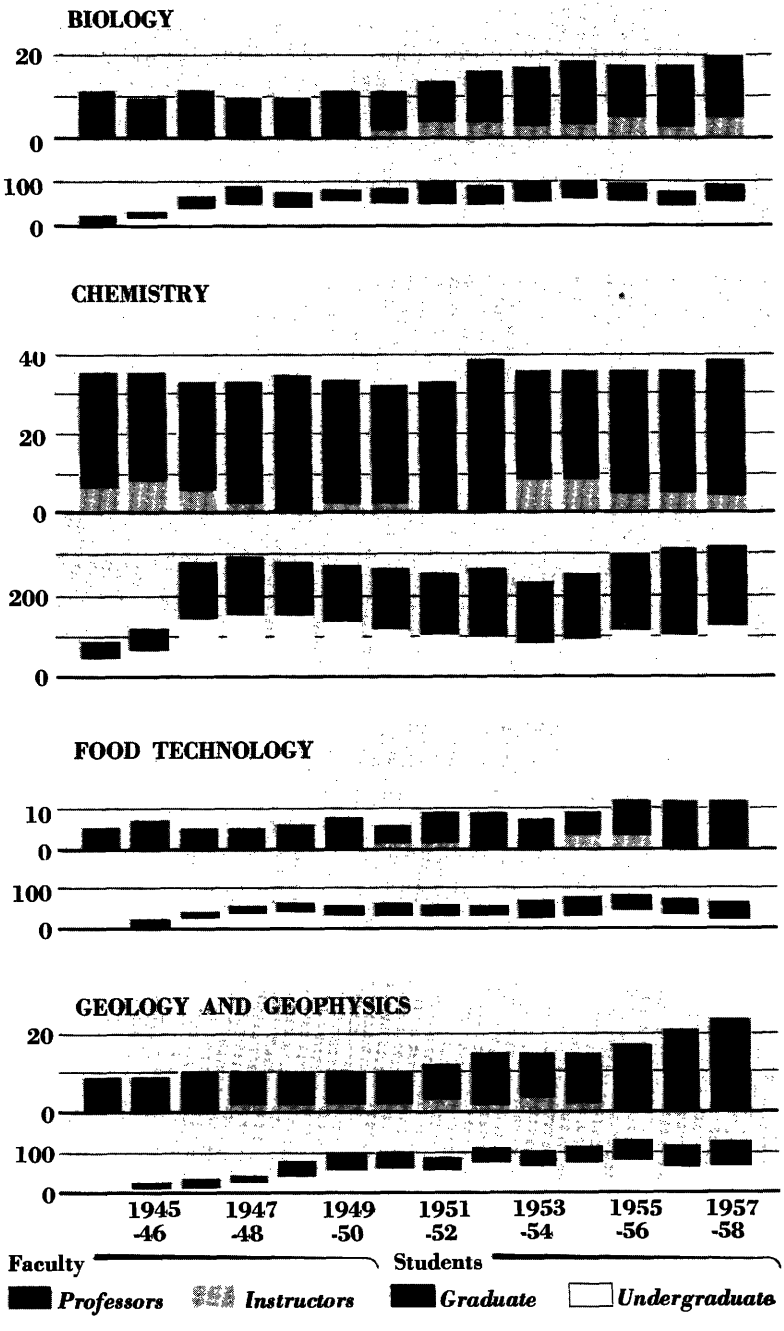
The Departments

The pattern of growth in the School of Science is closely paralleled by that of its largest department, Physics. In this department, the enrollment of major students has jumped from 400 (shortly after the first postwar discontinuity) to almost 800, while the faculty has been increased from 35 to 66. A noteworthy feature of this pattern is that the student distribution has changed quite radically. The number of undergraduates enrolled has almost doubled since 1946, while the number of graduate students has increased from 180 to only 210. This limitation in growth arises from the Institute's policy of assigning quotas for graduate enrollments in the various schools; the schools, in turn, have set up quotas for their departments. While there are small fluctuations here and there, the main pattern of graduate school enrollment is constant. The number of applicants, however, is increasing steadily. For example, this year roughly only one-sixth of those applying for graduate study in physics were accepted.

The chart reveals only inadequately the situation faced by the Department of Mathematics. Here the number of undergraduate and graduate students has increased modestly, but the actual teaching load has increased in far greater proportion; this is due to the demand of practically every department at the Institute for more mathematical training for larger numbers of its students. Hence the relatively large increase in mathematics faculty. It should be noted also that the Mathematics Department makes more extensive use of instructors than any other department in the School of Science. This is the result of a very important effort on the part of the department to attract outstanding young Ph.D.'s. Several highly qualified young doctoral graduates compete for the C. L. E. Moore Instructorships and contribute greatly to the vitality of the department in many respects.

The third large department in the School of Science, Chemistry, shows the same general pattern but to a less marked degree. Although the number of graduate majors applying continues to push against the quota limits, the number of undergraduates remains fairly constant.

The Departments of Biology and of Geology and Geophysics show a greater expansion in staff than in student body. This has made possible a considerable expansion of research activities and a rounding-out of fields of activity, which in turn is expected to result in an expansion of the student enrollment in these departments.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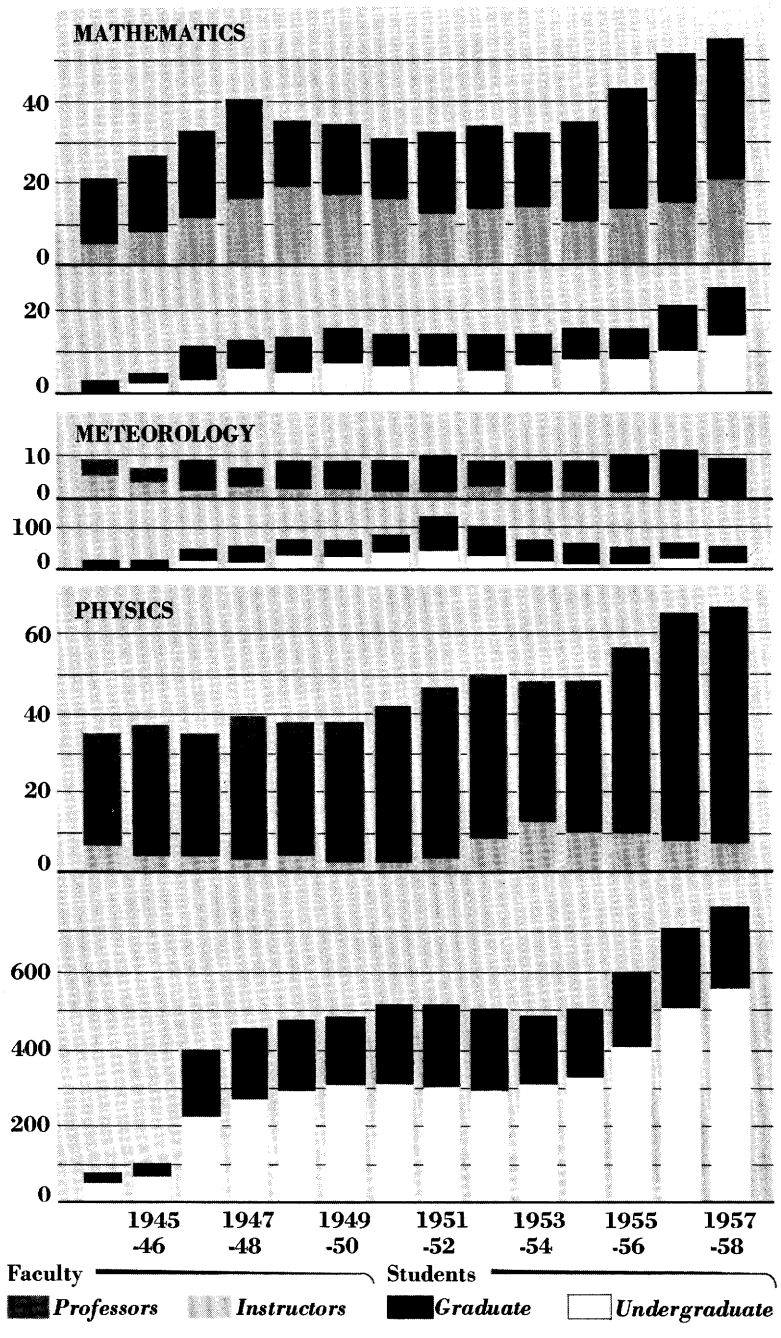
MATHEMATICS
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1951 -52
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1955 -56
1957 -58
Faculty
Students
Professors
Instructors
Graduate
Undergraduate

The remaining two Science departments — Food Technology and especially Meteorology — are predominantly graduate departments. Both in instruction and research these departments are collaborating in a very healthy way with the Departments of Biology and of Geology and Geophysics, respectively.

The Physical Science Study Committee

Before proceeding to a discussion of research activities contributing to the evolution of science itself, let us look at a noteworthy development involving both teaching and research of a new kind. This is the work of the Physical Science Study Committee. During the past year the Physics Department has made a large investment of time, effort, and enthusiasm in the work of this Committee.

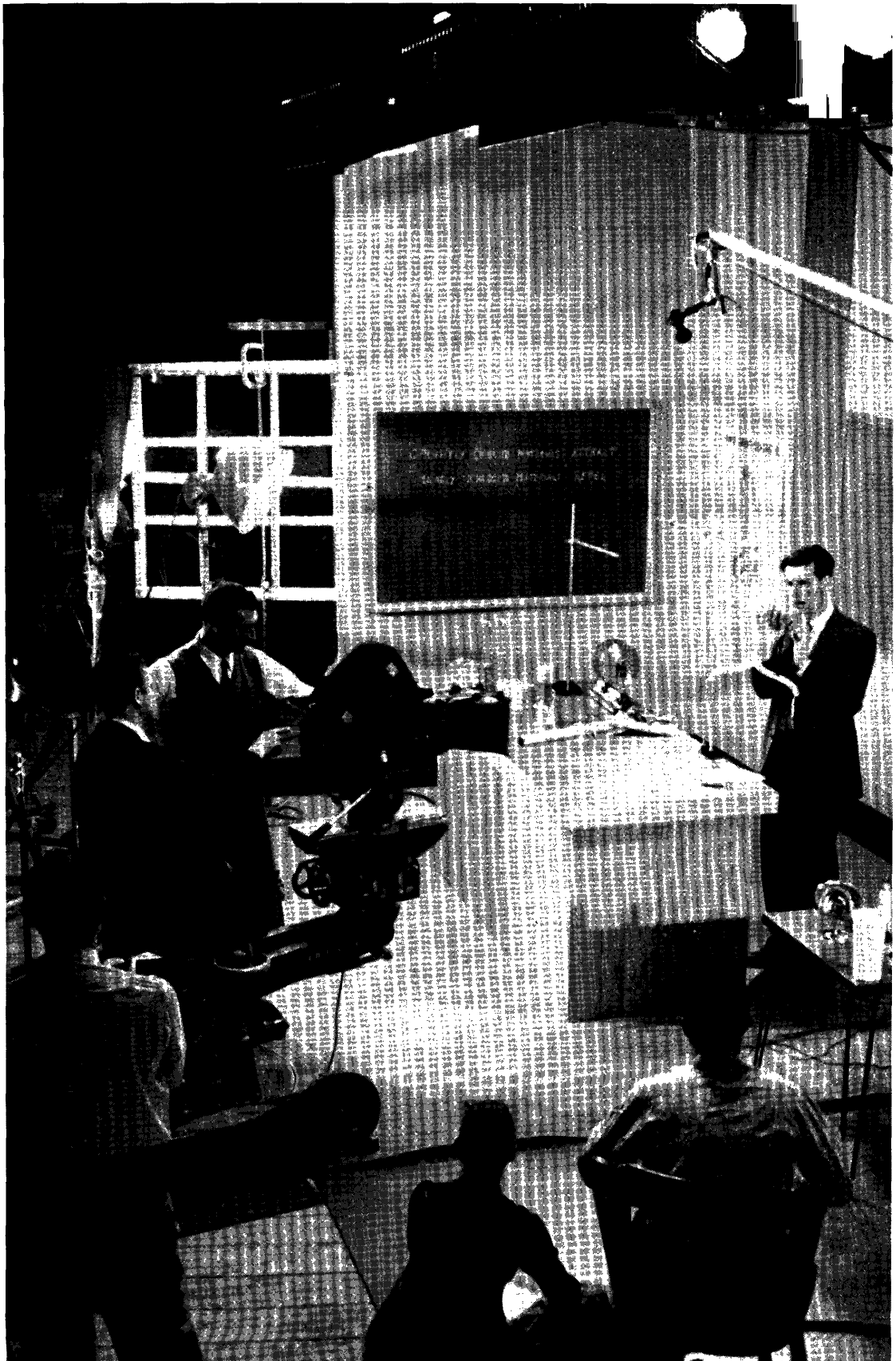
The Committee began to take shape early in 1956, as a consequence of the general dissatisfaction among university physicists with the state of secondary-school physics education. This dissatisfaction stemmed from many sources: college professors were discovering that students came to them with grossly inadequate secondary-school preparation; others, with children of high school age, were uneasy at the type of science training that was being made available to them; the place of science in the general culture fell far short of representing its value and its importance. In 1956, none of these considerations was new; but the need to take some sort of action was beginning to appear more and more urgent.

The first steps took the form of informal discussions, stimulated primarily by Dr. Jerrold R. Zacharias of the Department of Physics. It was quickly decided to establish an informal working group from interested physicists in and around Boston. Among those participating most frequently in this early work were Professor Nathaniel H. Frank, Professor Francis L. Friedman, Dr. James R. Killian, Jr., Dr. Edwin H. Land, Dr. Morris Meister, Professor E. H. Purcell, Professor Isidor I. Rabi, and Professor Zacharias. Communication with physicists in other academic centers left no doubt that wide support would be available when the time was appropriate.

Some indication of the enormity of the task undertaken may be gathered from the simple listing of the activities in which the committee is now engaged:

1. The preparation of a textbook for secondary-school students, written, edited, and published in preliminary form by the committee and its staff.

 Film production by the Physical Science Study Committee.



2. The preparation of a set of laboratory experiments, correlated with the text.

3. The preparation and preliminary publication of a laboratory manual.

4. The manufacture and distribution of laboratory kits for use in high school laboratories.

5. The preparation and production of 70 teaching films, each written and presented by a professional physicist.

6. The preparation and production of film notes for each film.

7. The preparation of a detailed and exhaustive teachers' manual and its publication in preliminary form.

8. The preparation of a number of films, as yet undetermined, to aid in the training of teachers.

9. The coordination of the entire program with universities, high schools, and local and state boards of education.

10. Direction of the preparation of examinations, both for routine academic use and to aid the committee in evaluating the work that is being done.

11. Organization and staffing of summer institutes for teacher training.

12. Organization and staffing of in-service institutes for teacher training.

13. Supervision of experimental use of the course in eight schools during 1957–58 and in approximately 300 during 1958–59.

14. Preparation of a 100-volume science library.

15. Preliminary studies of the extension of the committee program to (a) ninth grade classes, (b) liberal arts colleges, and (c) technical colleges.

Much of the above program is well under way, and parts are even nearing completion. The contribution of time and effort by the Physics Department staff is mentioned in the report of the Department. But it should be noted that this venture, coming at a time when all sections of the country are actively concerned with improvements in the teaching of science, is outstanding in its boldness and in its promise of producing noteworthy change. The experience of the P.S.S.C. is stimulating the discussion of comparable ventures in other fields.

Research

Major new research facilities came into being during the year or are nearing completion. Furthest along is the Computation Center,

which has contributed greatly to many research programs in the Institute and in the twenty-four collaborating universities and colleges throughout New England. A separate report on this is submitted in the section on Interdepartmental Laboratories and Activities.

It is expected that the nuclear reactor will be in full operation before this report appears. Its major value will be in the solution of specific nuclear problems. There is, however, another important field of research under development by Professor Clifford G. Shull, reported under the Department of Physics. This solid state research, involving the scattering of collimated neutron beams, is being undertaken in connection with physics programs and also in collaboration with the Departments of Metallurgy and Chemistry.

Finally, there is the Cambridge Electron Accelerator, now being constructed on Harvard property, which will be operated jointly by Harvard and M.I.T. Professor M. Stanley Livingston has been in charge of the construction program and has spent a great deal of his time during the past year on leave for this purpose.

LOUIS B. NELSON '59 FROM THE TECH

This unique two-handled shovel, used to break ground for the Cambridge Electron Accelerator, symbolized the cooperation of Harvard University and M.I.T. in this joint venture. Dr. Julius A. Stratton (left) and President Nathan Pusey found the device adequate, if cumbersome.

It is interesting to note that during the past year several new projects involving major research programs and facilities have been discussed, partly in collaboration with the School of Engineering. Detailed plans are being formulated as a basis for the solicitation of funds. The very valuable experience of the large interdepartmental laboratories — namely the Laboratory for Nuclear Science and the Research Laboratory of Electronics — is setting the pattern for much of the thinking about future developments. Among the great advantages of a loosely coordinated effort by a reasonably large group of people interested in similar research facilities are the following:

1. It is easier to secure longer contracts and thus to assure continuity of efforts.

2. It is easier to establish and maintain auxiliary facilities such as shops, analytical laboratories, and drafting rooms.

3. The bookkeeping and reporting is enormously simplified.

There is a very real need for interdepartmental laboratories to bridge the gap between the research activities of individuals requiring only modest facilities and the interuniversity groups, such as those at Brookhaven or Oak Ridge.

More detailed accounts of the educational program and of the research activities of the School are contained in the reports of the various departments and of the interdepartmental laboratories.

GEORGE R. HARRISON, FRANCIS BITTER

DEPARTMENT OF BIOLOGY

The teaching program in biology has been modernized by the revision of certain subjects and the introduction of several new ones. The undergraduate subject in biophysics has been revised by Dr. Carolyn Cohen to make it more suitable for all science students, and many of the biophysics research staff of M.I.T. have contributed. Professor Cyrus Levinthal offered a new graduate subject on the biophysics and genetics of viruses. Professor Patrick Wall taught an advanced subject in neurophysiology. Visiting Professor Rollin D. Hotchkiss of the Rockefeller Institute contributed a subject on recent advances in microbial genetics. All of these were open to students outside the Biology Department as well as to regular biology graduate students.

During the year, new research laboratories in biophysics were set up on the seventh floor of the Dorrance Building. In addition, preparative and analytical centrifuges were acquired, as were three new electron microscopes. The Biology Department now has the best facilities in the world for teaching and research in the field of electron microscopy.

Special attention has been devoted during the year to building up the graduate student program with reference to number and quality of students. A major development was the acquisition of several new fellowships, so that all graduate students in good standing in the Department are now supported by either fellowships or assistantships.

During the year, the Department of Biology was host to meetings of the Electron Microscope Society, The Biophysics Society, The Peripatetic Society, and the New England Colleges Conference of Biology Students. The Department held a reception and open house in conjunction with each meeting.

Personnel

During the spring term, Professor Hotchkiss played a leading role in the graduate teaching program in microbiology. This program will be expanded next year by Dr. Salvador Luria, Visiting Professor from the University of Illinois. In addition, we will have with us Dr. Vernon Ingram from Cambridge University as Visiting Associate Professor of Biochemistry and Dr. J. Z. Young as Visiting Professor of Biology from University College.

Professor Alexander Rich, formerly associated with the National Institutes of Health, has joined the Department as Associate Professor of Biophysics. He will teach General Biology and a graduate subject in molecular biophysics.

The Arthur D. Little Lecturer this year was Professor Leo Szilard of the University of Chicago. In addition to his other duties, he spent two weeks in the Biology Department and presented several seminars and discussions in the field of biophysics.

Drs. W. Terry Jenkins and Lewis N. Lukens, Instructors in Biochemistry, have accepted posts elsewhere and will leave during the summer.

Research

Research in the Department of Biology was greatly accelerated by the participation of many postdoctoral fellows as well as graduate

students who worked under the supervision of the faculty. The following brief summaries list only the outstanding accomplishments of the year.

Professor Francis O. Schmitt and his associates have analyzed squid nerve, from which they have isolated several interesting peptides. Professor Cecil E. Hall has collaborated with physical chemists in measuring with the electron microscope the size and shape of certain giant molecules of proteins and nucleic acids. Professor Levinthal has extended his studies on molecular differentiation in viruses to a consideration of the mechanism of control of enzyme synthesis in bacteria. Professor Herman W. Lewis has been carrying on similar studies on the inheritance of pigment in fruit flies. Professor David F. Waugh has developed new techniques of ultracentrifugation for determining molecular weight and chemical properties of biologically active molecules when present in a highly impure state. Professor Wall has developed techniques for inserting micro-electrodes into single fibers and cells of the spinal cord. From these studies it appears that repetitive firing before a synapse is generated within the fiber itself, while in contrast the repetitive firing of the cells seems to be driven by outside systems.

Because they are unusually large, nerve fibers from giant squid taken in South American waters are particularly valuable for studies of nerve fiber structure and chemical composition.

The biochemists have been active in determining the biosynthesis and mode of action of several of the vitamins which participate in enzyme systems. Professor Gene M. Brown has studied the biosynthesis of thiamine and pantothenic acid. Professor John M. Buchanan has discovered a new role for vitamin B_{12} in the synthesis of an enzyme required for the formation of methionine. Professor Irwin W. Sizer has considered the mechanism of transamination of amino acids, with particular reference to the catalytic role played by pyridoxin in accepting and transmitting amino groups. Professor Bernard S. Gould, in his studies of wound healing, has demonstrated for the first time a direct local role of vitamin C in initiating the biosynthesis of collagen in a healing wound.

Professor Edward Herbert has isolated from liver cells certain fractions which are capable of bringing about the synthesis of ribonucleic acid. Professor Howard P. Jenerick has developed new techniques for studying the electronic properties of the cell membrane. Professor Eugene Bell has employed high-frequency ultrasound in his studies of the role of various germ layers in developing embryos. By these techniques he has shown that the ectoderm does not play an essential role in limb bud formation. Professor Kurt S. Lion has completed a text on *Instrumentation Elements*, scheduled for early publication.

IRWIN W. SIZER

DEPARTMENT OF CHEMISTRY

During the past academic year the Department of Chemistry completed the first stage of its revised undergraduate curriculum. The change consisted of replacing second-year Qualitative and Quantitative Analysis with Organic Chemistry in the sophomore year. Under the new curriculum, students majoring in chemistry, chemical engineering, biology, food technology, and the chemical sciences option of industrial management registered for the subject as sophomores. During the year of change, this subject was taught to all students registering as sophomores and juniors and accordingly resulted in a double teaching load for the faculty concerned. The subject was taught as successfully to sophomores as to juniors, and the records made by students in the two different years were essentially identical.

The anticipated advantages of teaching sophomores subject matter to which they had had little introduction as freshmen were fully realized. In the coming year, juniors taking Inorganic Chemistry and Analytical Chemistry will be offered completely new subjects.

Approximately 80 per cent of the Department's staff either are participating currently or have participated in instruction in the freshman program in General Chemistry. This program was altered during the year to include advance distribution to students of a syllabus covering the subject matter of the lectures, recitations, and laboratory. The fact that all freshmen had this material available proved to be a decided advantage in teaching the course.

Since 1947, the Department has had no increase in faculty. However, a number of the men who have retired during that period are continuing to teach or to direct research on a part-time basis. The optimum size of the staff requires attention during the next few years and probably should be increased by approximately 10 per cent. Such an increase would require additional funds, space, and equipment. The Department is graduating 25 to 30 S. B. candidates and 40 to 45 doctoral candidates each year. Its group of graduate students, about 200 in number, is one of the largest in the country.

Personnel

Professor Derek H. R. Barton served as the sixth Arthur D. Little Visiting Professor of Chemistry during the spring term of 1958 and delivered a series of approximately twenty lectures on "Selected Topics in the Chemistry of Natural Products." Professor Barton's lectures were attended by a large group of M.I.T. students and faculty as well as guests from other universities and industries located in the Boston area.

Dr. George H. Büchi was awarded the first Leopold Ruzicka Prize, established in 1957 in honor of the seventieth birthday of Nobel Lauriat Professor Leopold Ruzicka of the Federal Technical Institute in Zürich. It is awarded annually to the Swiss citizen under 45 years of age considered to have made the outstanding contribution to research in chemistry, regardless of the nation in which the research was done. It is an extraordinary honor to Dr. Büchi, working as he does in the United States, to receive this first Ruzicka Prize. Dr. Büchi also received the Fritzsche Award of the American Chemical Society for outstanding contributions to the field of structure determination of terpenes. In this research he has combined the best features of classical methods of structure determi-

nation with extensive use of physical methods, and he has been guided by mechanistic considerations of possible biogenetic pathways.

There were three retirements among members of the Chemistry Department faculty during the 1957–58 academic year: Professor Leicester F. Hamilton, Professor Avery A. Morton, and Professor Walter C. Schumb. Professor Hamilton will continue as Executive Officer of the Department during the 1958–59 academic year, and Professor Schumb will continue with a program of research as Emeritus Lecturer.

Dr. Walter R. Thorson has accepted an appointment as Assistant Professor of Physical Chemistry, effective July 1, 1958.

Research

Research in the Department is accomplished primarily by the collaboration of graduate students, postdoctoral fellows, and undergraduates with members of the faculty. The following brief summaries outline some of the Department's recent outstanding accomplishments.

Professors Charles D. Coryell and John W. Irvine, Jr., have completed comprehensive theoretical treatments of the anion exchange of anionic complexes of metals and of the extraction of these into organic solvents and have accumulated substantial data illustrating and exploiting the power of these treatments.

Professor Carl W. Garland has investigated the low-temperature elastic properties of hexagonal metals. A force model for the metals has been established, and theoretical lattice heat capacities have been calculated.

Professor Richard C. Lord and Dr. Monroe V. Evans have shown that the proposed "aromatic" seven-membered ring structure for the tropilidene molecule is supported by spectroscopic evidence and that bicyclic structures are inconsistent therewith.

Professor William R. Moore is studying the separation of closely related substances by gas chromatography, and he has devised simple equipment and techniques for both the analytical and preparative separation of many organic compounds. The results include the first separation of nuclear spin isomers by this method.

Dr. James W. Ross has been investigating some new electrochemical techniques for the analysis of traces of metal ions at extremely high dilutions. The kinetics of the electroreduction of transition metal ions are also being studied.

Professor George Scatchard, who for twenty years has been studying vapor-liquid equilibrium by steady-state distillation, has now developed a static method which measures only the total volume, the over-all composition, and the total pressure as a function of the temperature.

Dr. Dietmar Seyferth has continued studies of the physical properties and chemical reactions of vinyl-metal compounds, including addition, cleavage, and polymerization reactions.

Professor John C. Sheehan and Drs. H. G. Zachau and William B. Lawson have determined the complete structure, including stereochemistry, of the antibiotic Etamycin, which possesses interesting activity against Gram-positive organisms and causes a reversible leucopenia in dogs.

Professor Walter H. Stockmayer has been studying the dielectric behavior of high polymers with various kinds of dipoles; measurements over ranges of frequency, temperature, pressure, and concentration permit the determination of energy and volume barriers to rotation of the polar groups and other interesting properties.

Professor C. Gardner Swain and Dr. Richard F. W. Bader have developed a statistical mechanical theory which predicts, from measured vibrational and librational frequencies, all of the thermodynamic differences between light and heavy water (H_2O and D_2O) and mixtures of the two; the thermodynamic differences for solution of ions; relative equilibrium constants involving hydronium and hydroxide ions; and kinetic solvent isotope effects. This entails a revision of current views on the structure of water and the process of ionic hydration. In addition, a new mechanistic tool has been developed for determining the direction of electron flow in cyclic processes or for distinguishing proton transfers from hydride transfers.

ARTHUR C. COPE

DEPARTMENT OF FOOD TECHNOLOGY

The Department of Food Technology experienced an active year from the standpoint of staff participation in research programs, conferences, and symposia.

Noteworthy progress has been made in research on the effects of ionizing radiations on milk and milk products. Basic studies in

this field have led to the characterization of a number of chemical components in milk fat which are changed by bombardment with ionizing energy. This work has been part of the research program in ionizing radiations, a field in which the Department has pioneered, and part of a program involving the chemistry of flavors, a new area of departmental research which has recently been expanded under grants-in-aid from the Nestlé Company, Inc.; the Carnation Company; and the Department of the Army, Quartermaster Corps.

During the year, a grant-in-aid from the Campbell Soup Company has made possible the initiation of research on the chemistry of flavor in marine products. This, together with an earlier grant from the United Fruit Company on the chemistry of the flavor of bananas, has allowed significant progress in this field.

An important new research project, relating to radiation protection of humans, was initiated during the past year under the sponsorship of the Max C. Fleischmann Foundation of Nevada.

The Department Visiting Committee believes the Department's foremost problem is to attract increasing undergraduate enrollment. To this end, the Department has completed a colored motion picture film illustrating its various activities in research and teaching, with the help of Arnold T. Hampson, President of Merchants Cold Storage & Warehouse Co., Inc. of Providence, Rhode Island, an outstanding amateur photographer. It will be available on request for showing to high schools throughout the country, through the cooperation of our departmental alumni. In addition, wherever possible, faculty members in the Department will make visits to secondary schools. The graduate student enrollment in the Department numbers well over 40 and is on the increase, with outstanding graduate students being attracted from universities all over the world.

During the year the Institute of Food Technologists outlined a program of undergraduate education believed the most desirable as preparation for careers in food science and food technology. Professor Bernard E. Proctor and Dr. Charles N. Frey participated in these discussions, and the recommended program is closely related to the undergraduate curriculum at M.I.T. In connection with these discussions, Professors Proctor and Samuel A. Goldblith prepared a report on the first twenty-five years of teaching in food technology at the Institute.

In early May of this year, the Board of Directors of the American Meat Institute Foundation attended a short symposium at the

Institute. Professor Proctor described the various activities of the Department, and the members were given demonstrations of the Department's current research developments.

Professor John T. R. Nickerson spent the summer in Sweden, advising the Swedish government on its new Institute for Food Preservation Research at Göteborg. Professor Nickerson has been elected Treasurer of the Northeast Section of the Institute of Food Technologists.

Professor Proctor has been active during the year as representative of the Institute of Food Technologists on the Food Protection Committee of the National Research Council, studying impending legislation in Congress on new food laws which will greatly affect the national food industry. Professor Proctor has also served as a member of the Milk and Food Research Panel of Consultants to the Robert A. Taft Sanitary Engineering Center of the U. S. Public Health Service.

Professor Goldblith has served on the National Council of the Institute of Food Technologists and is a member of the High-Level Radiation Dosimetry Subcommittee of the Committee on Foods of the National Research Council. He is also an active member of the National Publications Committee of the Institute of Food Technologists.

New additions to the staff during the past year include three research associates: Dr. Emily Wick, an expert in flavor research who will participate in flavor chemistry studies in the Department; Dr. Sanford Miller, from Rutgers University, who has strengthened our staff in the field of nutrition; and Ernst R. Pariser, a graduate of Cambridge University with wide experience in the biochemistry of fat and oil technology, who has joined our staff to participate in an important research program on protein for underdeveloped countries sponsored by the United Nations Children's Emergency Fund.

BERNARD E. PROCTOR

DEPARTMENT OF GEOLOGY AND GEOPHYSICS

A year ago the curricula of Courses XII (four years) and XII-A (five years) were revised to provide broad undergraduate training for later graduate work in geology, geochemistry, geophysics, meteor-

ology, and oceanography. These revised curricula provide a large number of elective hours which students may use to sample a broad area of the earth sciences or to concentrate in a restricted field. Students have shown much interest in this diversified program, and the five best seniors were admitted to the five-year Honors Course in February, 1957. The first of the five-year students received the two degrees, S.B. and S.M., concurrently at the June, 1958, Commencement.

Undergraduate enrollment (excluding freshmen) again totaled slightly less than fifty students, but the number of graduate students increased from forty-eight degree candidates in 1956–57 to sixty-two for 1957–58. This large increase was greater than expected because of fewer withdrawals than usual; we plan to reduce the number of graduate students to approximately fifty, as that is about the optimum number that can be handled adequately with our present staff and space. Geologists, geophysicists, and geochemists with advanced degrees are in good demand, and our most recent graduates have had little difficulty in securing good positions.

Departmental Activities

The tenth Summer School of Geology was held at the Nova Scotia Centre for the Geological Sciences, with Dr. Walter L. Whitehead, Lecturer and Emeritus Associate Professor, as Director; Professor Roland D. Parks as Assistant Director in charge of geological surveying; and Dr. Nathaniel McL. Sage as Lecturer in charge of field camps. Professor Richard R. Doell gave a week of instruction in practical field use of the several different geophysical instruments.

Twenty-seven students — fifteen from M.I.T., eight from seven other U.S. institutions, and four from Canadian universities — received basic field instruction; in addition, three M.I.T. graduate students and two from Yale University carried on field work for Ph.D. theses.

This summer's operation was the tenth session held at Crystal Cliffs and the last for Professor Whitehead as Director, as he retired in June, 1957. During his decade as Director, 340 students have attended the Summer School. Of these, 265 have taken regular class work and 75 have carried on independent field work for theses. Of the 265, 197 have come from M.I.T., 44 from 17 other U. S. schools, 21 from Nova Scotian schools, and 3 from New Brunswick (Mt. Allison). Of these same 265, 228 have come from 34 different

The geology summer camp, conducted in cooperation with Nova Scotian universities at the Nova Scotia Centre for the Geological Sciences near Antigonish, completed its tenth season during 1957.

states, 26 from 4 different provinces, and 11 from abroad — Argentina, China, Cuba, France, Holland, India, Mauritius, Mozambique, Mexico, Pakistan, and Venezuela.

The end of the first decade of the School and the retirement of Professor Whitehead as Director were celebrated at the Closing Exercises on August 30, the day after St. Francis Xavier University had awarded Professor Whitehead an Honorary Doctor's degree. At these exercises the Chairman of the Department presented to the Minister of Mines of Nova Scotia a special report entitled *Ten Years in Nova Scotia, The Massachusetts Institute of Technology Summer School of Geology, 1948–57.*

Dr. Arthur J. Boucot, formerly geologist with the U. S. Geological Survey and last year a Guggenheim Fellow in Europe, joined the staff of the Department in the fall as an Assistant Professor of Geology. He will assume directorship of the Summer School of Geology in Nova Scotia in the summer of 1958. A specialist on Devonian stratigraphy and paleontology, Professor Boucot carried on active research in both areas; he will have several thesis students working in Maine under his general supervision next summer.

One third-year student in geophysics, along with fourteen other students from fourteen other colleges, participated in the Student Cooperative Plan of Geophysical Service, Inc., working as a field assistant on a seismograph crew in Louisiana. An outstanding feature of this carefully planned training program is a series of forty

short lectures delivered to the student group by professional geologists and geophysicists during the orientation week at Dallas before the students go to their field assignments. This cooperative training program, started seven years ago as a joint venture by M.I.T. and G.S.I., has grown to a nationwide effort.

For the second year, a two-term sequence of lectures in oceanography was offered by staff members of the Woods Hole Oceanographic Institution. Professor John B. Hersey lectured on physical oceanography, and Dr. Francis A. Richards on chemical oceanography. These lectures have helped to stimulate interest in oceanography among M.I.T. students, and eight of our graduate students will work at Woods Hole during the summer of 1958. Professor Hersey and Professor William S. Von Arx, also on the staff at Woods Hole, participate in cooperative thesis research which the Department initiated there.

The biweekly earth sciences colloquium and numerous less formal seminars, colloquia, and discussion groups brought many nationally and internationally known earth scientists to M.I.T. and further stimulated the growing interest in unifying all earth sciences.

Activities and Changes

Dr. Stephen M. Simpson, Jr., was on leave for the school year in order to carry on research in the R.C.A. Laboratories in Waltham. He will resume his duties as Assistant Professor of Geophysics in July, 1958.

Associate Professor Gordon J. F. MacDonald resigned at the end of the school year to accept a professorship in geophysics in the Institute of Geophysics, University of California.

Research

Current projects in the Departments of Geology and Geophysics and of Meteorology, and at the Woods Hole Oceanographic Institution, constitute a major over-all research effort in the earth sciences and will form a large and important part of the future program of the recently established interdepartmental Laboratory of Earth Sciences. In addition to new projects started during the past year, we plan to initiate other programs of research — in cooperation with the Woods Hole Oceanographic Institution, whenever appropriate — with the objective of unifying our efforts in attacking the major problems of our physical environment.

The research program of the Department is largely supported by agencies of the federal government. The largest area of effort is in quantitative and theoretical investigations of the nature, composition, and age of the earth's crust and interior.

Professor Martin J. Buerger, besides directing the School for Advanced Study, continued to develop the theory of image-seeking functions and its application in crystal-structure analysis. One of the new developments now permits solving Patterson syntheses of crystals containing atoms of about equal scattering power. With one of his former students, Dr. L. V. Azaroff, he published *The Powder Method in X-ray Crystallography*. Professor Buerger was elected an Honorary Member of the German Mineralogical Society in August, 1957, and served as American delegate to the organizational meeting of the International Mineralogical Association at Madrid in April, 1958.

In the Mass Spectrometry Laboratory, research on the variations in radiogenic isotope abundances resulted in precise age determinations of rocks from various parts of the earth. A continuing program of age correlations in the older parts of all the continents is being conducted by Professors Patrick M. Hurley, Harold W. Fairbairn, and William H. Pinson, Jr., in collaboration with geologists in a dozen other countries.

Professors Fairbairn and MacDonald and several graduate students collaborated on photometric analyses of minerals in metamorphic rocks to determine the nature of the thermal equilibrium in these rocks.

In the Cabot Spectrographic Laboratory, under the direction of Professor William H. Dennen, principal efforts were devoted to developing new analytical techniques and to the study of the ratio and distribution of the major and minor elements in sediments and sedimentary rocks. Professor Ely Mencher worked closely with several petroleum companies in securing desired samples for analysis.

Professor MacDonald carried on theoretical studies of mineral stabilities at extreme pressures, with special reference to the constitution of the earth's interior; he also continued investigation of polar wandering and continental stability in terms of recently proposed new theories on the nature of the earth's interior. He was a Visiting Investigator in the Department of Astrophysics at California Institute of Technology last summer.

Professor William F. Brace and graduate students continued studies of indentation hardness as an indicator of plastic behavior of

single crystals and rock fracturing as a function of bonding strength. He and Professor Doell started a regional gravity survey of the Boston Basin area. Professor Doell spent the summer investigating the physical nature of glacial ice in northwestern British Columbia and then resumed his general studies of remanent magnetism in rocks, paying special attention to paleomagnetic interpretations as they bear on polar wandering and continental drift.

Theodore R. Madden and his group of graduate students extended and modified electrical methods developed in our Geophysical Laboratory for locating conductive mineral deposits, utilizing frequency-dependent effects that result from localized polarization. Dr. Takeshi Kiyono, Professor of Electronics Engineering in Kyoto University, spent the year on a Fulbright grant doing research with Mr. Madden in the field of electromagnetic theory as applied to geophysics.

Professor John W. Winchester and his students carried on experiments in radioactivity and geochemistry, including determination of potassium and sodium in rocks by alpha-particle activation, determination of strontium isotopes and rubidium in rocks by deuteron and proton activation, determination of selected rare earths by neutron activation, study of the absorption of boron by kaolinite from solutions of various pH and salinity, and determination of the equilibrium vapor pressure of hydrated minerals by infrared spectroscopy. A program of neutron activation analysis of geological materials using the new M.I.T. Reactor is planned to begin in September, 1958.

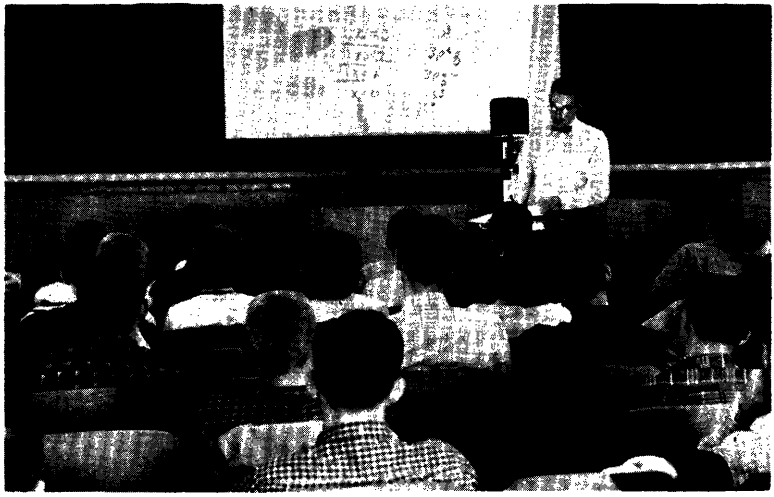
Dr. James C. Savage, Lecturer in Geophysics, spent the year studying problems concerning the propagation of seismic waves in layered structures and gave a series of special lectures on wave propagation. He will join the Faculty of Science of the University of British Columbia in September, as Instructor in Geophysics.

Dr. Harry Hughes, Visiting Lecturer in Geophysics, began measurements of the electrical conductivity of minerals under the pressure and temperature conditions which exist in the earth's crust and mantle, for the purpose of determining temperatures possible in the earth's interior; he gave a series of special lectures on the physics of the earth. He will continue next year as Assistant Professor of Geophysics, and plans to continue his research during the summer in the Dunbar Geophysical Laboratory at Harvard.

ROBERT R. SHROCK

DEPARTMENT OF MATHEMATICS

During the year, the Department of Mathematics made a thorough study of the mathematics program offered to students in the first three years; the policy in regard to outside-of-classroom work was also reviewed. On the basis of this study, several changes have been made. The most important of these was a rather complete revision of the program in the fourth, fifth, and sixth terms of mathematics — that is, in M22, Differential Equations, and in M351 and M352, Advanced Calculus for Engineers. The new program for these three subjects will be an integrated three-semester program using a single text. The first of the three semesters (M22) will be devoted to differential equations and probability. The introduction of probability into this course is new and was decided upon after a careful consideration of the needs of engineering and science students throughout the Institute. The work in the next two semesters will consist of vectors and vector field theory, functions of a complex variable, Fourier series, partial differential equations — including solution by series and solution by integrals, and linear vector spaces and matrices. The Department feels that the new program will furnish a strong mathematical training for engineers and scientists who are continuing beyond the usual three-semester sequence in



The new first-year elective subject in Discrete Mathematics proved a popular choice among members of the Class of 1961.

calculus. On an experimental basis the Department will give lectures in M11 (first-semester calculus) during the fall semester of 1958–59 to 150 to 160 students from six regular sections. The group will have two hours of lecture per week and will be divided into six small sections for one recitation hour each week. Professor Eric Reissner will give the lectures.

During the spring semester, the Department offered a new freshman elective, M101, Introduction to Discrete Mathematics. This elective, which was in addition to the usual one in number theory offered each fall, was chosen by approximately one-sixth of the freshman class. The material consisted of work on logic, algebra of sets, introduction to probability, and related topics which have not customarily been available to freshmen at the Institute. The course was taught by Professor Hartley Rogers, Jr. in a single section. As an experiment, the lectures during three weeks of the course were given over closed-circuit television, with Professor Rogers giving the lectures in the WGBH television studio and the students watching five receivers in the Little Theatre of Kresge Auditorium.

The year was marked by another peak in enrollment in mathematics subjects and by a peak in the number of mathematics majors. During the fall semester a total of 3,585 students enrolled in mathematics subjects in 130 sections. An interesting aspect of this enrollment is the large increase in the number of students taking mathematics beyond the required first two years. Twenty years ago, in the fall of 1937, 21 per cent of the roll cards in mathematics were for subjects other than the required first two years; this amounted to 315 students. Ten years later, in the fall of 1947, 30 per cent of the mathematics registration was in this category. Five years ago, in the fall of 1952, this figure was 37 per cent. In the fall of 1957, the figure was 47 per cent, with 1,693 students enrolled in mathematics subjects other than the required first two years.

In accordance with the increased national interest in mathematics, the number of undergraduate students electing to major in mathematics continued to show substantial increase. Twenty years ago, in the fall of 1937, three freshmen entering M.I.T. indicated that they intended to become mathematics majors. Fifteen years later, in the fall of 1952, this figure was 23, while last fall it was 45. The total number of undergraduate mathematics majors — that is, freshmen, sophomores, juniors, and seniors combined — totalled 14

in the fall of 1937, 63 in the fall of 1952, 103 in the fall of 1956 and 135 last fall. As a consequence of this large increase in the number of majors, the Department is making a careful study of its procedure in regard to the undergraduate thesis. It is clear that some revision will be necessary in order to handle the large number of students who will soon be writing undergraduate mathematics theses.

Professional Activities and Visitors

Members of the Department were active in research, in the fields of algebra, algebraic geometry, elasticity, cybernetics and the theory of automata, differential equations, differential geometry, elasticity, hydrodynamics, mathematical logic, number theory, numerical analysis, partial differential equations, probability and statistics, topological algebra, and topology. During the year, Professors Kenkichi Iwasawa, Henry P. McKean, Jr. and Claude E. Shannon were on leave; Professor Iwasawa had a Guggenheim Fellowship at The Institute for Advanced Study, Professor McKean was on a Fulbright award and a National Science Foundation Postdoctoral Fellowship at the University of Kyoto, Japan, and Professor Shannon was at the Institute of Behavioral Sciences at Stanford. Professor Daniel B. Ray spent the spring semester on leave on an Alfred P. Sloan Award at The Institute for Advanced Study.

During the year, the Department had several visiting members on the faculty. Professors Lennart Carleson of the University of Upsala and Shing-Shen Chern of the University of Chicago were visiting professors during the fall semester, and Professors Armand Borel of The Institute for Advanced Study in Princeton; Guy Hirsch of the University of Brussels; Michael S. Longuet-Higgins of the National Institute of Oceanography, Wormley, England; and Barrett O'Neill of the University of California, Los Angeles, were here during the spring term.

Professor Jürgen Moser of New York University was with us on a visiting basis during the academic year and will join our faculty as associate professor next year. Dr. Pesi R. Masani of Bombay University, India, spent the year on a part-time basis jointly at Harvard and at M.I.T. Dr. Masatake Kuranishi of Nagoya University, Japan, spent the fall semester in our Department as research associate.

During the fall semester, Professors Warren Ambrose, Reissner, Rogers, and Isadore M. Singer each visited the undergraduate

mathematics departments of a selected group of colleges and universities in New England and New York to meet with students who were interested in pursuing graduate work in mathematics. One result of these visits was an increase in the number and quality of students from this group of colleges who will be enrolled in our Graduate School next year.

Professor Reissner was appointed a member of the Executive Committee of the Applied Mechanics Division of the American Society of Mechanical Engineers for a five-year term. In September, Professor Carleson, Dr. Kenneth M. Hoffman, and Professor William T. Martin attended, by invitation, a two-week Conference on Analytic Functions at The Institute for Advanced Study. Various other members of the Department spoke at colloquia and at meetings of mathematical and other scientific and engineering societies in Cambridge and elsewhere during the year.

WILLIAM T. MARTIN

DEPARTMENT OF METEOROLOGY

There has been a noticeable awakening of interest in meteorology on the national level during the past year. This has been due in part to the International Geophysical Year and to the reports of the Advisory Committee on Weather Control and of the Committee on Meteorology of the National Academy of Sciences, both of which emphasized the need for a substantial augmentation of the meteorological research effort. Much of the popular and official interest was stimulated by speculations of large-scale control of weather and climate. The Department has not yet received any tangible benefits from this enhanced interest, but it augurs well for the immediate future.

The graduate enrollment in meteorology has been about the same this year as last. The rapid development of the field has caused the faculty of the Department to undertake a thorough review of the subjects of instruction with a view to the more complete integration of the instructional program. Professor Jule G. Charney introduced a new graduate subject on Planetary Fluid Dynamics, designed to follow the subject in Theoretical Hydrodynamics offered by Professor Chia-Chiao Lin of the Department of Mathematics. This

two-term sequence in hydrodynamics is part of the earth sciences program adopted last year when it was decided to offer graduate or fourth-year subjects in the principal areas of classical physics of fundamental importance to the earth sciences. Professor Frederick Sanders has developed a unique and most effective program of instruction in the synoptic laboratory, in which the students use graphical and numerical methods for the integration of the equations governing the motion of the atmosphere, starting from the current observed conditions. This procedure provides the needed integration between the theoretical and experimental aspects of meteorology and represents an important advance in meteorological education.

Research

The research program of the Department consists of ten major projects, each of which is supported by contracts with agencies of the federal government. Some difficulty was experienced during the year as a result of the expenditure ceilings that were imposed on the defense agencies, but this situation was finally resolved before it caused a major disruption of the research effort. Some further difficulty may be anticipated because of the current reorientation of the research objectives of the Air Force.

Professors Charney and Norman A. Phillips have made extensive use of the Computation Center for testing dynamical models of the atmosphere. Particular emphasis has been placed on models that include the radiational energy input and the frictional dissipation. The representation of the radiational properties of the atmosphere has been guided by Dr. Lewis D. Kaplan's fundamental investigations on the divergence of the flux of long-wave radiation. It is hoped that a model can be evolved that will represent the behavior of the atmosphere for periods of months and years. This would provide the basis for understanding climate and might suggest an answer to the possibility of artificial climate control.

Professor Victor P. Starr and his group have assembled extensive information on the transports of momentum, energy, and water vapor in the atmosphere. With the aid of theoretical studies, this has led to the formulation of a general theory of the establishment and maintenance of the global circulations of the atmosphere. Maps of the horizontal divergence of water vapor have clearly revealed the major sources and sinks of water vapor. In general,

these results confirm inferences drawn from other sources; but one rather surprising result has been the location of a water-vapor source in the vicinity of the Sahara. It appears that these results could well form the basis for a study of the natural water resources of the earth.

Professor Hurd C. Willett has continued his study of the changes of the global circulation patterns over periods ranging from days to years. He has developed interesting theories for past and present climatic changes, and he feels that these are closely related to variations in the energy output of the sun. Past studies of solar-weather relationships have been hampered by inadequate indices of solar activity. More recent measures of solar activity, intensified during the International Geophysical Year, offer promise of more definitive information.

Professor Edward N. Lorenz has been developing the time series approach to changes in the atmospheric flow patterns. He has demonstrated that although linear statistics provide a useful representation of the atmospheric time series, this technique is definitely limited by the inherent nonlinearity of the atmosphere. He has accordingly begun to employ a nonlinear approach, selecting from the infinite variety of nonlinear expressions those suggested by the governing dynamical equations.

The exacting and difficult task of measuring and counting cloud and rain drops from an airplane moving at more than two hundred miles per hour has been undertaken by Professor Delbar P. Keily and his associates. A novel electric probe for counting and sizing cloud drops, which operates satisfactorily in the laboratory, is now undergoing flight tests. Attention has also been given to instrumentation for sizing rain drops, which must be handled in special ways to avoid their rupture at airplane speeds.

The Weather Radar Project has developed special equipment for presenting pulse-averaged and range-corrected isointensity contours. These can be quantitatively related to the rainfall, thus providing improved means for determining the distribution of precipitation in time and space over an area of the order of 1,000 square miles. We have long known that radar offers the best available means for studying the smaller but often intense phenomena of the atmosphere, such as squall lines and thunderstorms. These phenomena are also related to the larger-scale features as depicted on conventional weather charts, and their study thus involves the integration of the radar data with the conventional weather observation. As a result of our interest in this important area, a new project,

which will cooperate closely with the Weather Radar Project, has been initiated under the direction of Professor James M. Austin.

The dynamics and energetics of the tropical hurricane is a subject of considerable theoretical and practical interest. Professor Morton G. Wurtele, with the advice and assistance of Professors Charney, Lorenz, and Starr and Dr. Hsiao L. Kuo, has been engaged in developing theoretical models of the hurricane. Certain prominent features of the hurricane, such as the eye and the spiral rain bands, still await completely satisfactory explanations, but many of the gross features have been clarified.

Much of the effort devoted to weather forecasting, whether it employs numerical models or more conventional techniques, is directed to the prognostication of the horizontal field of motion. Important weather phenomena such as clouds and precipitation are the result of vertical motion. There are semiempirical relations between the horizontal and vertical fields of motion that have been used with some success to forecast the weather from the horizontal flow. The numerical models now used provide a means for the objective determination of the vertical motion, and Professor Frederick Sanders has been comparing the sign and magnitude of such vertical velocities with the observed cloudiness and precipitation. The relations are in the expected sense, but there are discrepancies which may in part be traced to deficiencies in the numerical forecasting models. Such comparisons between the models and the real atmosphere represent the experimental side of meteorology that is essential to the development of the more widely heralded theoretical approaches.

A project at the Round Hill Field Station under the general supervision of Professor Henry G. Houghton has been studying the mechanics of the diffusion of gaseous materials in the lower layers of the atmosphere. As a result of extensive field observations at Round Hill and at O'Neill, Nebraska — sites with quite different characteristics — it has been found possible to relate the behavior of a plume of pollutant from a point source to very simple parameters over a wide range of atmospheric conditions. The parameters required are the standard deviation of the azimuth wind direction and a measure of the vertical stability of the lower atmosphere. Progress has also been made in the understanding of the structure of atmospheric turbulence, and it is hoped that this can be extended to a study of the mechanism of the decay of turbulent energy in the boundary layer.

Personnel

The faculty of the Department have participated in numerous outside professional activities. Professor Houghton retired as a Councilor of the American Meteorological Society in January, and Professor Austin was elected to a three-year term in the same office. Miss Elizabeth A. Kelley conducted the weekly program, "Weather for You," on WGBH-TV. Professor Lorenz, Professor Phillips, and Dr. Aaron Fleisher were invited to participate in the Scandinavian-American Meteorological Meeting in Bergen, Norway, in June. Dr. Kuo spent the spring term at the University of Chicago as Visiting Associate Professor. Professor Houghton was appointed as a United States delegate to the Aerology Commission of the World Meteorological Organization. Professor Charney served as a member of the Committee on Meteorology of the National Academy of Sciences, and Professor Houghton was elected Chairman of the University Committee on Atmospheric Research.

HENRY G. HOUGHTON

DEPARTMENT OF PHYSICS

While a great part of the effort of the Physics Department staff has traditionally been devoted to research, and still is, the most important new development during the past year has been the very major effort devoted to problems in teaching. Many Department members have contributed to the work of the Physical Science Study Committee, which has been engaged in preparing material for a one-year high school physics course and all the various aids to teaching considered necessary. This work, which is a cooperative effort involving organizations and individuals from many parts of the United States, has been under the direction of senior members of the Physics Department and has been supported by a considerable subsidiary effort on the part of junior members of the Department. Professor Jerrold R. Zacharias has been responsible for the project since its initiation. He has been relieved of all teaching duties in the Department for the year but has continued to direct the operation of his research laboratory. Professor Nathaniel H. Frank has

been on leave since March to devote himself exclusively to the work of the Committee. Professors Francis L. Friedman, Bruno B. Rossi, and Uri Haber-Schaim have also devoted a major part of their time to this effort. Other members of the Department who have contributed to a lesser though still very considerable extent include Professors Herman Feshbach, William L. Kraushaar, John G. King, Robert W. Williams, Nathan S. Wall, Arthur K. Kerman, Roy M. Weinstein, and David H. Frisch.

It is hoped that the work of the P.S.S.C. may gradually be turned over to others and that the experience gained may now be of use in our own undergraduate science teaching program. We are now making such plans, particularly concerning the teaching of physics in the first two years. This will be aimed at the training not only of future scientists and engineers but also of men and women who will themselves be teaching the new methods to school and college science teachers. If funds become available, a major undertaking along these lines is contemplated. In any event, the Physics Department will continue its intensive efforts for increasingly effective teaching.

A review of graduate courses being offered by the Department has just been completed, and a revision of the treatment of classical electromagnetic theory and a consolidation of courses in classical mechanics has been effected.

Research

The research work of most of the members of the Department is reported separately by the interdepartmental laboratories — the Laboratory for Nuclear Science, the Research Laboratory of Electronics, and the Spectroscopy Laboratory. In addition, the following items are of particular interest.

The Solid State and Molecular Theory Group, under the direction of Professor John C. Slater, has been carrying out calculations of atomic and molecular energy levels and of energy levels in solids. In atomic energy levels, they have been working with the atoms of the iron group, using the Whirlwind computer for obtaining wave formations. In the study of molecular energy levels, they have done considerable work with light molecules, particularly lithium hydride and hydrogen fluoride, investigating the wave functions and dipole moments as well as the energy levels.

In addition to these calculations, work has been in progress on the general properties of energy levels in paramagnetic salts,

on the interaction of electronic motion and lattice vibration in ionic crystals, and other similar problems.

The nuclear reactor will be used by Professor Clifford G. Shull to provide slow neutron beams for crystal diffraction studies. Three spectrometers are nearing completion and will be in use during the coming year. The magnetic properties of solids, and particularly of domains and their boundaries, will be investigated.

Professor Bertram E. Warren has continued his work on the temperature diffuse scattering of X-rays by crystalline solids and its interpretation in terms of the elastic spectrum. During the year an elastic spectrum for silicon has been obtained. X-ray diffraction studies of cold work in metals have shown the importance of faulting, and during the year methods have been devised for measuring the probability of deformation faults and twin faults in cold work metals.

Personnel

Professor Frank, Head of the Department, has been on leave since March 1; Professor Francis Bitter, Associate Dean of Science, has been Acting Head of the Department during this period.

Professor Hans Mueller was on leave of absence during the summer of 1957 and the first term of the year 1957–58 to continue work on the writing of a book on thenomenological optics.

Professor Victor F. Weisskopf has been on leave for the entire year to study and lecture in Europe and for one term at CERN in Geneva.

Professor Albert G. Hill has been on leave for the entire year to continue as Director of Research of the Institute for Defense Analyses.

Professor George E. Valley has been on leave for the entire year to serve as Chief Scientist for the Air Force.

Professor Hans M. Mark delayed his arrival until April 1 in order to finish an experimental program at Livermore, California, with apparatus that has since been dismantled.

Professor Clark Goodman has been on leave for the entire year as Assistant Director of the Reactor Division in the Atomic Energy Commission. He has resigned his position as of June 30, 1958, in order to become Vice President (Technique) of Schlumberger, Ltd.

The Department welcomed four visiting scientists from the U.S.S.R. — Professors Blokhinstev, Dzelopov, Niktin, and Okun — who conducted several seminars on Russian physics.

FRANCIS BITTER

INTERDEPARTMENTAL LABORATORIES AND ACTIVITIES

As the reports which follow indicate, interdepartmental research activities contribute a substantial and growing part of the total research effort in the School of Science. Indeed, as has been mentioned previously, these cooperative activities may well set the pattern of future research organizations at M.I.T.

Laboratory for Nuclear Science

As indicated last year, the marked stimulation experienced recently in both low-energy and high-energy nuclear physics (evidenced, for example, by the appearance of a number of new experimental techniques in both fields and by the 6-Bev Cambridge Electron Accelerator currently under construction as a joint Harvard-M.I.T. project) is having a profound effect upon the Laboratory. The past year has been representative of what will undoubtedly be a period of several years of significant reorientation, particularly in regard to the careful development of new facilities. Notable achievements in this direction were the establishment of a "Nuclear Data Center," which permits the centralization of those aspects of nuclear data-taking common to many experiments; the initiation and implementation of a number of extensive experiments in high-energy physics, including a large-scale bubble chamber program; plans for use of some of the radically new visual particle detection techniques; and implementation and installation of the Cosmic Ray Group's "giant" air shower experiment in New Mexico.

Although research emphasis and scope have undergone marked change, the essential character of the Laboratory's programs remain the same. As previously, the main areas of research include: inorganic and organic nuclear chemistry and chemistry of the fission elements (including Professors Charles D. Coryell, Frederick D. Greene II, David N. Hume, John W. Irvine, Jr., George Scatchard, and C. Gardner Swain); cosmic ray research (Professors Bruno B. Rossi, David O. Caldwell, George W. Clark, William L. Kraushaar, John D. Linsley, Stanislaw Olbert, and Robert W. Williams, and Drs. Herbert S. Bridge, Yosh Pal, and Livio Scarsi); photomeson and photonuclear research with the Laboratory's synchrotron and linear accelerator, and high-energy studies of the fundamental particles using nuclear emulsions and bubble chambers (Professors Bernard T. Feld, David H. Frisch, Irwin A. Pless, Robert A.

Schluter, Roy M. Weinstein, and Roger W. Williams, and Drs. William Bertozzi, Peter T. Demos, David A. Hill, Paul D. Luckey, Jr., Louis S. Osborne, David M. Ritson, Charles P. Sargent, and Albert Wattenberg); theoretical nuclear physics (Professors Victor F. Weisskopf, Herman Feshbach, Marvin H. Friedman, Kerson Huang, Francis E. Low, and Felix M. H. Villars, and Drs. H. McManus and R. Thaler); nuclear energy level studies using the O.N.R. Van de Graaff generator (Professors William W. Buechner, Robert J. Van de Graaff, and Harald A. Enge, and Drs. Frederic J. Eppling, C. H. Paris, A. Sperduto, and Robert E. White); studies with the Rockefeller Van de Graaff proton accelerator (Dr. Leon E. Beghian and Professor Paul R. Scharenberg); radioactivity research (Professors Robley D. Evans and Martin Deutsch and Dr. Bernard Gittelman); and studies of nuclear structure using the Markle cyclotron (Professor Nathan S. Wall and Dr. D. R. Sweetman).

Participants in the work of the Laboratory during the past year totalled 296 persons, including 35 academic staff members and 84 graduate students of the Departments of Chemistry and Physics; 34 D.S.R. staff members; 72 full-time nonstaff employees; 54 part-time nonstaff employees (mostly undergraduate students); and 17 visiting scientists representing 10 countries in addition to the United States. Theses carried by students working in the Laboratory involved 24 Ph.D. degrees.

There has been a noteworthy change in the Laboratory's financial support picture. In addition to an increase in funding consistent with an enhanced experimental program, there occurred on April 1, 1958, with the granting of A.E.C. Contract AT(30-1)-2098, a transfer of contractual responsibility for the Laboratory's physics research. Although the main support for these studies continues, as in the past, to be provided by the Atomic Energy Commission and the Office of Naval Research, formal sponsorship passed on that date from the Office of Naval Research to the Atomic Energy Commission. Support of the contract is being supplied also by the Air Force Office of Scientific Research. Other research support includes an A.E.C. contract for research in nuclear chemistry; a grant from the National Science Foundation for cosmic ray air shower studies; and a contract with the Air Force Office of Scientific Research provided expressly for the development of special nuclear instrumentation. Total expenditures under all grants and contracts over the past year were approximately $1,650,000.

Symbolic of the effort to order the program of the Laboratory in the high-energy field has been the emergence, during the past year, of a "High-Energy Accelerator Physics" group, encompassing studies centered about the Laboratory's electron synchrotron and work with other high-energy accelerators throughout the country. Linked very closely and naturally with the problem of achieving intellectual and technical preparedness for the rapidly approaching Cambridge Electron Accelerator, considerable effort has been devoted to the planning and execution of experiments at Brookhaven and Berkeley, as well as to the development of experiments appropriate to the new high intensity of the synchrotron. Among experiments of note have been the measurement of X-ray scattering from protons (following earlier work indicating that the proton has a relatively complex structure); a number of significant experiments involving mesons and the "strange particles"; and the development of a novel Cerénkov counter which promises to extend significantly the scope of available techniques for high-energy particle counting. Tested at Brookhaven, the detector is scheduled for use at Berkeley in a series of highly interesting experiments involving the scattering and interactions of heavy mesons.

Work in the closely allied field of bubble chamber research has developed most vigorously, as expected. Investigation has been completed of the asymmetry of the μ^+ meson decay process and has contributed to the confirmation of the two-component neutrino theory. An extensive exposure was made using the 9″ propane chamber at the Cornell synchrotron. Construction has begun on the large hydrogen bubble chamber proposed last year.

The highly successful cooperative effort in bubble chamber research among members of the Laboratory for Nuclear Science and physicists from Harvard, Brandeis, and Brown Universities should be noted as an exemplary and encouraging development in respect to future research with the Cambridge Electron Accelerator. Organized as the "Cambridge Bubble Chamber Group," those active have been unusually successful in planning an over-all program for bubble chamber research involving physicists in the Cambridge area. As a result, an extremely effective attack, optimizing skills and interests and minimizing duplication, has been achieved. Construction of the large hydrogen chamber at M.I.T. in collaboration with the Harvard workers during the next year, for example, will be paralleled by the initiation of a large scanning equipment program at Brown University.

Proposed as a crucial sequel to the first large air shower cosmic ray experiment performed at Harvard, Massachusetts, a "giant" air shower experiment has finally been implemented and is currently being installed at the "Volcano Ranch" site near Albuquerque, New Mexico. Data from the original Harvard experiment is being subjected to reanalysis in the Computation Center to yield more accurate results. The Harvard apparatus has been dismantled and shipped to Bolivia for a collaborative experiment with University of La Paz physicists. Data from this site will shed light on the fluctuations in longitudinal air shower development; the spectrum of very high-energy primary cosmic rays; and on the angular distribution of cosmic rays at the equator. Considerable data from the smaller air shower apparatus at Kodaikanal, India, has been processed and is now being sorted and tabulated. Related cosmic ray studies have included continuous operation of the high-count rate monitor to observe unusual short-term cosmic ray fluctuations; a proposed underground measurement of μ-meson polarization as a means of determining the relative frequency of π and K mesons in air showers; and the design and partial construction of an apparatus to detect high-energy α-rays.

As part of its program for the study of the fundamental particles, the cosmic ray group is now obtaining final results from data obtained at the Brookhaven cosmotron with the large multiplate cloud chamber. A particularly interesting determination — the sign of the asymmetry parameter in the parity nonconserving decay $\Lambda^0 \rightarrow p + \pi^-$ — was made quite incidentally by a gratifyingly alert interpretation of the proton scattering in the iron plates of the chamber, yielding a result consistent with the predictions of a universal fermi interaction.

Work in nuclear chemistry has been extensive. New areas for analytical chemistry have been explored in the study of trace concentration electrodeposition of copper, nickel, and manganese; of irreversible electroreduction; and of voltametry in very thin layers of solutions. Major theoretical advances have been made relevant to solvent-extraction and ion-exchange separation. A study of cation-exchange equilibria has provided a valuable tool for exploring the molecular basis of cation-exchange specificity. Organic chemistry studies have included development of a statistical-mechanical treatment for isotope effects in reactions in light and heavy water; and studies, using tritium, of the methanolisis of trityl chloride down to 5×10^{-7} M methanol in benzene. Considerable

detail has been acquired on the mechanism of displacement reactions, oxidation steps, and the stereospecificity of free-radical reactions. Work in inorganic chemistry has produced a large body of new information, with the aid of the Laboratory's new Air-Force-supported Nuclear Data Center, on the decay schemes of short-lived nuclides. Of special interest have been the neutron-rich isotopes of palladium, silver, cadmium, and indium, as found in deuteron fission, where isomerism is commonplace and the decay chains show interesting genetic relations. Some ten new species have been discovered in this region. Efforts are being made to build up a center for reactor chemistry to parallel that for work at the Laboratory's particle accelerators.

In the area of precision nuclear spectroscopy, detailed studies were carried out on isotopes of vanadium, chromium, scandium, calcium, silver, copper, iron, nickel, and potassium, among others. The unique combination of the O.N.R. accelerator and the broad-range magnetic spectrograph makes possible high-resolution studies over a range of atomic numbers and of excitation energy hitherto unaccessible; and it has resulted in a considerable expansion, both qualitatively and quantitatively, of the knowledge of excited states of nuclei.

The nuclear instrumentation program supported by the Air Force Office of Scientific Research is coming to a highly satisfactory and successful conclusion. The multiple gap spectrograph being built under this program should be completed and put into use during the coming year. Designed especially for high-resolution, angular distribution nuclear spectroscopy studies, it will make possible many important experiments not feasible with present equipment. The second aspect of the program, of broad importance to the Laboratory as a whole, has been the establishment of the "Nuclear Data Center." Basically an experiment in the utilization of research equipment, the Center is cable-connected to several particle accelerator areas, among others. The endeavour has been to centralize those problems of data handling and recording common to many experiments, thereby making possible more elaborate facilities and more refined and satisfactory maintenance procedures. The Center has been used extensively and very successfully for experiments with the cyclotron, the Rockefeller generator, for radioactivity and radio-chemical experiments; and to some extent by the synchrotron and linear accelerator. There is every indication that

the same approach will be most fruitful also in connection with the Cambridge Electron Accelerator.

Research during the past year with the Rockefeller generator has consisted mainly of an investigation of the helicity of positrons from Al^{25}, carried out as part of a program to investigate the consequences of parity nonconservation in beta-decay. Work continues also toward the conversion of the generator into a pulsed machine, capable of delivering pulse beams of 2×10^{-9} sec. duration, for what is hoped to be a major investigation of the properties of short-lived nuclear states as well as the interaction of fast neutrons with nuclei.

The time-of-flight measurements of photoneutron spectra at the linear accelerator have proven to be of unusual interest. The data, which seem to be quantitatively reliable, are not in good agreement with the idea of compound nucleus decay, particularly at high neutron energies. An effort to increase the energy of the accelerator by incorporating commercially available high power ferrite isolators seems to have considerable promise of success. The energy of one section of the accelerator has been increased by approximately 25 per cent.

Applied radioactivity studies have continued on the long-term effects of internally deposited radioactive materials in human beings. An international file has been established of histories of all known individuals carrying body burdens of radioactivity. New instrumentation has been developed for extremely low-level detection.

Cyclotron research has been centered on problems of nuclear structure and of the mechanism of various types of nuclear reactions. A variety of alpha-particle-induced reactions have been studied, yielding among other things strong evidence for the fairly simple direct interaction mechanism and a measurement of some of the gross properties of the nucleus. Studies have been continued on the elastic scattering of protons, deuterons and alpha particles, with a view to better determination of the nuclear potential parameters.

The research of the theoretical group has, as usual, covered a wide variety of topics. Considerable progress has been made in the field of nuclear reactions and the optical model of the nucleus-nucleon scattering. Recently evaluated forces between nucleons have been employed to explain the scattering and absorption of neutrons and protons of high energy by nuclei. At lower energies,

a new unified formulation of the theory of these processes has been made. There has also been much interest in the properties of static nuclei. For the first time, the evaluation of the moment of inertia involved in the rotation of the nucleus has become possible. New light has been shed on the saturation problem. In the general area of field theory, a very important theorem has been developed which relates the low-energy component of the radiation spectrum and the scattering phase shifts.

PETER T. DEMOS

Spectroscopy Laboratory

During the year, seven members of the professorial staff and twenty postdoctoral fellows and predoctoral students participated in the research program of the Spectroscopy Laboratory. The published results of their work are listed near the end of this Report.

The controlled ruling engine of Professor George R. Harrison produced six 10-inch diffraction gratings of very high optical performance and many other gratings of fine quality. These gratings are superior in a number of ways to those previously ruled.

Lines of a number of elements have been examined to prepare for use of radioactive isotopes as light sources, to determine isotopic purity of spectral lamps, and to determine isotopic abundances in samples of geologic interest. In each case the echelle spectrograph developed in the Laboratory gave useful information about the relative intensities of the various spectral lines. The large Bitter electromagnet for Zeeman effect studies has been rebuilt and is now being used by Dr. Sumner P. Davis and his students.

In the field of hyperfine structure spectroscopy, the group headed by Professors Francis Bitter and Lee C. Bradley has been making notable progress in the study of stable and radioactive mercury, using both microwave and standard optical techniques. Of particular interest are the attempts to measure changes in nuclear charge distribution resulting from the excitation of a nucleon. This is a new approach to the study of nuclear structure which appears to be very promising. Preliminary results have been obtained for the ground and isomeric states of Hg^{197}, and work on xenon and indium isomers is underway. A considerable study of light sources for spectroscopic work is planned, particularly with a view to making lamps with very few radiating atoms. Facilities for handling and storing radioactive materials are nearing completion.

In the field of infrared spectroscopy, the recently constructed spectrometer for the far infrared region has been giving interesting results. The pure rotational spectra of ozone, nitrogen dioxide, and sulfur dioxide were studied for the first time in this region; and the effect of centrifugal distortion on the shape of the rotating molecules was evaluated. Other infrared studies under Professor Richard C. Lord included a measurement of frequencies of torsional oscillation in tetrafluoroethane and deuterated methylamine, as well as of the low-lying ring-distortion frequency in oxycyclobutane. A small grating spectrometer equipped with a refrigerated lead-sulfide detector has been used to study the emission spectrum of the hydrazine decomposition flame.

Other investigations in chemical spectroscopy were carried out under the direction of Professors George Scatchard (spectroscopic measurement of the vapor pressures of metals in alloys), Carl W. Garland (infrared spectra of absorbed substances), and F. Albert Cotton (vibrational spectra of inorganic compounds).

RICHARD C. LORD

Laboratory of Earth Sciences

Although hampered by space limitations, significant progress has been made in the development of an integrated effort in the earth sciences involving the Departments of Geology and Geophysics and of Meteorology and the Woods Hole Oceanographic Institution.

The earth science colloquium series was continued this year and provided a means for the stimulation of interest in a broad range of geophysical problems. The Laboratory of Earth Sciences has not been able as yet to provide physical facilities, but its mere existence has fostered a greater exchange of ideas between the research workers in the several earth science areas. An informal seminar on thermal convection has met every two weeks, alternating between Cambridge and Woods Hole. This has emphasized the many problems common to the oceans and the atmosphere and has promoted joint attacks on them.

HENRY G. HOUGHTON

Solar Energy Program

Although the solar energy research program sponsored by Dr. Godfrey L. Cabot is under the School of Science, its various activities are, in fact, in the Schools of Engineering, Science, and Architecture.

The solar-energy-heated house in Lexington, completed this year and opened briefly to the public, is being retained by the Institute for experimental study; the program is jointly directed by a committee from the Departments of Chemical, Civil, and Mechanical Engineering and the Department of Architecture. Research in the Chemistry Department continues on actinometry and on the photochemical production of hydrogen gas from water by light absorbed by ferrous and by ceric ions under Professor Lawrence J. Heidt; and on light-catalysed organic syntheses under Professor George H. Büchi. In the Department of Chemical Engineering, a study of selective black surfaces has yielded one of unusually high selectivity for solar energy and consequently quite promising as a surface for flat-plate collector design. Four fellowships — in chemistry, chemical engineering, and physics — are maintained by grants from the Cabot Solar Energy Fund.

HOYT C. HOTTEL

The Computation Center

The Computation Center has completed its first year of activity in its new location in the Karl Taylor Compton Laboratories and with its new I.B.M. 704 computer, donated and maintained by the International Business Machines Corporation. In all, some 400 different problems were solved on the machine, representing such diverse fields as economics, physics, psychology, and engineering, and carried out by graduate students and staff from M.I.T. and from the twenty-four cooperating universities in New England. Some of these problems broke new ground in the use of digital computers. For example, the machine was programmed to simulate the flow of automobile traffic in a vehicular tunnel and to simulate the flow of spare parts in a national system of warehouses and distribution points. The staff of the programming research group of

the Center has developed many procedures which simplify the use of the machine; has helped beginning users in many ways; and has actively cooperated with many groups using the machine — for example, with the group studying the machine translation problem. These activities and many others are described in the semi-annual reports of the Center.

The Center has been used as a laboratory in a number of the regular subjects taught at M.I.T. which relate to computer application. The machine has served in a like capacity for students of other universities in the vicinity. In addition, a special two-week course in coding is given each August for students and faculty desiring to use the machine the following academic year. Shorter coding courses are also given during the year, both at M.I.T. and at some of the selected cooperating universities.

PHILIP M. MORSE

Treasurer

The major trends and developments in Institute financial affairs for the fiscal year 1957–58 are summarized in the following exhibit.

	1957–58	*1956–57*	*Change*
Academic operations	$20,905,000	$19,489,000	+$1,416,000
Division of Sponsored Research	54,344,000	49,118,000	+ 5,226,000
Total funds	91,773,000	87,471,000	+ 4,302,000
Plant assets	43,251,000	41,309,000	+ 1,942,000
Gifts and grants	7,732,000	8,498,000	− 766,000
Investments — market value	132,150,000	128,086,000	+ 4,064,000
Investments — book value	89,267,000	85,314,000	+ 3,953,000

Operations

The operations of the Institute in 1957–58 are set out in the following exhibit.

Revenues and Funds

	1957–58	*1956–57*
Tuition and other income	$6,485,000	$6,458,000
Investment income	1,913,000	1,793,000
Gifts and other receipts	4,481,000	4,215,000
Contract allowances for indirect expenses	6,211,000	5,230,000
Auxiliary activities	1,815,000	1,793,000
Total	**$20,905,000**	**$19,489,000**

Expenses

Academic	$8,718,000	$8,116,000
General and administration	7,149,000	6,272,000
Plant operations	3,210,000	3,136,000
Auxiliary activities	1,828,000	1,965,000
Total	**$20,905,000**	**$19,489,000**

The increase in academic expenses during 1957–58 reflected primarily the further improvement of faculty salaries and increased compensation of the employees of the Institute. The growth in academic expenses was financed in part by a special distribution of investment income and a further increase in the use of gifts and other receipts for current purposes. Contract allowances for indirect expenses on sponsored research were higher in 1957–58, in keeping with the increase in general and administration expenses including salary and wage adjustments and employee benefits. In 1957–58 the volume of sponsored research was 12 per cent above the preceding year.

Gifts

The gifts for 1957–58 are compared to 1956–57 in this table.

	1957–58	*1956–57*
Gifts for endowment	$1,138,000	$2,381,000
Gifts for buildings	195,000	731,000
Gifts for current use — invested	1,987,000	1,330,000
Industrial Liaison support	1,188,000	1,293,000
Other funds for current use	3,224,000	2,763,000
Total gifts	**$7,732,000**	**$8,498,000**

Endowment gifts received in 1957–58 included $200,000 from the estates of Frank Hanchett and Hazel Hanchett Harvey for the Walter R. Hanchett Fund, $216,000 from the estate of F. Estelle Mosman, $178,000 from the estate of Philip A. Mosman '87, $145,000 for the Archer E. Wheeler Scholarship Fund, and $100,000 from the Donner Foundation as the first receipt for an endowed professorship. Gifts directly to the Alumni Fund of $436,590 are included in gifts for current use — invested, and made up a part of the total credited by the Alumni Fund Office. Contributions for the Faculty Salary Adjustment Fund of $1,256,000 were received during 1957–58 and served to increase the gifts for current use — invested over 1956–57. The list of gifts, grants, and bequests to the Institute for the year 1957–58 is in Section II of this report.

Funds

Endowment and other funds increased by $4,302,000 during 1957–58.

	1957–58	*1956–57*
Endowment for general purposes	$36,162,000	$34,902,000
Endowment for designated purposes	20,768,000	19,882,000
Total endowment funds	**$56,930,000**	**$54,784,000**
Other funds	34,843,000	32,687,000
Total funds	**$91,773,000**	**$87,471,000**

New endowment resources were added during the year for faculty salaries, for the academic departments, for undergraduate scholarships, and for plant operations. Increases were recorded in funds for the Faculty Salary Adjustment Fund, for new faculty appointments, and for the funding of faculty tenure salaries and related expenses now met with other resources. The reserve for the transfer of investment real estate to academic plant was augmented by drawing on unrestricted funds. Building funds decreased during the year as interim payments were made to contractors. A substantial proportion of the reserve of accumulated investment income was set aside for 1958–59 operations, and the balance in the reserve is included in unallocated investment income on June 30, 1958. With retirement funds included, the total book value of the funds on June 30, 1958, was $102,830,000.

Plant Facilities

The nuclear reactor was largely completed during the year, and construction progress at the David Flett du Pont Athletic Center brought the book value of the educational plant of the Institute to $43,251,000 on June 30, 1958, compared to $41,309,000 on June 30, 1957.

Investments

The investment position of the Institute on June 30, 1958, and June 30, 1957, is presented in the following table, which is exclusive of the investments of the M.I.T. Pension Association and the Supplementary Retirement Plan.

	June 30, 1958		*June 30, 1957*	
	Book Value	*Market Value*	*Book Value*	*Market Value*
General investments:				
Bonds	$43,759,000	$43,869,000	$42,550,000	$39,957,000
Stocks	24,054,000	63,754,000	22,122,000	64,049,000
Real estate	12,087,000	12,087,000	11,863,000	11,863,000
Commercial paper	2,471,000	2,471,000	2,208,000	2,208,000
Total	**$82,371,000**	**$122,181,000**	**$78,743,000**	**$118,077,000**
Special investments	4,766,000	7,839,000	4,791,000	8,229,000
Student notes receivable	2,130,000	2,130,000	1,780,000	1,780,000
Total	**$89,267,000**	**$132,150,000**	**$85,314,000**	**$128,086,000**

Funds sharing in the income from the general investments earned 6.2 per cent on the average book value compared to 6.14 per cent last year. This year 5 per cent plus a special distribution from accumulated investment income of ½ of 1 per cent was allocated to the funds. The total income on the general and special investments in 1957–58 was $4,548,000, compared to $4,263,000 in 1956–57. Of the total investment income of the year, $1,913,000 was used directly for current expenses, $900,000 was added to balances of expendable funds which in turn were used for current operating expenses to the extent of $938,000, and $531,000 was added to funds for scholarships, loans, and buildings. Investment income was also added to endowment principal and accumulated investment income, as in former years.

The proportion of the general investments in bonds at market value was 33.8 per cent on June 30, 1957, and 35.9 per cent on June 30, 1958. The proportion of investment income from bonds increased from 30.1 per cent to 33.9 per cent. At market values the

proportion of the general investments in common stocks decreased from 53.7 per cent on June 30, 1957, to 51.3 per cent on June 30, 1958. Investment income represented by common stock dividends declined from 57.0 per cent in 1956–57 to 54.2 per cent in 1957–58.

The investments of the M.I.T. Pension Association and the Supplementary Retirement Fund on June 30, 1958, and June 30, 1957, are presented in the following exhibit.

	June 30, 1958		*June 30, 1957*	
	Book Value	*Market Value*	*Book Value*	*Market Value*
Pension Association	$8,390,000	$11,250,000	$7,260,000	$9,800,000
Supplementary Retirement Fund	2,667,000	2,827,000	1,545,000	1,606,000
Total	**$11,057,000**	**$14,077,000**	**$8,805,000**	**$11,406,000**

General

The increase in the funds of the Institute of $4,302,000 in 1957–58 compares with $4,792,000 in 1956–57, when a substantial endowment gift was received. The increase in endowment was $2,146,000 in 1957–58 in contrast to $3,700,000 in 1956–57.

Student loans outstanding expanded further during the year to $2,130,000 on June 30, 1958, compared to $1,780,000 on June 30, 1957, and $787,000 five years ago. As tuition has increased, the loan funds of M.I.T. have become a more important source of financing for students at the Institute.

Marked growth continued in the staff retirement plan investments, to $11,057,000 at book value on June 30, 1958, compared to $8,805,000 on June 30, 1957, and $4,244,000 five years ago. The increase in these investments in part reflects the improved retirement program for the staff initiated in 1955.

JOSEPH J. SNYDER

BALANCE SHEET June 30, 1958

Schedule A

INVESTMENTS

General investments:			
U. S. Government bonds		$14,255,160	
Other bonds		29,503,719	
Preferred stocks		1,050,128	
Common stocks		23,003,866	
Real estate (including $5,665,680 devoted to Institute use) and mortgages		12,087,088	
Commercial paper		2,471,260	
	(A-1)		$ 82,371,221
Investments of funds separately invested	(A-2)		4,765,594
Students' notes receivable	(A-13)		2,129,889
Total investments			89,266,704
Less temporary investment of general-purpose cash			892,010
			$ 88,374,694

CURRENT AND DEFERRED ASSETS

Cash:			
General purposes		$ 4,824,962	
Restricted to certain research contracts		653,481	
Students' safe-keeping deposits		73,014	$ 5,551,457
Temporary investment of general-purpose cash			892,010
Accounts receivable:			
U. S. Government	(A-14)	$ 2,376,100	
Other	(A-14)	360,564	2,736,664
Contracts in progress, principally U. S. Government	(A-15)		8,351,355
Inventories, deferred charges, and other assets	(A-16)		1,537,864
			$ 19,069,350

EDUCATIONAL PLANT

Land, buildings, and equipment	(A-20)	$ 43,250,973
		$150,695,017

BALANCE SHEET June 30, 1958

Schedule A

INVESTED FUNDS

Endowment funds:			
Income for general purposes	(A-3)	$36,161,692	
Income for designated purposes	(A-4)	20,768,026	$ 56,929,718
Student loan funds	(A-5)		3,459,146
Building funds	(A-6)		608,200
Other expendable funds:			
General purposes	(A-7)	$ 172,923	
Designated purposes	(A-8)	14,332,336	14,505,259
Unexpended endowment income for designated purposes	(A-4)		1,261,531
Agency and annuity funds	(A-9 & A-10)		1,226,858
General investments — gain and loss account	(A-11)		6,288,876
Investment income authorized for distribution to funds in 1958-59	(A-12)		3,610,000
Unallocated investment income	(A-12)		485,106
			$ 88,374,694

CURRENT LIABILITIES AND FUNDS

Accounts payable and accrued wages		$ 2,854,490	
Students' advance fees and deposits	(A-17)	433,712	
Students' safe-keeping deposits		73,014	
Withholdings, deposits, and other credits	(A-18)	1,803,262	
Advances by the U. S. Government for certain research contracts		10,506,474	
Total current liabilities			$ 15,670,952
Gifts and other receipts for current expenses	(A-19)		3,398,398
			$ 19,069,350

EDUCATIONAL PLANT CAPITAL

Endowment for educational plant	(A-21)	$ 43,250,973
		$150,695,017

SOURCES OF REVENUES AND FUNDS USED TO MEET EXPENSES OF CURRENT OPERATION

for the year ended June 30, 1958

Schedule B

EDUCATIONAL AND GENERAL

Sources of revenues and funds used

Tuition and other income	(B-1)	$ 6,485,329
Investment income	(B-2)	1,913,101
Gifts and other receipts	(B-2)	4,480,543
Contract allowances for general and administration, and plant operation expenses (see below)	(B-3)	6,211,252
Dining and student housing	(B-7)	1,815,171
		$20,905,396

Expenses of current operation

Academic departments	(B-4)	$ 8,717,623
General and administration	(B-5)	7,149,325
Plant operation	(B-6)	3,209,859
Dining and student housing	(B-7)	1,828,589
		$20,905,396

RESEARCH CONTRACTS

Revenues

Government (except Lincoln Laboratory)		$26,255,833
Lincoln Laboratory		32,494,528
Industrial and other sponsors		3,098,428
	(B-3)	**$61,848,789**

Expenses

Direct costs and expenses	(B-3)	$54,343,713
Allowance for use of facilities and other reserves	(B-3)	1,293,824
Allowances for general and administration, and plant operation expenses	(B-3)	6,211,252
		$61,848,789

STATEMENT OF FUNDS for the year ended June 30, 1958

Schedule C

	Balance June 30, 1957	*Gifts and Other Receipts*	*Investment Income*	*Transfers In — (Out)*	*Expenses*	*Other Charges*	*Balance June 30, 1958*
Endowment funds:							
Income for general purposes (A-3)	$34,902,034	$ 660,898	$1,933,772	$ 25,752	$1,360,764	.....	$36,161,692
Income for designated purposes (A-4)	19,881,866	645,599	*	240,561	.....	.....	20,768,026
Student loan funds (A-5)	3,195,043	148,286	96,252	20,540	.....	$ 975	3,459,146
Building funds (A-6)	1,666,559	195,236	93,110	93,486	8	1,440,183	608,200
Other expendable funds:							
General purposes (A-7)	481,712	78,576	28,760	(333,334)	12,277	70,514	172,923
Designated purposes (A-8)	11,646,460	3,667,426	686,519	64,640	740,589	992,120	14,332,336
Unexpended endowment income for designated purposes (A-4)	1,239,886	2,350	1,177,056	(264,021)	552,116	341,624	1,261,531
Agency and annuity funds (A-9 & A-10)	1,195,388	125,242	65,782	(89,417)	220	69,917	1,226,858
General investments — gain and loss account (A-11)	6,323,823	(34,947)	.....	.....	.....	.....	6,288,876
Investment income authorized for distribution to funds in 1958–59	.....	.....	.....	3,610,000	.....	.....	3,610,000
Unallocated investment income (A-12)	3,628,360	.....	466,746	(3,610,000)	.....	.....	485,106
Total invested funds	**$84,161,131**	**$ 5,488,666**	**$4,547,997**	**$(241,793)**	**$2,665,974**	**$2,915,333**	**$88,374,694**
Gifts and other receipts for current expenses (A-19)	3,309,777	5,066,622	.....	241,793	3,727,670	1,492,124	3,398,398
	$87,470,908	**$10,555,288**	**$4,547,997**	**$.....**	**$6,393,644**	**$4,407,457**	**$91,773,092**

Gifts received during year	$ 7,732,039	
Appropriations from research contract allowances	1,296,584	
Net realized gain on investments	212,111	
Reserved from operating revenues of service activities	618,288	
Other	696,266	
Investment income used to meet expenses of current operation		$1,913,101
Gifts and other receipts used to meet expenses of current operation		4,480,543
Expenditures for buildings added to educational plant		$1,983,967
Scholarship and fellowship awards		943,682
Direct research costs charged against gifts designated therefor		311,282
Other charges to funds not representing operating expenses		1,168,526

* Investment income on endowment funds for designated purposes is included under the caption "Unexpended endowment income for designated purposes."

AUDITORS' CERTIFICATE

TO THE AUDITING COMMITTEE OF THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY:

We have examined the financial statements of Massachusetts Institute of Technology:

Schedule A — Balance Sheet as of June 30, 1958.

Schedule B — Sources of Revenues and Funds Used to Meet Expenses of Current Operation for the Year ended June 30, 1958.

Schedule C — Statement of Funds for the Year ended June 30, 1958.

Our examination was made in accordance with generally accepted auditing standards, and accordingly included such tests of the accounting records and such other auditing procedures as we considered necessary in the circumstances. It was not possible to confirm certain receivables from the United States Government, but we satisfied ourselves as to such receivables by means of other auditing procedures.

In our opinion, said statements present fairly the financial position of Massachusetts Institute of Technology at June 30, 1958, and the results of its operations for the year then ended on a basis consistent with that of the preceding year.

LYBRAND, ROSS BROS. & MONTGOMERY

Boston, Massachusetts, September 16, 1958

REPORT OF THE AUDITING COMMITTEE

TO THE CORPORATION OF THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY:

The Auditing Committee reports that Lybrand, Ross Bros. & Montgomery were employed to make an audit of the books and accounts of the Institute for the fiscal year ended June 30, 1958, and their certificate is submitted herewith.

Respectfully,

DWIGHT C. ARNOLD
RALPH LOWELL
HAROLD B. RICHMOND, *Chairman*

GIFTS, GRANTS, AND BEQUESTS

Received during the year ended June 30, 1958

Donors are listed alphabetically except in the cases of those who gave to such group efforts as the Alumni Fund, Class Funds, Parents' gifts, the Olive Barnard Fund, etc. Total gifts for these funds are shown at the end of the alphabetical list.

A schedule showing the amounts received by fund classifications compared with the ten previous years follows the list of gifts.

HAROLD ABBOTT AND ASSOCIATES, INC.	
General purposes	$ 1,000.00
J. ALLAN ABBOTT '23	
Faculty Salary Adjustment Fund	5,000.00
WILLIAM L. ABRAMOWITZ '35	
Allan Winter Rowe ('01) Memorial Fund	250.00
ALLEN ABRAMS '15	
Faculty Salary Adjustment Fund	50.00
ACADEMIC PRESS, INC.	
Academic Press Fund — Research Laboratory of Electronics	500.00
THE ACUSHNET FOUNDATION	
Faculty Salary Adjustment Fund	1,000.00
CHARLES E. ADAMS TRUST	
Frank W. and Carl S. Adams Memorial Fund	19,500.00
FRANK W. AND CARL S. ADAMS TRUST	
Frank W. and Carl S. Adams Memorial Fund	20,500.00
AEROJET-GENERAL CORPORATION	
Industrial Liaison Program	10,000.00
WILLIAM R. AHRENDT '41	
Faculty Salary Adjustment Fund	250.00
AIR FORCE AID SOCIETY	
Undergraduate scholarships	2,475.00
ALBERT AND GREENBAUM FOUNDATION	
Faculty Salary Adjustment Fund	500.00
PHILIP M. ALDEN '22	
Faculty Salary Adjustment Fund	50.00
BISSELL ALDERMAN '35	
Faculty Salary Adjustment Fund	500.00
ALLEGHENY LUDLUM STEEL CORPORATION	
Research in metallurgy	8,000.00
Matching gifts — Faculty Salary Adjustment Fund	1,000.00
Matching gifts — Alumni Fund	960.00

ALLIED CHEMICAL AND DYE CORPORATION	
Program for Senior Executives	$ 3,000.00
Research in chemistry	3,000.00
ALLIED RESEARCH ASSOCIATES	
Faculty Salary Adjustment Fund	250.00
ALLIS-CHALMERS FOUNDATION, INC.	
Grant to supplement tuition	500.00
ALFRED S. ALSCHULER, JR. '35	
M.I.T. Club of Chicago Scholarship Fund	25.00
ALUMINUM COMPANY OF AMERICA	
Industrial Liaison Program	25,000.00
ALUMINIUM LABORATORIES, LTD.	
Industrial Liaison Program	20,000.00
AMERICAN BRAKE SHOE COMPANY	
Operating fund	3,500.00
Undergraduate scholarships	2,200.00
AMERICAN CAN COMPANY	
General purposes	1,000.00
Industrial Liaison Program	15,000.00
Faculty Salary Adjustment Fund	1,200.00
AMERICAN CANCER SOCIETY, INC.	
Research in biology	500.00
AMERICAN CHICLE EDUCATIONAL TRUST	
Fellowship in food technology	2,600.00
Undergraduate scholarships	2,625.00
AMERICAN CYANAMID COMPANY	
Fellowship in chemistry	3,500.00
Soil Stabilization Laboratory	5,000.00
Research on thickening	4,000.00
AMERICAN IRON AND STEEL INSTITUTE	
Corrosion research in civil engineering	4,000.00
AMERICAN LITHIUM INSTITUTE, INC.	
Research in metallurgy	10,000.00
AMERICAN PETROLEUM INSTITUTE	
High voltage research in electrical engineering	27,500.00
AMERICAN RADIATOR AND STANDARD SANITARY CORPORATION	
General purposes	5,000.00
AMERICAN SMELTING AND REFINING COMPANY	
Program for Senior Executives	2,500.00
AMERICAN SOCIETY OF MECHANICAL ENGINEERS	
Steam research secretary	2,500.00
AMERICAN SOCIETY FOR METALS	
Fellowship in metallurgy	4,200.00
Undergraduate scholarships	300.00
AMERICAN SOCIETY FOR METALS FOUNDATION FOR EDUCATION AND RESEARCH	
Undergraduate scholarships	400.00
AMERICAN SOCIETY OF REFRIGERATING ENGINEERS	
Research in mechanical engineering	2,000.00

AMERICAN VISCOSE CORPORATION
Fellowship in the School of Chemical Engineering Practice ..... $ 1,400.00
Research in food technology 5,000.00

AMOCO FOUNDATION
Fellowship in the School of Chemical Engineering Practice 2,700.00

AMPERITE COMPANY, INC.
Faculty Salary Adjustment Fund 500.00

A. H. ANDERSON
Dean's Chapel Fund 250.00

ANDREW ANDERSON, JR. '27
Faculty Salary Adjustment Fund 200.00

HERBERT W. ANDERSON '15
Faculty Salary Adjustment Fund 335.00

RANDOLPH ANTONSEN '35
Faculty Salary Adjustment Fund 500.00

BENNETT ARCHAMBAULT '32
M.I.T. Club of Chicago Scholarship Fund 25.00
Faculty Salary Adjustment Fund 1,000.00

ARNOLD A. ARCHIBALD '28
Faculty Salary Adjustment Fund 400.00

WILLIAM C. ARKELL '10
Faculty Salary Adjustment Fund 5,000.00

ARMCO FOUNDATION
Undergraduate scholarships 2,300.00

ARMCO STEEL CORPORATION
Industrial Liaison Program 10,000.00

ARMOUR AND COMPANY
Soil Stabilization Laboratory 5,000.00

THE ARMOUR LABORATORIES
Research in biology — Waugh 2,000.00

ARTISAN METAL PRODUCTS, INC.
Allan Winter Rowe ('01) Memorial Fund 1,000.00

ASARCO FOUNDATION
Undergraduate scholarship 1,000.00
Geology Thesis Fund 1,000.00

ASSOCIATED FACTORY MUTUAL FIRE INSURANCE COMPANIES
Industrial Liaison Program 20,000.00

THE ATLANTIC REFINING COMPANY
Program for Senior Executives 5,500.00
Faculty Salary Adjustment Fund 2,000.00

SAMUEL S. AUCHINCLOSS '27
Faculty Salary Adjustment Fund 500.00

ESTATE OF E. C. AUSTIN
Undergraduate scholarship 100.00

AUTOMATIC ELECTRIC COMPANY
Program for Senior Executives 3,000.00

AVCO RESEARCH AND ADVANCED DEVELOPMENT DIVISION	
Industrial Liaison Program	$12,500.00
JULIAN M. AVERY ('18) FUND	
Julian M. Avery Fund	412.38
B-I-F INDUSTRIES, INC.	
Undergraduate scholarship	250.00
ELIZABETH K. BABB	
William Edgerton Music Fund	10.00
BABCOCK AND WILCOX COMPANY	
Research in mechanical engineering	15,000.00
Faculty Salary Adjustment Fund	2,700.00
ESTATE OF JASON S. BAILEY	
Jason S. Bailey Scholarship Fund	5,025.67
PHILIP C. BAKER '16	
Faculty Salary Adjustment Fund	100.00
BALLARD, BURGHER AND COMPANY	
Faculty Salary Adjustment Fund	200.00
JOHN B. BALLARD '35	
Faculty Salary Adjustment Fund	200.00
J. SELLERS BANCROFT '27	
Faculty Salary Adjustment Fund	487.50
OLIVER L. BARDES '21	
Development Fund	1,000.00
J. M. BARKER '07	
M.I.T. Club of Chicago Scholarship Fund	25.00
Faculty Salary Adjustment Fund	1,007.50
DANIEL P. BARNARD '21	
Faculty Salary Adjustment Fund	750.00
LOUIS BARNETT '09	
Faculty Salary Adjustment Fund	200.00
WARREN N. BARR, JR. '49	
M.I.T. Club of Chicago Scholarship Fund	25.00
WILLIAM J. BARRETT '16	
Faculty Salary Adjustment Fund	200.00
JOHN W. BARRIGER '21	
General purposes	250.00
HERMAN BARTHOLOMAY, JR. '41	
Faculty Salary Adjustment Fund	75.00
DAVID A. BARTLETT '39	
Faculty Salary Adjustment Fund	500.00
BATH IRON WORKS CORPORATION	
Undergraduate scholarships	1,500.00
ALEXANDER G. BATSNER '10	
Faculty Salary Adjustment Fund	200.00
BAUSCH AND LOMB OPTICAL COMPANY	
Spectroscopy Laboratory Fund	5,400.00
WALTER J. BEADLE '17	
Walter J. Beadle Fund	925.00
Faculty Salary Adjustment Fund	55,575.00
Class of 1917 Fund	930.70

BEAR CREEK MINING COMPANY	
Research in geology	$ 2,500.00
BEATRICE STEEL TANK COMPANY	
Undergraduate scholarship	200.00
BEAULIEU ELECTRICAL COMPANY	
Faculty Salary Adjustment Fund	100.00
BECHTEL CORPORATION	
Undergraduate scholarships	1,500.00
BECKETT PAPER COMPANY	
Faculty Salary Adjustment Fund	500.00
LEO M. BECKWITH '35	
M.I.T. Boston Stein Club — New England Scholarship Fund	100.00
OFFICE BELGE POUR L'ACCRIOSSEMENT DE LA PRODUCTIVITE BRUXELLES	
Program for Senior Executives	2,500.00
BELL AIRCRAFT CORPORATION	
Industrial Liaison Program	10,000.00
THE BELL FOUNDATION, INC.	
Undergraduate scholarships	4,800.00
GENERAL FRANK F. BELL '10	
Faculty Salary Adjustment Fund	100.00
BELL TELEPHONE COMPANY OF PENNSYLVANIA	
Program for Senior Executives	2,500.00
BELL TELEPHONE LABORATORIES	
Fellowship in electrical engineering	2,000.00
Industrial Liaison Program	30,000.00
BENDIX AVIATION CORPORATION	
Fellowship in electrical engineering	4,500.00
Undergraduate scholarships	1,100.00
LEAVITT N. BENT '06	
Faculty Salary Adjustment Fund	1,351.88
SAMUEL BERKE ('15) FUND	
Affiliates of the School of Industrial Management	5,000.00
DAVID W. ('31) AND IRENE BERNSTEIN	
M.I.T. Boston Stein Club — New England Scholarship Fund	500.00
Faculty Salary Adjustment Fund	250.00
BETHLEHEM STEEL COMPANY	
Faculty Salary Adjustment Fund	16,000.00
ERIC A. BIANCHI '29	
Faculty Salary Adjustment Fund	100.00
PEARL BIEMAN	
Undergraduate scholarships	500.00
GORDON Y. BILLARD '24	
Gordon Y. Billard Fund	1,560.00
BIRD ELECTRONIC CORPORATION	
Faculty Salary Adjustment Fund	2,000.00

THE BLACKALL FOUNDATION	
Faculty Salary Adjustment Fund	$ 500.00
BLUE SEAL EXTRACT COMPANY	
Faculty Salary Adjustment Fund	200.00
BOEING AIRPLANE COMPANY	
Fellowship in aeronautical engineering	2,500.00
Industrial Liaison Program	10,000.00
CECIL BOLING '32	
Faculty Salary Adjustment Fund	500.00
BORDEN FOOD PRODUCT COMPANY	
Research in food technology	2,500.00
BORG WARNER CORPORATION	
Industrial Liaison Program	10,000.00
GREATER BOSTON CHAMBER OF COMMERCE	
Industrial Relations Section	200.00
BOSTON INSULATED WIRE AND CABLE COMPANY	
General purposes in electrical engineering	500.00
BOSTON MANUFACTURERS MUTUAL INSURANCE COMPANY	
Industrial Relations Section	100.00
BOSTON WOVEN HOSE AND RUBBER COMPANY	
Industrial Relations Section	200.00
L. H. G. BOUSCAREN '04	
M.I.T. Club of Chicago Scholarship Fund	25.00
THE BOVAIRD SUPPLY COMPANY	
Faculty Salary Adjustment Fund	250.00
JAMES H. BOYD '26	
Faculty Salary Adjustment Fund	25.00
MARION W. BOYER '25	
Faculty Salary Adjustment Fund	700.00
THE BOYS CLUB OF NEW YORK, INC.	
Undergraduate scholarship	1,000.00
R. TULLY BRADFORD '45	
Faculty Salary Adjustment Fund	25.00
PROFESSOR CHARLES B. BREED '97	
Charles B. Breed Fund in civil engineering	100.00
ELLIS W. BREWSTER '13	
Faculty Salary Adjustment Fund	2,000.00
ERNEST R. BRIDGEWATER '18	
Faculty Salary Adjustment Fund	250.00
BRISTOL LABORATORIES, INC.	
Research in chemistry	10,650.00
CHARLES P. BRITTON '33	
Faculty Salary Adjustment Fund	25.00
THE BROKEN HILL PROPRIETARY CO., LTD.	
Program for Senior Executives	3,000.00
HENRY S. BROMLEY, JR.	
Faculty Salary Adjustment Fund	50.00
THOMAS D'A. BROPHY '16	
Faculty Salary Adjustment Fund	1,000.00

GORDON S. BROWN '31	
Electrical engineering commons room	$ 200.00
PHILIP S. BROWN '20	
Faculty Salary Adjustment Fund	100.00
BROWN AND SHARPE FOUNDATION	
Industrial Relations Section	250.00
THE BUDD COMPANY	
General purposes	1,925.00
BENJAMIN C. BUERK '30	
Faculty Salary Adjustment Fund	1,000.00
HAROLD BUGBEE '20	
Faculty Salary Adjustment Fund	200.00
THE BULLARD COMPANY CHARITY FUND, INC.	
Special purposes in metallurgy	1,260.00
DENISON K. BULLENS '09	
Denison K. Bullens Scholarship and Loan Fund	6,000.00
THE BULOVA WATCH COMPANY FOUNDATION, INC.	
General purposes	500.00
GORDON BUNSHAFT '33	
Faculty Salary Adjustment Fund	50.00
C. LALOR BURDICK '13	
Faculty Salary Adjustment Fund	499.42
CEDRIC BURGHER '13	
Faculty Salary Adjustment Fund	100.00
HOMER A. BURNELL '28	
M.I.T. Club of Chicago Scholarship Fund	50.00
Faculty Salary Adjustment Fund	1,000.00
GEORGE W. BURPEE '06	
Faculty Salary Adjustment Fund	500.00
GEORGE H. BURT '20	
M.I.T. Club of Chicago Scholarship Fund	25.00
VANNEVAR BUSH '16	
Chancellor's Fund	2,000.00
GODFREY L. CABOT '81	
Faculty Salary Adjustment Fund	4,675.00
CALIFORNIA COMPANY	
Program for Senior Executives	3,000.00
CAMBRIDGE ELECTRIC LIGHT COMPANY	
Faculty Salary Adjustment Fund	1,000.00
CALVIN A. CAMPBELL '25	
Faculty Salary Adjustment Fund	300.00
JOHN M. CAMPBELL '25	
Faculty Salary Adjustment Fund	1,000.00
CAMPBELL SOUP COMPANY	
Program for Senior Executives	5,500.00
Graduate fellowship in food technology	4,200.00
Faculty Salary Adjustment Fund	10,000.00
WALTER E. CAMPBELL '26	
Frances and William Emerson Fund	25.00

JOHN J. CAMPOBASSO '28	
Faculty Salary Adjustment Fund	$ 100.00
THE CARBORUNDUM COMPANY	
Research in mechanical engineering	12,400.00
Comminution research in metallurgy	2,500.00
CHARLES W. CARL, JR.	
General undergraduate school endowment	50.00
JOHN P. CARLISLE	
Mrs. William H. Carlisle, Sr., Memorial Fund	50.00
CARNATION COMPANY	
Research in food technology	5,000.00
CARNEGIE CORPORATION OF NEW YORK	
Center for International Studies	105,200.00
DONALD F. CARPENTER '22	
Choral Society European trip	100.00
WILLIAM K. CARPENTER	
R. R. M. Carpenter ('01) Fellowship in chemical engineering	2,500.00
RICHARD S. CARROLL '28	
Faculty Salary Adjustment Fund	100.00
CHARLES A. CARY '12	
Faculty Salary Adjustment Fund	1,000.00
CHARLES R. CARY '04	
Faculty Salary Adjustment Fund	200.00
LOUIS CATES '02	
Faculty Salary Adjustment Fund	17,682.50
CBS FOUNDATION, INC.	
Faculty Salary Adjustment Fund	2,000.00
CHARLES F. CELLARIUS '16	
Faculty Salary Adjustment Fund	25.00
CHAMPION PAPER FOUNDATION	
Undergraduate scholarships	975.00
CHANCE VOUGHT AIRCRAFT, INC.	
Undergraduate scholarships	3,250.00
Industrial Liaison Program	10,000.00
BERNARD L. CHAPIN '23	
Faculty Salary Adjustment Fund	50.00
THE CHASE MANHATTAN BANK	
Program for Senior Executives	2,500.00
CHARLES A. CHAYNE '19	
Faculty Salary Adjustment Fund	2,000.00
CHEMICAL CLUB OF NEW ENGLAND	
Undergraduate scholarships	300.00
CHEMSTRAND CORPORATION	
Undergraduate scholarships	1,000.00
Chemistry equipment	500.00
FRANCIS J. CHESTERMAN '05	
Faculty Salary Adjustment Fund	500.00

CHORAL SOCIETY	
Choral Society European trip	$ 2,000.00
GEORGE A. CHUTTER '21	
William H. Timbie Fund	100.00
CINCINNATI MILLING MACHINE COMPANY	
Cincinnati Milling Machine Scholarship	11,400.00
CITIES SERVICE RESEARCH AND DEVELOPMENT COMPANY	
Industrial Liaison Program	25,000.00
CIVIC FILMS, INC.	
Robert D. Kohn Fund	12,088.48
CIVIL AIR PATROL, INC.	
Undergraduate scholarships	2,200.00
CLARK FOUNDATION	
Undergraduate scholarships	7,100.00
GEORGE R. CLARK CHAPTER, INDIANA SOCIETY OF PROFESSIONAL ENGINEERS	
Undergraduate scholarship	50.00
W. VAN ALAN CLARK, JR. '42	
General purposes — School of Industrial Management	500.00
FRANKLIN G. CLEMENT '23	
Faculty Salary Adjustment Fund	50.00
WILLIAM F. CLEMENTS '21	
Faculty Salary Adjustment Fund	100.00
ARCHIE P. COCHRAN '20	
Faculty Salary Adjustment Fund	1,000.00
PHILIP L. COLEMAN '23	
General purposes	50.00
M.I.T. Club of Chicago Scholarship Fund	100.00
Faculty Salary Adjustment Fund	500.00
Philip L. Coleman Fund	10,000.00
STEWART P. COLEMAN '21	
Faculty Salary Adjustment Fund	2,725.94
EMILIO G. COLLADO '31	
Faculty Salary Adjustment Fund	198.74
COLLIER CARBON CHEMICAL CORPORATION	
Faculty Salary Adjustment Fund	1,000.00
COLONIAL STORES, INC.	
Program for Senior Executives	3,000.00
COLUMBIA GAS SYSTEM, INC.	
Program for Senior Executives	3,000.00
COLUMBIA SOUTHERN CHEMICAL CORPORATION	
Program for Senior Executives	3,000.00
Fellowship in chemical engineering	3,000.00
RANDOLPH P. COMPTON	
Choral Society European trip	500.00
W. Danforth Compton ('47) Memorial Fund	1,080.00
COMPTON TRUST	
W. Danforth Compton ('47) Memorial Fund	9,903.94

COMSTOCK AND WESTCOTT, INC.	
Faculty Salary Adjustment Fund	$ 75.00
ESTATE OF ARTHUR J. CONNER '88	
General purposes	6,711.31
CONSOLIDATED METAL PRODUCTS CORPORATION	
Research in metallurgy	1,000.00
CONTINENTAL CAN COMPANY, INC.	
Fellowship in metallurgy	6,000.00
Industrial Liaison Program	10,000.00
CONTINENTAL OIL COMPANY	
Industrial Liaison Program	25,000.00
CONVAIR DIVISION, GENERAL DYNAMICS CORPORATION	
General purposes	500.00
CARLE C. CONWAY ('53) SCHOLARSHIP FOUNDATION	
Undergraduate scholarships	1,300.00
W. W. COOK	
Undergraduate scholarships	100.00
BENJAMIN COOPER '23	
Undergraduate scholarships	1,000.00
LAMMOT DU PONT COPELAND	
Faculty Salary Adjustment Fund	1,655.03
CORNING GLASS WORKS	
Food technology expenses	248.07
Research in metallurgy — Grant	2,000.00
WILLIAM H. CORREALE '24	
Faculty Salary Adjustment Fund	100.00
JASPER E. CRANE '04	
Faculty Salary Adjustment Fund	1,000.00
THOMAS F. CREAMER '40	
Faculty Salary Adjustment Fund	1,203.12
THOMAS CREESE '56	
Choral Society European trip	31.00
CREOLE PETROLEUM CORPORATION	
Program for Senior Executives	3,000.00
General purposes	1,000.00
JAMES H. CRITCHETT '09	
Faculty Salary Adjustment Fund	4,080.00
LEONARD CRONKHITE '05	
Faculty Salary Adjustment Fund	112.45
R. E. CROSS '33	
Faculty Salary Adjustment Fund	1,000.00
CRUCIBLE STEEL COMPANY OF AMERICA	
Engineering Foundation research on thickening	2,500.00
ESTATE OF EUNICE MCLELLAN CRUFT	
Eunice M. Cruft Scholarship Endowment Fund	5,934.18
CHARLES E. CULPEPPER FOUNDATION	
Undergraduate scholarship	900.00
CURTIS UNIVERSAL JOINT COMPANY, INC.	
Ralph E. Curtis Scholarship Fund	2,000.00

MARSHALL B. DALTON '15	
Faculty Salary Adjustment Fund	$ 700.00
ESTATE OF GORHAM DANA '91	
Gorham Dana Fund	1,800.00
C. GEORGE DANDROW '22	
Faculty Salary Adjustment Fund	333.33
JOHN L. DANFORTH '40	
Faculty Salary Adjustment Fund	60.00
FRED H. DANIELS '11	
Faculty Salary Adjustment Fund	1,000.00
RICHARD T. DAVIDSON '28	
Faculty Salary Adjustment Fund	25.00
RALPH V. DAVIES '16	
Faculty Salary Adjustment Fund	200.00
DAVIS AND FURBER MACHINE COMPANY	
Research in mechanical engineering	1,500.00
RALPH H. DAVIS '31	
Faculty Salary Adjustment Fund	25.00
WALTON T. DAVIS '23	
Faculty Salary Adjustment Fund	250.00
DAVISON OIL COMPANY	
Undergraduate scholarship	100.00
LUIS DE FLOREZ '11	
Admiral Luis de Florez Awards	1,731.25
DELBAR PRODUCTS, INC.	
Faculty Salary Adjustment Fund	750.00
OSCAR A. DELIMA '19	
Faculty Salary Adjustment Fund	333.00
DELTA RADIO COMPANY	
Faculty Salary Adjustment Fund	100.00
DENNISON FOUNDATION, INC.	
Industrial Relations Section	250.00
THOMAS C. DESMOND '09	
Geology Faculty Fund	1,000.00
Thomas C. Desmond Scholarship	1,200.00
Faculty Salary Adjustment Fund	5,000.00
DEWEY AND ALMY CHEMICAL COMPANY	
Industrial Relations Section	250.00
Faculty Salary Adjustment Fund	250.00
BRADLEY DEWEY, SR. '09	
Faculty Salary Adjustment Fund	963.75
BRADLEY DEWEY, JR. '40	
Faculty Salary Adjustment Fund	1,162.50
DAVIS R. DEWEY '41	
Faculty Salary Adjustment Fund	1,056.25
RUSSELL DE YOUNG ('40) FOUNDATION	
Faculty Salary Adjustment Fund	1,000.00
DIAMOND CHAIN COMPANY, INC.	
Program for Senior Executives	3,000.00

CHARLES R. DIEBOLD	
Faculty Salary Adjustment Fund	$ 1,012.50
DIEHL MANUFACTURING COMPANY	
Program for Senior Executives	3,000.00
JOSEPH E. DIETZGEN '41	
M.I.T. Club of Chicago Scholarship Fund	25.00
PHILIP M. DINKINS '18	
Faculty Salary Adjustment Fund	200.00
RAY P. DINSMORE '14	
Faculty Salary Adjustment Fund	1,048.25
DOLE FLORAL COMPANY	
Undergraduate scholarships	100.00
DONNER FOUNDATION, INC.	
Donner Foundation Professorship	100,000.00
DORR-OLIVER, INC.	
Research in mechanical engineering	3,000.00
DOUGLAS AIRCRAFT COMPANY, INC.	
Fellowship in aeronautical engineering	2,750.00
Faculty Salary Adjustment Fund	5,000.00
DOW CHEMICAL COMPANY	
Fellowship in chemical engineering	5,000.00
Soil Stabilization Laboratory	7,000.00
DOW CORNING CORPORATION	
Undergraduate scholarships	1,100.00
PHILIP B. DOWNING TRUST	
Philip B. Downing Scholarship	485.00
DOW H. DRUKKER, JR. '25	
Faculty Salary Adjustment Fund	100.00
DRYSALTERS CLUB OF NEW ENGLAND	
Aeroelastic Laboratory Donations Fund	100.00
DONALD L. DUECKER '50	
Technology Loan Fund	24.20
CHARLES O. DUEVEL, JR. '24	
Faculty Salary Adjustment Fund	100.00
DORIS DUKE FOUNDATION	
Undergraduate scholarships	1,000.00
JAMES W. DUNHAM '26	
M.I.T. Club of Chicago Scholarship Fund	25.00
EDGAR P. DUNLAEVY '24	
Faculty Salary Adjustment Fund	250.00
CARL T. DUNN '15	
M.I.T. Club of Chicago Scholarship Fund	25.00
PARKER S. DUNN '31	
Faculty Salary Adjustment Fund	300.00
E. I. DU PONT DE NEMOURS & COMPANY	
Fundamental research in chemistry	15,000.00
Fellowship in mechanical engineering	3,500.00
Fellowship in physics	3,560.00
E. I. du Pont de Nemours, Inc., Teaching Fund	4,000.00

IRENEE DU PONT '97	
Faculty Salary Adjustment Fund	$209,687.50
JAMES Q. DU PONT '26	
Development Fund	80.00
MRS. LAMMOT DU PONT	
David F. du Pont Athletic Center	48,969.38
DWIGHT DUPLEX, INC.	
Faculty Salary Adjustment Fund	150.00
EARL H. EACKER '22	
Faculty Salary Adjustment Fund	713.88
ROLAND D. EARLE '28	
Development Fund	100.00
Faculty Salary Adjustment Fund	350.00
E ASTMAN KODAK COMPANY	
Fellowship in chemical engineering	4,500.00
Scholarship in the School of Chemical Engineering Practice	1,100.00
Fellowship in chemistry	3,900.00
Fellowship in physics	4,233.00
Industrial Liaison Program	20,000.00
Faculty Salary Adjustment Fund	3,500.00
Arthur D. Little Lectureship	800.00
MRS. GEORGE EATON	
Choral Society European trip	10.50
EATON MANUFACTURING COMPANY	
Program for Senior Executives	3,000.00
EDGERTON, GERMESHAUSEN, AND GRIER, INC.	
Edgerton stroboscopy research	600.00
Edgerton, Germeshausen, and Grier Research Fund	5,877.73
Edgerton film research	1,800.00
CHARLES EDISON '13	
Faculty Salary Adjustment Fund	990.00
MR. AND MRS. THEODORE M. EDISON '23	
Faculty Salary Adjustment Fund	1,000.00
GEORGE P. EDMONDS '26	
Faculty Salary Adjustment Fund	1,668.00
NATALIE DU PONT EDMONDS	
Faculty Salary Adjustment Fund	5,557.50
EDUCATIONAL TELEVISION AND RADIO CENTER	
Research in industrial management	1,300.00
EUGENE R. EISENBERG '43	
M.I.T. Boston Stein Club — New England Scholarship Fund	100.00
SAMUEL S. EISENBERG '15	
Karl T. Compton Prize Fund	180.00
MARTIN H. EISENHART '07	
Faculty Salary Adjustment Fund	200.00
ELECTRIC REGULATOR CORPORATION	
Electric Regulator Corporation Scholarship Fund	1,000.00

ELECTRO METALLURGICAL COMPANY	
Comminution research	$ 4,200.00
Union Carbide Fellowship in metallurgy	4,200.00
ELECTROLUX CORPORATION	
Industrial Liaison Program	10,000.00
BRADFORD M. ENDICOTT '49	
General purposes	10,912.50
WILLIAM ENGS '27	
Faculty Salary Adjustment Fund	25.00
ROBERT C. ERB '17	
Faculty Salary Adjustment Fund	2,900.62
Class of 1917 Fund	233.88
ESSICK FOUNDATION, INC.	
Faculty Salary Adjustment Fund	500.00
ESSO EDUCATION FOUNDATION	
Research in mathematics	5,000.00
Esso Education Foundation Fund	25,000.00
Industrial Relations Section	1,500.00
Faculty Salary Adjustment Fund	5,000.00
ESSO RESEARCH AND ENGINEERING COMPANY	
Enjay Laboratories Research Fund	10,000.00
Program for Senior Executives	3,000.00
ESSO STANDARD OIL COMPANY	
Program for Senior Executives	5,500.00
ETHICON, INC.	
Research in biology	5,000.00
ETHYL CORPORATION	
Fellowship in chemistry	3,100.00
Research in mechanical engineering	5,421.45
CARLETON J. EVERETT '26	
Faculty Salary Adjustment Fund	75.00
JAMES M. EWELL '37	
Faculty Salary Adjustment Fund	100.00
MAURICE AND LAURA FALK FOUNDATION	
Research in social sciences	16,000.00
ROBERT S. FAUROT '44	
M.I.T. Club of Chicago Scholarship Fund	25.00
Faculty Salary Adjustment Fund	500.00
FAY, SPOFFORD, AND THORNDIKE	
Faculty Salary Adjustment Fund	2,500.00
FEDERAL TELECOMMUNICATION LABORATORIES, INC.	
Industrial Liaison Program	10,000.00
HUGH S. FERGUSON '23	
Faculty Salary Adjustment Fund	421.88
JAMES P. FERRALL '17	
Faculty Salary Adjustment Fund	400.00
JAMES H. FERRY, JR. '39	
Faculty Salary Adjustment Fund	4,037.50

FIRMENICH, INC.	
Research in chemistry	$ 18,000.00
Firmenich, Inc., Fund	5,000.00
Spectrometer equipment	10,000.00
FIRST NATIONAL BANK OF BOSTON	
Industrial Relations Section	1,000.00
FIRST NATIONAL CITY BANK OF NEW YORK	
General purposes	1,650.00
FIRST NATIONAL STORES, INC.	
Food research	2,500.00
Industrial Relations Section	500.00
D. K. ESTE FISHER, JR. '16	
Faculty Salary Adjustment Fund	25.00
FISHER FOUNDATION	
Research in mechanical engineering	1,000.00
FISHER GOVERNOR COMPANY	
Industrial Liaison Program	10,000.00
JOSEPH FISHMAN '34	
M.I.T. Boston Stein Club — New England Scholarship Fund	250.00
MAX C. FLEISCHMANN FOUNDATION OF NEVADA	
Research in food technology	50,000.00
RALPH A. FLETCHER '16	
Faculty Salary Adjustment Fund	1,000.00
FLUOR FOUNDATION	
Fluor Foundation Fellowship	3,000.00
FOOD MACHINERY AND CHEMICAL CORPORATION, BECCO CHEMICAL DIVISION	
Soil Stabilization Laboratory	3,000.00
FORD FOUNDATION	
Faculty research grant in industrial management	20,000.00
General purposes — School of Industrial Management	800.00
General purposes — Center for International Studies	75,000.00
Research grant in economics — Brown	4,250.00
Research grant in economics — Nelson	3,680.00
Research grant in economics — Willis	2,720.00
Research grant in economics — Beausoleil	4,100.00
Research grant in economics — Pfister	5,400.00
Research grant in economics — Samuelson	18,500.00
Research grant in economics — Crispo	4,400.00
Faculty research in economics	15,000.00
India Study — Center for International Studies	212,500.00
HORACE S. FORD	
Karl T. Compton Laboratories	1,250.00
FORD MOTOR COMPANY	
General purposes	3,000.00
Industrial Liaison Program	20,000.00
FORTE-FAIRBAIRN, INC.	
Faculty Salary Adjustment Fund	250.00

FOUNDATION FOR INSTRUMENTATION EDUCATION AND RESEARCH, INC.	
Fier Fellowship	$ 2,000.00
FOUNDRY EDUCATIONAL FOUNDATION	
Scholarship in metallurgy	4,500.00
Taylor Research Fund	500.00
THE FOXBORO COMPANY	
Industrial Liaison Program	10,000.00
JOHN M. FRANK '07	
M.I.T. Club of Chicago Scholarship Fund	25.00
Faculty Salary Adjustment Fund	1,000.00
LOUIS FRANK '34	
Karl T. Compton Laboratories	100.00
MRS. ELEANOR FRASHER	
Undergraduate scholarships	1,100.00
J. EARL FRAZIER '24	
Faculty Salary Adjustment Fund	375.00
ESTATE OF EVERT W. FREEMAN '20	
Evert W. Freeman Scholarship Endowment	11,043.58
FRENCH GOVERNMENT	
Modern Language Fund	300.00
MRS. KATHRYN CARLTON FRENCH	
John R. Loofbourow Memorial Fund	1.00
FRIEDLANDER AND GOLDEN, INC.	
Faculty Salary Adjustment Fund	166.66
J. FRUCHTBAUM	
Nuclear reactor	500.00
GEORGE A. FULLER COMPANY	
Faculty Salary Adjustment Fund	500.00
FUNDACION CREOLE	
Soil Stabilization Laboratory	30,000.00
DONALD R. FUNK '29	
Faculty Salary Adjustment Fund	333.00
FARLEY GANNETT '02	
Faculty Salary Adjustment Fund	500.00
GARDNER FOUNDATION	
Undergraduate scholarship	500.00
L. ROBERT GARDNER '45	
Frances and William Emerson Fund	1,200.00
ESTATE OF LESTER D. GARDNER '98	
Lester D. Gardner Lectureship Fund	10,000.00
RAYMOND C. GARDNER '50	
Technology Loan Fund	22.56
THE GARRETT CORPORATION	
Industrial Liaison Program	10,000.00
WILLIAM W. GARTH, JR. '36	
Faculty Salary Adjustment Fund	100.00

GENERAL DYNAMICS CORPORATION	
Fellowship in chemical engineering	$ 4,400.00
Fellowship in electrical engineering	4,000.00
Industrial Liaison Program	20,000.00
GENERAL ELECTRIC COMPANY	
Turbo machine research	10,000.00
Program for Senior Executives	3,000.00
Heat Measurement Laboratory	2,532.00
GENERAL ELECTRIC EDUCATIONAL AND CHARITABLE FOUNDATION	
Fellowship in industrial management	1,100.00
Fellowship in chemical engineering	1,650.00
Fellowship in chemistry	3,200.00
Fellowship in economics	1,100.00
Fellowship in electrical engineering	1,100.00
Fellowship in mechanical engineering	1,100.00
Fellowship in metallurgy	3,600.00
Fellowship in physics	4,300.00
General purposes	9,000.00
GENERAL FOODS FUND, INC.	
Fellowship in food technology	1,000.00
GENERAL MOTORS CORPORATION	
Research in metallurgy	1,500.00
Fellowship in mechanical engineering	6,200.00
Undergraduate scholarships	46,850.00
Industrial Liaison Program	100,000.00
Industrial Relations Section	1,000.00
General purposes	28,800.00
A-C SPARK PLUG DIVISION	
Fellowship in aeronautical engineering	4,200.00
ALLISON DIVISION	
Turbo machine research	20,000.00
ELECTRO-MOTIVE DIVISION	
Program for Senior Executives	3,000.00
GERBER PRODUCTS COMPANY	
Fellowship in food technology	2,500.00
ESTATE OF ALBERT CHAMPION GILBERT '05	
General purposes	97.08
THE GILLETTE COMPANY	
Industrial Liaison Program	20,000.00
MRS. HENRY GINSBURG	
M.I.T. Boston Stein Club — New England Scholarship Fund	25.00
GIVAUDAN CORPORATION	
Research in chemistry	623.70
GLEASON WORKS FOUNDATION, INC.	
Undergraduate scholarships	5,000.00
LEONARD H. GOODHUE, JR. '30	
Faculty Salary Adjustment Fund	50.00
CHARLES H. GOODMAN '54	
Faculty Salary Adjustment Fund	100.00

GOODYEAR FOUNDATION, INC.	
Fellowship in aeronautical engineering	$ 6,500.00
Undergraduate scholarships	1,500.00
JOHN F. GORDON	
Faculty Salary Adjustment Fund	100.00
MORRIS J. ('22) AND ANNA GORDON	
M.I.T. Boston Stein Club — New England Scholarship Fund	250.00
SAMUEL F. GORDON '23	
Faculty Salary Adjustment Fund	50.00
ALLEN A. GOULD '10	
Faculty Salary Adjustment Fund	150.00
FELIX AND CECILE GOULED FOUNDATION	
Undergraduate scholarships	1,250.00
RALPH F. GOW '25	
Faculty Salary Adjustment Fund	200.00
W. R. GRACE COMPANY, POLYMER CHEMICALS DIVISION	
Research in chemical engineering	4,750.00
GRADUATE STUDENT STAFF IN ELECTRICAL ENGINEERING	
Electrical engineering commons room	200.00
DAVID GRAHAM '29	
M.I.T. Club of Chicago Scholarship Fund	25.00
DAVID GRAHAM ('29) FOUNDATION	
Faculty Salary Adjustment Fund	500.00
MRS. CARL W. GRAM	
Class of 1909 Memorial Scholarship Fund	2,098.12
GRAMERCY GUILD GROUP, INC.	
General purposes	50.00
ELISHA GRAY, II '28	
M.I.T. Club of Chicago Scholarship Fund	50.00
GRAY FOUNDATION, INC.	
Faculty Salary Adjustment Fund	1,000.00
GREAT ATLANTIC AND PACIFIC TEA COMPANY	
Industrial Relations Section	500.00
GREEN FOUNDATION	
Faculty Salary Adjustment Fund	3,000.00
GREEN GIANT COMPANY	
Campbell Special Fund in Food Technology	1,000.00
MALCOLM GREEN '50	
M.I.T. Boston Stein Club — New England Scholarship Fund	15.00
CRAWFORD H. GREENEWALT '22	
Faculty Salary Adjustment Fund	15,000.00
EARLE A. GRISWOLD '23	
Faculty Salary Adjustment Fund	1,368.75
GROISSER AND SHLAGER IRON WORKS	
M.I.T. Boston Stein Club — New England Scholarship Fund	1,000.00
Faculty Salary Adjustment Fund	1,000.00

GROVE LABORATORIES, INC.	
Faculty Salary Adjustment Fund	$ 100.00
GRUMMAN AIRCRAFT ENGINEERING CORPORATION	
General purposes	7,000.00
Faculty Salary Adjustment Fund	2,500.00
HERBERT AND ERNST GRUNFELD TRUST	
Special equipment	250.00
ERNEST A. GRUNSFELD '18	
Grunsfeld European Fellowship	1,750.00
B. SUMNER GRUZEN '26	
M.I.T. Boston Stein Club — National Scholarship Fund	200.00
RONALD O. GUBELMAN '22	
Faculty Salary Adjustment Fund	100.00
THOMAS E. GUERIN '28	
Faculty Salary Adjustment Fund	50.00
CARL T. GUETHING '16	
Faculty Salary Adjustment Fund	100.00
PROFESSOR ERNST '24 AND MRS. GUILLEMIN	
William Edgerton Music Fund	10.00
GULF RESEARCH AND DEVELOPMENT COMPANY	
Industrial Liaison Program	20,223.00
Fellowship in geology	3,800.00
ROBERT C. GUNNESS '34	
General purposes	175.00
M.I.T. Club of Chicago Scholarship Fund	25.00
Faculty Salary Adjustment Fund	333.33
HUMPHREY M. HALEY '04	
Undergraduate scholarships	20,000.00
BRYANT HALIDAY	
Choral Society European trip	100.00
PROFESSOR MORRIS HALLE	
R. L. E. Speech Communication Conference	919.83
ROBERT L. HALLOCK '22	
Faculty Salary Adjustment Fund	25.00
HAM FOUNDATION, INC.	
Faculty Salary Adjustment Fund	1,000.00
G. WARREN HAMBLET, JR. '26	
Allan Winter Rowe ('01) Memorial	500.00
WALTER J. HAMBURGER '21	
Faculty Salary Adjustment Fund	100.00
ESTATE OF FRANK HANCHETT	
Walter R. Hanchett Fund	100,000.00
HANCOCK MANUFACTURING COMPANY	
Faculty Salary Adjustment Fund	1,000.00
ROBERT HANCOCK '27	
Faculty Salary Adjustment Fund	1,500.00
HANDY AND HARMAN	
Faculty Salary Adjustment Fund	500.00

EDWARD J. HANLEY '24	
General purposes	$ 400.00
Faculty Salary Adjustment Fund	500.00
V. N. HANSFORD '37	
General purposes	6.00
HUGO H. HANSON '12	
Faculty Salary Adjustment Fund	100.00
CYRUS S. HAPGOOD '33	
Faculty Salary Adjustment Fund	250.00
HARBISON-WALKER REFRACTORIES COMPANY	
Taylor Research Fund	1,000.00
FORREST G. HARMON '23	
Faculty Salary Adjustment Fund	100.00
JOSEPH HARRINGTON, JR. '30	
Faculty Salary Adjustment Fund	100.00
WILLIS F. HARRINGTON '05	
Faculty Salary Adjustment Fund	17,637.50
DOROTHY V. HARRIS	
General Undergraduate Scholarship Endowment	5.00
WALLACE K. HARRISON ARCHITECTURAL FOUNDATION, INC.	
Research fund	750.00
HART PRODUCTS CORPORATION	
Faculty Salary Adjustment Fund	1,000.00
THE HARTFORD INVESTMENT COMPANY	
Faculty Salary Adjustment Fund	300.00
ESTATE OF HAZEL HANCHETT HARVEY	
Walter R. Hanchett Fund	100,000.00
JOEL D. HARVEY '22	
Faculty Salary Adjustment Fund	500.00
MRS. HARRY L. HAVENS	
Class of 1909 Memorial Scholarship Fund	10.00
RAYMOND B. HAYNES '13	
Faculty Salary Adjustment Fund	300.00
CRAIG HAZELET '18	
Faculty Salary Adjustment Fund	350.00
EDWARD J. HEALY '23	
Faculty Salary Adjustment Fund	100.00
HENRY R. HEDGE '96	
Faculty Salary Adjustment Fund	250.00
HENDERSON FOUNDATION	
Faculty Salary Adjustment Fund	666.67
DOROTHY AND JOHN HENNESSY ('24) FOUNDATION	
Faculty Salary Adjustment Fund	1,000.00
WILLIAM T. HENRY ('70) TRUST	
General purposes	33,800.00
HERCULES POWDER COMPANY	
Industrial Liaison Program	15,000.00
M. S. HERELOVE	
Undergraduate scholarship	100.00

ROBERT L. HERSHEY '23	
Faculty Salary Adjustment Fund	$ 1,200.00
HEVI-DUTY ELECTRIC COMPANY FOUNDATION, INC.	
Faculty Salary Adjustment Fund	1,000.00
EDWIN W. HIAM '48	
Faculty Salary Adjustment Fund	2,553.75
LAURENCE C. HICKS '31	
Faculty Salary Adjustment Fund	516.56
HIGH VOLTAGE ENGINEERING CORPORATION	
High voltage research	15,000.00
COURTLAND C. C. HILL '40	
Dean Fuller Memorial Fund	15.00
FRANCES G. HILL	
Bancroft Hill Scholarship	10,000.00
LUCIUS T. HILL '17	
Faculty Salary Adjustment Fund	100.00
ERNEST C. HINCK, JR. '27	
Faculty Salary Adjustment Fund	500.00
BARRETT G. HINDES '22	
Faculty Salary Adjustment Fund	1,800.25
HUDSON '24 AND MRS. HOAGLAND	
Faculty Salary Adjustment Fund	500.00
HAROLD R. HOBKIRK '40	
Faculty Salary Adjustment Fund	200.00
ERIC F. HODGINS '22	
Faculty Salary Adjustment Fund	250.00
HOFFMANN LAROCHE, INC.	
Roche Anniversary Foundation Fund	7,000.00
CHARLES B. HOLLAND ('37) TRUST	
Charles B. Holland Fund	815.88
HOLMES AND NARVER, INC.	
Faculty Salary Adjustment Fund	3,000.00
PHILETUS H. HOLT, II '30	
Faculty Salary Adjustment Fund	250.00
H. P. HOOD AND SONS	
Campbell Research Fund in Food Technology	2,000.00
Industrial Relations Section	100.00
THE HOPEDALE FOUNDATION	
Special equipment	1,666.68
Faculty Salary Adjustment Fund	1,000.00
OSCAR H. HOROVITZ '22	
Faculty Salary Adjustment Fund	500.00
Oscar Horovitz Fund	200.00
THEODORE V. HOUSER	
Faculty Salary Adjustment Fund	250.00
ALAN F. HOWARD '18	
Faculty Salary Adjustment Fund	333.33
PAUL H. HOWARD '18	
Faculty Salary Adjustment Fund	200.00

MARY HOWE	
Choral Society European trip	$ 100.00
HOMER V. HOWES '20	
Faculty Salary Adjustment Fund	1,500.00
HUGHES AIRCRAFT COMPANY	
Industrial Liaison Program	20,000.00
HUMBLE OIL AND REFINING COMPANY	
Program for Senior Executives	3,000.00
Fellowship in chemical engineering	3,100.00
STANLEY M. HUMPHREY '28	
M.I.T. Club of Chicago Scholarship Fund	25.00
SAMUEL P. HUNT ('95) FOUNDATION	
Undergraduate scholarship	500.00
MRS. C. G. HURLIMANN	
Undergraduate scholarships	8,370.00
GODFREY M. HYAMS TRUST	
Hyams Radiation Research Fund	16,000.00
MRS. DORA D. IDE	
William H. Donner Prize Scholarship	13,200.00
H. O. C. INGRAHAM '06	
Faculty Salary Adjustment Fund	50.00
INLAND STEEL — RYERSON FOUNDATION, INC.	
Undergraduate scholarships	5,000.00
INTERNATIONAL BUSINESS MACHINES CORPORATION	
Computation Center Building Fund	47,935.70
Industrial Liaison Program	25,000.00
Industrial Relations Section	1,000.00
Program for Senior Executives	5,500.00
Fellowship in electrical engineering	3,600.00
Fellowship in physics	2,600.00
Computation Center — operators for participating colleges	12,215.59
Computation Center — operators for M.I.T.	8,288.80
Computation Center — operators for New England colleges	3,656.17
Computation Center — research associates and assistants	29,960.00
Computation Center — management and machine maintenance	40,764.33
Undergraduate scholarships	5,600.00
INTERNATIONAL NICKEL COMPANY, INC.	
Fellowship in metallurgy	8,470.30
Undergraduate scholarships	3,201.80
Industrial Liaison Program	10,000.00
General purposes	1,000.00
I. T. E. FOUNDATION	
Faculty Salary Adjustment Fund	2,500.00
DUGALD C. JACKSON, JR. '21	
Dugald C. Jackson Professorship	80.00
WILLIAM R. AND LUCILLA S. JACKSON ('30) CHARITABLE TRUST	
Faculty Salary Adjustment Fund	150.00

JAKOBSON SHIPYARD, INC.	
Undergraduate scholarships	$ 1,000.00
JOHN V. JANES '23	
Faculty Salary Adjustment Fund	50.00
MELVIN R. JENNEY '21	
Faculty Salary Adjustment Fund	1,000.00
JOHN HANCOCK MUTUAL LIFE INSURANCE COMPANY	
Program for Senior Executives	6,000.00
Industrial Liaison Program	40,000.00
JOHNS-MANVILLE SALES CORPORATION	
General purposes	1,000.00
THE JOHNSON FOUNDATION	
General purposes	500.00
STEPHEN R. JOHNSON	
Undergraduate scholarship	200.00
HENRY D. JOHNSTON '27	
Faculty Salary Adjustment Fund	25.00
HENRY W. JONES '26	
Faculty Salary Adjustment Fund	807.50
JONES AND LAUGHLIN STEEL CORPORATION	
Metallurgy equipment	2,500.00
Undergraduate scholarships	3,625.00
JOYCE COMPANY	
Faculty Salary Adjustment Fund	500.00
KAHN PAPER COMPANY	
Faculty Salary Adjustment Fund	300.00
KAISER ALUMINUM AND CHEMICAL CORPORATION	
General purposes	2,000.00
HARRY KALKER '23	
Faculty Salary Adjustment Fund	1,487.50
RICHARD A. KANE '55	
Undergraduate scholarships	1,084.50
PAUL C. KANGIESER	
Faculty Salary Adjustment Fund	5.00
SYDNEY B. KAROFSKY '37	
M.I.T. Boston Stein Club — New England Scholarship Fund	100.00
MITCHELL B. KAUFMAN CHARITABLE FUND	
Faculty Salary Adjustment Fund	1,000.00
HENRY C. KAWECHI '34	
Faculty Salary Adjustment Fund	5,050.00
SIDNEY L. KAYE '30	
M.I.T. Boston Stein Club — Chapel Fund	155.00
M.I.T. Boston Stein Club — New England Scholarship Fund	40.00
CHARLES W. KELLOGG '02	
Faculty Salary Adjustment Fund	1,875.00
M. W. KELLOGG COMPANY	
Research in mechanical engineering	2,400.00

I. AUSTIN KELLY, III '26	
Faculty Salary Adjustment Fund	$ 1,000.00
THE KENDALL COMPANY	
Industrial Relations Section	500.00
KENNECOTT COPPER CORPORATION	
Fellowship in metallurgy	4,000.00
Undergraduate scholarships	2,000.00
HERBERT W. KENWAY '05	
Faculty Salary Adjustment Fund	100.00
KENWOOD OIL COMPANY	
Faculty Salary Adjustment Fund	500.00
DR. F. G. KEYES	
Special expenses in chemistry	129.87
KIDDER PEABODY COMPANY	
Randolph P. Compton Scholarship Fund	5,400.00
KIMBERLEY-CLARK FOUNDATION, INC.	
Fellowship in chemical engineering	6,000.00
CHARLES A. ('96) AND MARJORIE KING	
Research in biology	12,500.00
ROBERT J. KING '03	
Karl T. Compton Laboratories	1,000.00
KINSMAN TRANSIT COMPANY	
Faculty Salary Adjustment Fund	500.00
AUGUSTUS B. KINZEL '21	
Faculty Salary Adjustment Fund	500.00
WILLIAM J. KIRK '28	
Mrs. William Carlisle, Sr., Memorial Fund	50.00
HALL KIRKHAM '23	
Faculty Salary Adjustment Fund	50.00
JOHN R. KIRKPATRICK '48	
Faculty Salary Adjustment Fund	100.00
W. W. KIRKPATRICK, JR.	
Undergraduate scholarships	100.00
BENGT R. F. KJELLGREN '24	
Faculty Salary Adjustment Fund	161.87
MORRIS H. KLEGERMAN '28	
Faculty Salary Adjustment Fund	1,000.00
GEORGE O. KNAPP ('37) FUND	
Knapp Memorial Scholarship	1,500.00
FRED C. KOCH ('22) FOUNDATION	
Faculty Salary Adjustment Fund	5,000.00
HAROLD E. KOCH '22	
Faculty Salary Adjustment Fund	350.00
AUGUST KOCHS	
Faculty Salary Adjustment Fund	14,531.25
H. W. KOCHS '24	
M.I.T. Club of Chicago	25.00
CARL J. KOHLER '28	
Faculty Salary Adjustment Fund	1,000.00

MAVIS H. KOHLER	
General Undergraduate Scholarship Endowment.	$ 16.00
F. J. KOLB, JR. '38	
General purposes	6.00
KOPPERS COMPANY, INC.	
Industrial Liaison Program	10,000.00
AUSTIN V. KUHNS '17	
Faculty Salary Adjustment Fund	400.00
KULJIAN CORPORATION	
Undergraduate scholarships	1,000.00
FRANCIS M. KURTZ '22	
Faculty Salary Adjustment Fund	500.00
MR. AND MRS. ROGER M. KYES	
Faculty Salary Adjustment Fund	1,000.00
LEON W. LA BOMBARD '41	
Faculty Salary Adjustment Fund	50.00
PHILIP DE G. LA BOMBARDE '47	
Faculty Salary Adjustment Fund	50.00
ROBERT LACY '98	
Faculty Salary Adjustment Fund	25.00
LAHEY FOUNDATION	
Research in electrical engineering	7,500.00
ROBERT E. LAMB, INC.	
General Undergraduate Scholarship Endowment.	200.00
BARRON P. LAMBERT '26	
Faculty Salary Adjustment Fund	1,500.00
F. LANDON CARTAGE COMPANY	
Faculty Salary Adjustment Fund	100.00
LAPOINTE MACHINE TOOL COMPANY	
Scanlon Memorial Fund	5,000.00
Industrial Relations Section	500.00
ALLEN LATHAM, JR. '30	
Faculty Salary Adjustment Fund	2,500.00
PIERRE F. LAVEDAN '20	
M.I.T. Club of Chicago Scholarship Fund	25.00
Faculty Salary Adjustment Fund	500.00
ROBERT H. LEACH '00	
Faculty Salary Adjustment Fund	1,359.37
LEE CRANE SERVICE, INC.	
Faculty Salary Adjustment Fund	150.00
LENNOX INDUSTRIES	
Program for Senior Executives	3,000.00
NORMAN B. ('38) AND ROBERT H. ('36) LEVENTHAL	
M.I.T. Boston Stein Club — New England Scholarship Fund	500.00
MAC ('25) AND ANNE LEVINE FUND	
M.I.T. Boston Stein Club —New England Scholarship Fund	200.00

EDWARD C. LEVY FOUNDATION	
General Undergraduate Scholarship Endowment.	$ 1,100.00
LIBERTY MUTUAL INSURANCE COMPANY	
Industrial Liaison Program	10,000.00
ELI LILLY AND COMPANY	
Research in chemistry	2,000.00
LILLY VARNISH COMPANY	
Faculty Salary Adjustment Fund	333.33
OTTO G. LINDBERG	
Gustaf Robert Lindberg Endowed Scholarship Fund	40,000.00
LINDE COMPANY DIVISION OF UNION CARBIDE CORPORATION	
Fellowship in chemistry	4,400.00
PAUL W. LITCHFIELD '96	
Litchfield Scholarship Fund	15,925.00
Faculty Salary Adjustment Fund	1,000.00
ARTHUR D. LITTLE, INC.	
Expansion engine research	3,750.00
Industrial Liaison Program	10,000.00
WALTER E. LOBO '26	
Faculty Salary Adjustment Fund	25.00
LOCKHEED AIRCRAFT CORPORATION	
Faculty Salary Adjustment Fund	1,500.00
LOCKHEED LEADERSHIP FUND	
Lockheed Leadership Fellowship	2,500.00
Undergraduate scholarships	12,600.00
LEO LOEB '08	
Faculty Salary Adjustment Fund	500.00
WESLEY H. LOOMIS, III '35	
Faculty Salary Adjustment Fund	500.00
KENNETH S. LORD '26	
Faculty Salary Adjustment Fund	50.00
LORD MANUFACTURING COMPANY	
Research in civil engineering	13,200.00
LUDLOW MANUFACTURING AND SALES COMPANY	
Industrial Relations Section	200.00
JAMES A. LYLES '27	
Faculty Salary Adjustment Fund	634.68
CLYDE MAC CORNACK '03	
Faculty Salary Adjustment Fund	1,000.00
FRED F. MAC KENTEPE '14	
M.I.T. Club of Chicago Scholarship Fund	50.00
Faculty Salary Adjustment Fund	500.00
MAGNUS PRODUCTS CORPORATION	
Faculty Salary Adjustment Fund	750.00
CHARLES T. MAIN, INC.	
Charles T. and Charles R. Main Memorial Fund	1,000.00
H. N. MALLON	
Faculty Salary Adjustment Fund	50.00

T. A. MANGELSDORF '26	
Faculty Salary Adjustment Fund	$ 500.00
HAROLD C. MANSON '10	
Faculty Salary Adjustment Fund	50.00
MANUFACTURING CHEMISTS ASSOCIATION, INC.	
Research in building construction — civil engineering	25,000.00
RICHARD J. ('32) AND DIANA L. MARCUS	
M.I.T. Boston Stein Club — National Scholarship Fund	1,250.00
LEROY F. MAREK, SR. '30	
Faculty Salary Adjustment Fund	500.00
ROBERT L. MARION	
Undergraduate scholarship	50.00
GEORGE J. MARITZ '48	
William Emerson Fund	150.00
MARKET FORGE COMPANY	
Industrial Relations Section	500.00
Faculty Salary Adjustment Fund	250.00
BERNARD M. MARKSTEIN, JR. '32	
Faculty Salary Adjustment Fund	30.00
ADELAIDE H. MARQUAND	
M.I.T. Choral Society European trip	493.59
LOU AND GENE MARRON FOUNDATION	
Research in biology	1,000.00
HAROLD F. MARSHALL '19	
Faculty Salary Adjustment Fund	50.00
ESTATE OF ALICE G. MARTIN	
Augustus B. Martin, Jr., Fund	75.00
THE MARTIN COMPANY	
Industrial Liaison Program	20,000.00
MARTIN COMPANY FOUNDATION	
Undergraduate scholarships	7,000.00
DOLPHE MARTIN '12	
Development Fund	10.00
THOMAS J. MARTIN '45	
General Undergraduate Scholarship Endowment	25.00
RICHARD D. MASON '31	
Faculty Salary Adjustment Fund	50.00
COMMONWEALTH OF MASSACHUSETTS	
Joint Highway Research Project in civil engineering	30,000.00
MASSACHUSETTS EYE AND EAR INFIRMARY	
Research in the Research Laboratory of Electronics	24,058.17
MASSACHUSETTS GENERAL HOSPITAL	
Research in biology	300.00
MASSACHUSETTS HEART ASSOCIATION	
Research in biology	1,150.00

M.I.T. CLUB OF SOUTHERN CALIFORNIA	
Undergraduate scholarships	$ 1,000.00
M.I.T. COMMITTEE FOR HUNGARIAN RELIEF	
Hungarian Relief Scholarship Fund	745.48
MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY	
New England Colleges Fund	131.61
ERLING S. MATHIESEN '29	
Faculty Salary Adjustment Fund	100.00
OSCAR MAYER COMPANY	
Research in food technology	10,000.00
MAYMAR CORPORATION	
Samuel Marx Architecture Fund	1,000.00
Frances and William Emerson Fund	1,000.00
Faculty Salary Adjustment Fund	1,000.00
SAMUEL K. MC CAULEY '41	
Faculty Salary Adjustment Fund	100.00
CHARLES R. MC COY '32	
Faculty Salary Adjustment Fund	1,000.00
HAROLD MC CRENSKY '38	
M.I.T. Boston Stein Club — New England Scholarship Fund	100.00
WARREN MC CULLOCH	
R. L. E. Neurophysiological Fund	200.00
MC CUNE FOUNDATION	
Undergraduate scholarship	500.00
MC DONNELL AIRCRAFT CORPORATION	
Industrial Liaison Program	10,000.00
J. FRANKLIN MC ELWAIN '97	
Industrial Relations Section	100.00
OWEN J. MC GARRAHAN COMPANY	
M.I.T. Boston Stein Club — New England Scholarship Fund	1,000.00
Faculty Salary Adjustment Fund	1,000.00
JAMES MC GOWAN, JR. '08	
Faculty Salary Adjustment Fund	10,993.12
MC GRAW-HILL PUBLISHING COMPANY	
Aviation Week Fellowship	2,700.00
EDWARD H. MC LAUGHLIN '18	
Faculty Salary Adjustment Fund	250.00
ELIZABETH MC NEAR	
General Undergraduate Scholarship Endowment	1,000.00
EDWARD MC SWEENEY '23	
General purposes — School of Industrial Management	100.00
ROBERT J. MEIER '41	
Faculty Salary Adjustment Fund	500.00
WILLIAM J. MEINEL	
Faculty Salary Adjustment Fund	250.00

JAMES C. MELVIN TRUST	
James C. Melvin Scholarship Fund	$ 19,800.00
HERBERT MENDELSON '16	
Faculty Salary Adjustment Fund	200.00
MERCK, SHARPE AND DOHME, INC.	
Research in chemistry	4,800.00
MERRILL FOUNDATION FOR ADVANCEMENT OF FINANCIAL KNOWLEDGE, INC.	
Research in economics	2,000.00
MERRILL LYNCH, PIERCE, FENNER AND SMITH	
Industrial Liaison Program	10,000.00
Undergraduate scholarship	200.00
Faculty Salary Adjustment Fund	2,500.00
DUNCAN MERRIWETHER	
Faculty Salary Adjustment Fund	25.00
GEORGE E. MERRYWEATHER '34	
Class of 1934 Compton Scholarship Fund	450.00
Faculty Salary Adjustment Fund	500.00
FRANCIS A. MESKER '27	
Faculty Salary Adjustment Fund	1,000.00
ESTATE OF ALICE METCALF	
Leonard Metcalf ('92) Memorial Fund	4,042.85
METCO FOUNDATION, INC.	
Faculty Salary Adjustment Fund	500.00
F. RICHARD MEYER, III '42	
M.I.T. Club of Chicago Scholarship Fund	25.00
Faculty Salary Adjustment Fund	100.00
PROFESSOR NICHOLAS A. MILAS	
Research in chemistry	22,441.00
MAXWELL D. V. MILLARD '33	
Faculty Salary Adjustment Fund	1,172.50
DAVID R. MILLER '48	
Development Fund	15.00
PAUL L. MILLER '24	
Faculty Salary Adjustment Fund	50.00
FRANK R. MILLIKEN '34	
Faculty Salary Adjustment Fund	250.00
MINE SAFETY APPLIANCES COMPANY	
Industrial Liaison Program	10,000.00
REGINALD B. MINER '24	
Faculty Salary Adjustment Fund	100.00
MINNEAPOLIS-HONEYWELL REGULATOR COMPANY	
Fellowship in electrical engineering	3,900.00
Industrial Liaison Program	20,000.00
MINTON FUND	
Faculty Salary Adjustment Fund	1,500.00
MOBIL OVERSEAS OIL COMPANY, INC.	
Program for Senior Executives	3,000.00

MONSANTO CHEMICAL COMPANY	
Plastics in Housing Design	$12,000.00
Fellowship in chemistry	3,850.00
ESTATE OF C. LILLIAN MOORE	
John A. Grimmons ('21) Fund	6,155.00
LEWIS MOORE '33	
Faculty Salary Adjustment Fund	350.00
PHILIP W. MOORE '01	
Faculty Salary Adjustment Fund	4,918.75
ROBERT L. MOORE '21	
Faculty Salary Adjustment Fund	666.67
MYLES MORGAN '23	
Faculty Salary Adjustment Fund	1,000.00
MORGAN WORCESTER, INC.	
Faculty Salary Adjustment Fund	2,500.00
MARION MORTON	
Undergraduate scholarship	50.00
WILLIAM F. MORTON '25	
Faculty Salary Adjustment Fund	500.00
FREDERICK T. MOSES '07	
Faculty Salary Adjustment Fund	1,731.25
ESTATE OF F. ESTELLE MOSMAN	
F. Estelle Mosman General Endowment Fund	215,843.75
ESTATE OF PHILIP A. MOSMAN '87	
Philip A. Mosman General Endowment Fund	177,759.81
MOTOROLA, INC.	
Industrial Liaison Program	10,000.00
C. S. MOTT FOUNDATION	
Faculty Salary Adjustment Fund	10,000.00
CARL M. MUELLER '41	
Faculty Salary Adjustment Fund	50.00
MRS. EMIL E. MUESER '16	
Undergraduate scholarship	550.00
WILLIAM H. MUESER '22	
Faculty Salary Adjustment Fund	500.00
WALTER F. MUNFORD '23	
Faculty Salary Adjustment Fund	400.00
JOHN J. MURPHY '23	
Faculty Salary Adjustment Fund	945.00
MUSCULAR DYSTROPHY ASSOCIATION OF AMERICA, INC.	
Research grant in biology	8,567.50
CHARLES R. MYERS, II '23	
Faculty Salary Adjustment Fund	50.00
NATIONAL ASSOCIATION OF ENGINE AND BOAT MANUFACTURERS, INC.	
Undergraduate scholarships	1,500.00
NATIONAL ASSOCIATION OF MUSIC MERCHANTS, INC.	
Special research	20,000.00

NATIONAL ASSOCIATION OF SECONDARY SCHOOL PRINCIPALS SCHOLARSHIP FUND	
Undergraduate scholarship	$ 700.00
NATIONAL BROADCASTING COMPANY	
Program for Senior Executives	3,000.00
NATIONAL CASH REGISTER COMPANY	
Industrial Liaison Program	10,000.00
NATIONAL DISTILLERS AND CHEMICAL CORPORATION	
Industrial Liaison Program	10,000.00
NATIONAL GEOGRAPHIC SOCIETY	
Edgerton film research	9,300.00
NATIONAL INSTITUTES OF HEALTH	
Research grant in biology — Glimcher	500.00
Research grant in biology — Coelho	500.00
Research grant in biology — Robinson	500.00
Research grant in biology — Schurin	500.00
Research grant in biology — Koerner	500.00
Research grant in chemistry	500.00
Special studies	100,000.00
Research grant in medicine	8,000.00
NATIONAL LEAD FOUNDATION, INC.	
Undergraduate scholarships	1,500.00
NATIONAL MERIT SCHOLARSHIP CORPORATION	
National Merit Scholarships	125,500.00
NATIONAL MULTIPLE SCLEROSIS SOCIETY	
Research in biology	6,850.00
NATIONAL RESEARCH CORPORATION	
Industrial Liaison Program	10,000.00
NATIONAL SCIENCE FOUNDATION	
Special expenses in biology	500.00
NATIONAL SHAWMUT BANK OF BOSTON	
Industrial Relations Section	500.00
NEAL BEAR CORPORATION	
General Undergraduate Scholarship Endowment	15.00
GEORGE ('24) AND BETTY NEITLICH	
M.I.T. Boston Stein Club — New England Scholarship Fund	100.00
ARTHUR T. NELSON '02	
Faculty Salary Adjustment Fund	100.00
THE NESTLÉ COMPANY, INC.	
Research in food technology	10,000.00
NEW JERSEY ZINC COMPANY	
Program for Senior Executives	3,000.00
NEW YORK STATE ELKS ASSOCIATION	
Undergraduate scholarship	500.00
NEWCOM, LIMITED	
Newcom Scholarship in geology	750.00
Geology Thesis Fund	750.00
JOHN R. NEWELL '34	
Faculty Salary Adjustment Fund	5,300.00

E. MORTIMER NEWLIN TRUST	
E. Mortimer Newlin Fund	$ 1,616.60
ARTHUR A. NICHOLS '28	
Faculty Salary Adjustment Fund	20.00
J. C. NICHOLS FOUNDATION	
Center for Urban and Regional Studies	2,400.00
JOHN L. ('19) AND MARGARET N. NIEGEL FOUNDATION	
Faculty Salary Adjustment Fund	900.00
JOHN P. NISSEN, JR. '23	
Faculty Salary Adjustment Fund	200.00
NORTH AMERICAN AVIATION, INC.	
Industrial Liaison Program	10,000.00
NORTHERN TRUST COMPANY	
Undergraduate scholarships	1,900.00
NORTON COMPANY	
Comminution research	2,000.00
NUTRITION FOUNDATION, INC.	
Karl T. Compton Fellowship in Nutrition	10,200.00
DANIEL J. O'CONNELL '29	
Faculty Salary Adjustment Fund	300.00
THOMAS O'CONNOR ('19) AND COMPANY, INC.	
Faculty Salary Adjustment Fund	2,000.00
OLIN MATHIESON CHEMICAL COMPANY	
Undergraduate scholarships	1,500.00
ORINOCO MINING COMPANY	
Program for Senior Executives	3,000.00
ORTHOPEDIC RESEARCH AND EDUCATION FOUNDATION	
Research in biology	3,680.00
EDWARD ORTON, JR., CERAMIC FOUNDATION	
Edward Orton, Jr., Ceramic Fund in physics	2,100.00
JOHN B. OSBORN '29	
Faculty Salary Adjustment Fund	200.00
HAROLD S. OSBORNE '08	
Harold S. Osborne Fund	10,702.38
PAUL B. OWEN '14	
Development Fund	40.00
OWENS-CORNING FIBERGLAS CORPORATION	
Research in building construction — civil engineering	19,462.14
Industrial Liaison Program	10,000.00
HOWARD W. PAGE '27	
Faculty Salary Adjustment Fund	3,213.75
RICHARD N. PALMER ('28) TRUST	
Richard N. Palmer Fund	497.28
PARKE DAVIS COMPANY	
New England Colleges Fund	283.62
EMERSON K. PATTEN '25	
Faculty Salary Adjustment Fund	25.00

ROBERT D. PATTERSON '20	
Faculty Salary Adjustment Fund	$ 100.00
ARTHUR F. PEASLEE '14	
Faculty Salary Adjustment Fund	1,500.00
KARL E. '04 AND DORIS M. PEILER	
Faculty Salary Adjustment Fund	200.00
PERKINS-GOODWIN COMPANY	
General purposes in industrial management	100.00
PETROLEUM HEAT AND POWER COMPANY	
Faculty Salary Adjustment Fund	250.00
CHARLES PFIZER COMPANY, INC.	
Research grant in chemistry	5,000.00
PHILCO CORPORATION	
Industrial Liaison Program	10,000.00
JOHN B. PIERCE ('48) FOUNDATION	
Corrosion Research Council	4,800.00
MARVIN PIERCE '18	
Faculty Salary Adjustment Fund	150.00
PITNEY-BOWES, INC.	
Undergraduate scholarships	2,000.00
Faculty Salary Adjustment Fund	500.00
PITTSBURGH PLATE GLASS COMPANY	
Operations research in physics	9,000.00
Industrial Liaison Program	50,000.00
ANDREW POGGENPOHL	
General Undergraduate Scholarship Endowment	10.00
RABBI HERMAN POLLACK	
M.I.T. Boston Stein Club — Chapel Fund	20.00
HAROLD W. POPE '39	
Faculty Salary Adjustment Fund	100.00
ESTATE OF MATTHEW POROSKY '08	
Faculty Salary Adjustment Fund	500.00
RENE POUCHAIN '17	
Faculty Salary Adjustment Fund	50.00
LEWIS J. POWERS '23	
Faculty Salary Adjustment Fund	400.00
JOHN LEE PRATT	
Faculty Salary Adjustment Fund	10,000.00
PRATT AND WHITNEY COMPANY, INC.	
Research in mechanical engineering	12,000.00
General purposes	3,000.00
GWILYM A. PRICE	
Faculty Salary Adjustment Fund	500.00
PRINCETON UNIVERSITY	
Research in utilization of human resources	7,515.83
PROCTER AND GAMBLE COMPANY	
Fellowship in chemical engineering	4,800.00
Fellowship in chemistry	4,600.00
Fatty acid research in food technology	7,000.00
Undergraduate scholarships	11,100.00
Faculty Salary Adjustment Fund	20,000.00

CHARLES D. PROCTOR '17	
Faculty Salary Adjustment Fund	$ 500.00
STANLEY M. PROCTOR ('43) COMPANY	
General purposes in industrial management	50.00
PUGET SOUND FOUNDATION	
H. W. McCurdy ('22) Scholarship	1,300.00
GEORGE M. PULLMAN EDUCATIONAL FOUNDATION	
Undergraduate scholarships	900.00
PYROTEX COMPANY, INC.	
Faculty Salary Adjustment Fund	100.00
SIDNEY H. RABINOWITZ FAMILY FOUNDATION	
Campbell Fund in food technology	1,000.00
RADIO CORPORATION OF AMERICA	
Program for Senior Executives	2,500.00
General purposes	300.00
Industrial Liaison Program	20,000.00
ALBERT S. RAIRDEN '22	
Faculty Salary Adjustment Fund	25.00
RAMO-WOOLDRIDGE CORPORATION	
Fellowship in electrical engineering	4,500.00
Fellowship in mathematics	4,300.00
Industrial Liaison Program	10,000.00
CAROLINE J. RAMSAY	
Faculty Salary Adjustment Fund	35,562.50
ESTATE OF GEORGE H. RAND	
George H. Rand Scholarship Fund	20,000.00
WILLIAM M. RAND	
Faculty Salary Adjustment Fund	100.00
RAYONIER FOUNDATION	
Undergraduate scholarship	1,000.00
RAYTHEON MANUFACTURING COMPANY	
General purposes	3,014.00
Industrial Liaison Program	10,000.00
READERS' DIGEST	
Karl T. Compton Laboratories	100.00
REED AND BARTON FOUNDATION, INC.	
Industrial Relations Section	250.00
MARY C. RENTSCHLER	
Faculty Salary Adjustment Fund	100.00
REPUBLIC AVIATION CORPORATION	
Industrial Liaison Program	10,000.00
REPUBLIC STEEL CORPORATION	
Program for Senior Executives	5,500.00
RESEARCH CORPORATION	
Vitamins A and D research — Milas	10,100.00
Research grant in chemistry — Green	4,900.00
Research grant in chemistry — Cotton	7,040.00
GEORGE RHODES '05	
Faculty Salary Adjustment Fund	1,491.56

FRANK A. ROBBINS, JR. '02	
Faculty Salary Adjustment Fund	$ 200.00
JOSEPH K. ROBERTS '28	
M.I.T. Club of Chicago Scholarship Fund	25.00
SUMMERFIELD G. ROBERTS	
Faculty Salary Adjustment Fund	100.00
ROCHESTER SAVINGS BANK	
Undergraduate scholarship	1,100.00
ROCKEFELLER FOUNDATION	
Research in city planning	9,000.00
Research grant in economics	5,500.00
Center for International Studies	83,136.00
Research in nuclear engineering	17,000.00
Computation Center research	26,760.00
Reactor Building Fund	125,000.00
ROHM AND HAAS COMPANY	
Research in chemistry	3,000.00
MAURICE H. ROLE '19	
M.I.T. Boston Stein Club — New England Scholarship Fund	50.00
WILLIAM ROSENWALD '24	
Faculty Salary Adjustment Fund	200.00
JOHN O. ROSS	
Faculty Salary Adjustment Fund	500.00
ROTH LABORATORY FOR PHYSICAL RESEARCH	
Faculty Salary Adjustment Fund	400.00
JANE E. ROW '02	
Faculty Salary Adjustment Fund	2,000.00
FRED M. ROWELL '21	
Faculty Salary Adjustment Fund	100.00
GEORGE L. ROY '17	
Faculty Salary Adjustment Fund	100.00
ROYAL BOND, INC.	
Faculty Salary Adjustment Fund	1,000.00
ARTHUR C. RUGE '33	
Faculty Salary Adjustment Fund	500.00
DAMON RUNYON MEMORIAL FUND FOR CANCER RESEARCH, INC.	
Research in biochemistry	8,000.00
High voltage research	20,000.00
LAURENCE P. RUSSE '41	
Faculty Salary Adjustment Fund	5.00
ARTHUR G. RUSSELL '32	
Faculty Salary Adjustment Fund	100.00
THOMAS F. RUSSELL '27	
Faculty Salary Adjustment Fund	500.00
ST. ANTHONY EDUCATIONAL FOUNDATION, INC.	
Undergraduate scholarship	100.00
HOWARD J. SAMUELS '41	
Faculty Salary Adjustment Fund	250.00

SANBORN COMPANY	
Faculty Salary Adjustment Fund	$ 1,000.00
JOSEPH SANDERS '31	
Class of 1931 Compton Scholarship Fund	503.75
Class of 1934 Compton Scholarship Fund	503.75
RICHARDS SANDERS '34	
Class of 1934 Compton Scholarship Fund	281.37
WILLIAM H. SANDLAS '17	
Faculty Salary Adjustment Fund	150.00
PAUL E. SANDORFF '39	
Aeroelastic Laboratory Donations Fund	140.00
HERMAN SCHAEVITZ '38	
Faculty Salary Adjustment Fund	500.00
OLIVER H. SCHARNBERG '32	
Faculty Salary Adjustment Fund	50.00
ARTHUR H. SCHEIN '52	
M.I.T. Boston Stein Club — New England Scholarship Fund	10.00
WILLIAM H. SCHIELD, JR. '46	
Faculty Salary Adjustment Fund	100.00
SCHLUMBERGER FOUNDATION	
Fellowship in electrical engineering	3,000.00
SCHLUMBERGER WELL SURVEYING CORPORATION	
Industrial Liaison Program	10,000.00
RICHARD E. SCHMIDT '87	
M.I.T. Club of Chicago Scholarship Fund	25.00
FRANZ J. SCHNEIDER, JR. '09	
Faculty Salary Adjustment Fund	100.00
GEORGE SCHNITZLER, '21	
M.I.T. Boston Stein Club — New England Scholarship Fund	10.00
NATHAN SCHOOLER '24	
Faculty Salary Adjustment Fund	500.00
SCIENTIFIC DESIGN COMPANY, INC.	
Fellowship in chemical engineering	4,075.00
SEARS, ROEBUCK AND COMPANY	
Program for Senior Executives	5,500.00
City Planning and Urban Renewal Fellowship	4,000.00
Industrial Liaison Program	10,000.00
SEARS, ROEBUCK FOUNDATION	
Undergraduate scholarship	250.00
LOUIS G. SEATON	
Faculty Salary Adjustment Fund	100.00
SAMUEL M. SEEGAL '22	
Faculty Salary Adjustment Fund	300.00
S. J. SEIDENSTICKER	
Class of 1898 Fund	100.00
EDGAR F. SEIFERT '19	
M.I.T. Club of Chicago Scholarship Fund	25.00

E. G. SENTER, JR. '17	
Faculty Salary Adjustment Fund	$ 100.00
SERENDIB FOUNDATION	
Faculty Salary Adjustment Fund	5,000.00
WILLIAM C. SESSIONS '26	
Faculty Salary Adjustment Fund	139.75
MORRIS F. SHAFFER '30	
M.I.T. Boston Stein Club — National Scholarship	5.00
DUNBAR L. SHANKLIN '23	
Faculty Salary Adjustment Fund	50.00
SHELL COMPANIES FOUNDATION, INC.	
Research in chemical engineering	7,500.00
Fellowship in mechanical engineering	3,600.00
Research in mechanical engineering	7,500.00
Research in metallurgy	7,500.00
Fellowship in physics	3,600.00
SHELL CHEMICAL CORPORATION	
Research in building construction — civil engineering	5,000.00
DAVID A. SHEPPARD '26	
Faculty Salary Adjustment Fund	562.38
SHERATON FOUNDATIONS, INC.	
Faculty Salary Adjustment Fund	200.00
WILLIAM J. SHERRY '21	
Karl T. Compton Laboratories	1,000.00
R. T. SHONE	
Charles B. Breed ('97) Fund	300.00
WICKLIFFE SHREVE	
Undergraduate scholarships	1,000.00
LAURANCE D. SIBLEY '33	
Faculty Salary Adjustment Fund	25.00
DANIEL SILVERMAN '29	
Faculty Salary Adjustment Fund	75.00
SAUL M. ('21) AND RIGI SILVERSTEIN	
M.I.T. Boston Stein Club — New England Scholarship Fund	100.00
SIMPLEX WIRE AND CABLE COMPANY	
Industrial Relations Section	350.00
EDWARD ('11) AND SADIE L. SISSON	
M.I.T. Boston Stein Club — New England Scholarship Fund	250.00
SKF INDUSTRIES, INC.	
Faculty Salary Adjustment Fund	1,000.00
SKIDMORE, OWINGS AND MERRILL	
Undergraduate scholarships	1,200.00
H. NELSON SLATER, JR. '50	
Jerome C. Hunsaker Professorship	50.00
NELSON SLATER '15	
Jerome C. Hunsaker Professorship	4,721.50

ALFRED P. SLOAN ('95) FOUNDATION, INC.	
Industrial management convocation	$ 7,111.20
General purposes in industrial management	275,000.00
Executive Development Program	170,000.00
Executive Development Program — Contingency Fund	7,500.00
Research grant in chemistry — Garland	6,250.00
Research grant in chemistry — House	9,592.00
Research grant in chemistry — Greene	8,750.00
Research grant in chemistry — Waugh	8,450.00
Research grant in mathematics — Nash	2,472.00
Research grant in mathematics — Ray	4,437.00
Research grant in physics — Cochran	6,250.00
Research grant in physics — Bradley	13,250.00
Research grant in physics — Frisch	3,125.00
Foreign Student Fellowships	70,000.00
National Scholarship Program	99,173.71
Student aid — travel	567.64
ISIDOR SLOTNIK '19	
Faculty Salary Adjustment Fund	166.67
A. O. SMITH CORPORATION	
Industrial Liaison Program	10,000.00
ARTHUR L. SMITH MEMORIAL FUND	
Faculty Salary Adjustment Fund	100.00
BEAUCHAMP E. SMITH	
Faculty Salary Adjustment Fund	500.00
CHARLES H. SMITH, JR. '42	
Faculty Salary Adjustment Fund	100.00
DAVID G. SMITH '31	
Faculty Salary Adjustment Fund	100.00
ESTATE OF LEMUEL D. SMITH '06	
Lemuel D. Smith Fund for general endowment	18,768.46
LESTER C. SMITH '25	
Faculty Salary Adjustment Fund	50.00
RICHARD B. SMITH '33	
M.I.T. Club of Chicago Scholarship Fund	25.00
EUGENE R. SMOLEY '19	
Faculty Salary Adjustment Fund	333.34
DALE R. SNOW	
Faculty Salary Adjustment Fund	100.00
SOCIETY OF NAVAL ARCHITECTS MARINE ENGINEERS	
Research in naval architecture	5,000.00
Undergraduate scholarships	3,000.00
SOCONY MOBIL OIL COMPANY, INC.	
Industrial Liaison Program	20,000.00
Geology Thesis Fund	400.00
Industrial Relations Section	1,000.00
SOUTHERN PACIFIC COMPANY	
Program for Senior Executives	3,000.00
ARCHIBALD H. SPAULDING '13	
Faculty Salary Adjustment Fund	250.00

HELEN S. SPENCER	
Faculty Salary Adjustment Fund	$ 116.48
HENRY K. SPENCER '09	
Faculty Salary Adjustment Fund	2,480.38
WILLIAM B. SPENCER '15	
Faculty Salary Adjustment Fund	200.00
SPERRY GYROSCOPE COMPANY	
Industrial Liaison Program	15,000.00
ESTATE OF EDNA S. SPITZ	
M.I.T. Women's Association	2,500.00
SPRAGUE ELECTRIC COMPANY	
Research in industrial management	12,500.00
Industrial Liaison Program	20,000.00
Ship Model Towing Tank Carriage Fund	1,000.00
SPRAGUE AND HENWOOD FOUNDATION	
Soil Stabilization Laboratory	2,000.00
STAINLESS, INC.	
Faculty Salary Adjustment Fund	1,000.00
STANDARD OIL COMPANY (INDIANA)	
Industrial Liaison Program	20,000.00
STANDARD OIL COMPANY (OHIO)	
Program for Senior Executives	2,500.00
STANDARD OIL COMPANY OF CALIFORNIA	
Fellowship in geology	3,550.00
Undergraduate scholarships	1,500.00
Industrial Liaison Program	50,000.00
General purposes	7,500.00
STANDARD OIL COMPANY OF TEXAS	
Fellowship in geology	750.00
Geology Thesis Fund	750.00
STANDARD OIL FOUNDATION, INC.	
Fellowship in chemical engineering	3,000.00
Standard Oil Foundation, Inc., Fund	25,000.00
STANDARD VACUUM OIL COMPANY	
Program for Senior Executives	3,000.00
A. W. STANLEY CHARITABLE FOUNDATION	
Faculty Salary Adjustment Fund	5,000.00
PHILIP B. STANLEY '06	
Faculty Salary Adjustment Fund	2,500.00
ELTON E. STAPLES '26	
Faculty Salary Adjustment Fund	200.00
ESTATE OF PERCY A. STAPLES '04	
Alfred E. Burton Memorial Fund	27,160.93
STEEL FOUNDERS' SOCIETY OF AMERICA	
Taylor Research Fund	36,512.00
DAVID ('13) AND DELLA STERN	
M.I.T. Boston Stein Club — New England Scholarship Fund	100.00
FRANCIS E. STERN '16	
Faculty Salary Adjustment Fund	100.00

B. STERNLICHT	
Miller Room Fund	$ 100.00
ESTATE OF ELIZABETH R. STEVENS	
Albert G. Boyden Scholarship Fund	34.96
EZRA F. STEVENS '27	
Faculty Salary Adjustment Fund	100.00
JOSEPH R. STEVENS '30	
Faculty Salary Adjustment Fund	1,500.00
RADCLIFFE STEVENS '17	
M.I.T. Club of Chicago Scholarship Fund	50.00
RAYMOND STEVENS '17	
Faculty Salary Adjustment Fund	1,481.25
ESTATE OF WILLIAM W. STEVENS '98	
Stevens-Wentworth Scholarship Fund	22,803.45
EARL P. STEVENSON '19	
Faculty Salary Adjustment Fund	1,432.50
BASIL O. STEWART '23	
Ruth Hornblower Churchill Memorial Fund	2,000.00
STEWART-WARNER CORPORATION	
Industrial Liaison Program	10,000.00
STEWART-WARNER FOUNDATION	
Faculty Salary Adjustment Fund	10,000.00
WILLIAM L. STEWART, JR. '23	
Development Fund	1,200.00
Karl T. Compton Laboratories	1,100.00
Faculty Salary Adjustment Fund	100.00
STOP AND SHOP FOUNDATION	
Industrial Relations Section	250.00
STORE KRAFT MANUFACTURING COMPANY	
Undergraduate scholarship	100.00
STOUFFER FOUNDATION	
Faculty Salary Adjustment Fund	300.00
IRVING STRAUSS	
Technology Loan Fund	500.00
SUN OIL COMPANY	
Industrial Relations Section	1,000.00
DAVID M. SUTTER '26	
General purposes	100.00
Faculty Salary Adjustment Fund	200.00
SWANTON LIME WORKS	
Faculty Salary Adjustment Fund	2,000.00
SWIFT AND COMPANY	
Program for Senior Executives	3,000.00
SYLVANIA ELECTRIC PRODUCTS, INC.	
Industrial Liaison Program	10,000.00
Industrial Relations Section	300.00
ELMER D. SZANTAY '35	
Faculty Salary Adjustment Fund	25.00

EDGAR W. TAFT '13	
Faculty Salary Adjustment Fund	$ 150.00
VERNON M. F. TALLMAN '14	
Faculty Salary Adjustment Fund	100.00
S. JOSEPH TANKOOS, JR. '43	
Faculty Salary Adjustment Fund	200.00
TASTY BAKING COMPANY	
Campbell Fund in food technology	5,000.00
RUSSELL C. TAYLOR '27	
Faculty Salary Adjustment Fund	100.00
TEAGLE FOUNDATION, INC.	
Teagle Foundation Scholarship Fund	22,615.00
TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY	
Research in civil engineering	12,545.48
TELEVISION SHARES MANAGEMENT CORPORATION	
Television Shares Management Corporation Prize Fund	2,000.00
EDWIN A. TERKELSEN '22	
Faculty Salary Adjustment Fund	200.00
L. G. L. THOMAS '20	
Faculty Salary Adjustment Fund	1,000.00
RALPH L. THOMAS '13	
Faculty Salary Adjustment Fund	100.00
FLETCHER P. THORNTON, JR. '36	
Faculty Salary Adjustment Fund	200.00
TI–GSI FOUNDATION	
Faculty Salary Adjustment Fund	3,000.00
Texas Instrument Company Fund	1,000.00
ROBERT J. TOBIN '20	
Faculty Salary Adjustment Fund	474.38
TOWLE MANUFACTURING COMPANY	
Industrial Relations Section	250.00
TREDENNICK BILLINGS COMPANY	
Faculty Salary Adjustment Fund	250.00
WILLIAM C. TREUHAFT	
Faculty Salary Adjustment Fund	100.00
TRIANGLE FOUNDATION, INC.	
Industrial Relations Section	250.00
TROPIC FOODS, INC.	
Banana research in food technology	6,000.00
JAMES E. TURNER '33	
James E. Turner Class of 1933 Fund	1,250.00
SMITH D. TURNER, JR. '26	
Faculty Salary Adjustment Fund	100.00
LAWRENCE C. TURNOCK, JR. '41	
Faculty Salary Adjustment Fund	20.00
UNION CARBIDE CORPORATION	
Research in industrial management	5,000.00
Research in electrical engineering	5,000.00
Undergraduate scholarships	7,400.00

UNION CARBIDE CHEMICALS COMPANY	
Fellowship in chemical engineering	$ 10,300.00
Research in mechanical engineering	5,500.00
UNION CARBIDE EDUCATIONAL FUND	
Undergraduate scholarships	1,250.00
UNITED AIRCRAFT CORPORATION	
General purposes	500.00
Industrial Liaison Program	20,000.00
UNITED-CARR FASTENER CORPORATION	
Industrial Relations Section	250.00
Faculty Salary Adjustment Fund	1,000.00
UNITED ENGINEERING TRUSTEES, INC.	
Engineering Foundation — research in metallurgy	2,500.00
Comminution research	3,000.00
Research on thickening	2,500.00
UNITED ENGINEERS AND CONSTRUCTORS, INC.	
Preceptorship in chemical engineering	1,000.00
UNITED NATIONS CHILDREN'S FUND	
Research in food technology	13,653.75
UNITED SHOE MACHINERY CORPORATION	
Program for Senior Executives	3,000.00
Industrial Relations Section	2,500.00
U. S. INDUSTRIAL CHEMICAL COMPANY, DIVISION OF NATIONAL DISTILLERS CHEMICAL CORPORATION	
Faculty Salary Adjustment Fund	50.00
UNITED STATES RUBBER COMPANY FOUNDATION	
Fellowship in chemistry	2,600.00
Undergraduate scholarships	11,400.00
UNITED STATES STEEL CORPORATION	
Industrial Relations Section	1,000.00
THE UPJOHN COMPANY	
Faculty Salary Adjustment Fund	5,000.00
UTICA METALS DIVISION OF KELSEY-HAYES COMPANY	
Industrial Liaison Program	10,000.00
VANADIUM-ALLOYS STEEL COMPANY	
Fellowship in metallurgy	3,500.00
HAROLD S. VAN BUREN '23	
Faculty Salary Adjustment Fund	400.00
E. J. VAN PATTEN '24	
Faculty Salary Adjustment Fund	33.00
JOHN R. VICKERY '35	
Faculty Salary Adjustment Fund	500.00
VICTORIA FOUNDATION, INC.	
Victoria Foundation, Inc., Fund	100,000.00
VINGO TRUST II	
Faculty Salary Adjustment Fund	10,000.00
VOORHEES, WALKER, SMITH AND SMITH	
Fellowship in architecture	2,500.00

ROBERT R. WAGSTAFF '37 Faculty Salary Adjustment Fund	$ 200.00
SCOTT WALKER '40 Faculty Salary Adjustment Fund	500.00
WALLACE AND TIERNAN, INC., LUCIDOL DIVISION Research in chemistry	12,000.00
MARTIN WALTER, JR. '26 Faculty Salary Adjustment Fund	250.00
COLONEL HARRY A. WANSKER '17 Faculty Salary Adjustment Fund	25.00
J. PRINCE WARNER '26 Faculty Salary Adjustment Fund	500.00
WILLIAM W. WARNER '11 Faculty Salary Adjustment Fund	5,928.00
JOSEPH A. WARREN '91 Faculty Salary Adjustment Fund	504.00
DALE E. WASHBURN '23 Faculty Salary Adjustment Fund	100.00
ARTHUR L. WASSERMAN '22 Faculty Salary Adjustment Fund	50.00
THOMAS J. WATSON, JR. Faculty Salary Adjustment Fund	586.00
JERVIS B. WEBB COMPANY Faculty Salary Adjustment Fund	2,000.00
EDWIN S. WEBSTER ('88) FOUNDATION Faculty Salary Adjustment Fund	15,000.00
ALBERT H. '21 AND PEARL K. WECHSLER M.I.T. Boston Stein Club — New England Scholarship Fund	500.00
D. REID WEEDON, JR. '41 Faculty Salary Adjustment Fund	100.00
MELVILLE K. WEILL '09 Faculty Salary Adjustment Fund	500.00
WEIRTON STEEL COMPANY Fellowship in metallurgy	10,400.00
ROBERT WELLES '15 Faculty Salary Adjustment Fund	1,000.00
DAVID Q. WELLS '30 Faculty Salary Adjustment Fund	50.00
EDWARD H. WELLS, JR. '27 Faculty Salary Adjustment Fund	80.00
PRESTON A. WELLS '46 Faculty Salary Adjustment Fund	13,725.00
HOLLAND R. WEMPLE '13 Faculty Salary Adjustment Fund	1,500.00
EUGENE S. WEST '40 Development Fund	30.00

ESTATE OF EVERETT WESTCOTT	
Everett Westcott Fund	$ 800.00
ESTATE OF MARION WESTCOTT	
Marion Westcott Fund	547.79
WESTERN ELECTRIC COMPANY	
Program for Senior Executives	3,000.00
Undergraduate scholarships	4,200.00
WESTINGHOUSE EDUCATIONAL FOUNDATION	
George Westinghouse Professorship	15,000.00
Nuclear Reactor Fund	15,000.00
Fellowship in industrial economics	3,000.00
Faculty Salary Adjustment Fund	25,000.00
WESTINGHOUSE ELECTRIC CORPORATION	
Turbo machine research	20,000.00
Program for Senior Executives	8,500.00
Westinghouse Curriculum Workshop	4,000.00
Undergraduate scholarships	1,500.00
H. T. WESTON, JR. '17	
Undergraduate scholarship	100.00
WEYERHAEUSER TIMBER FOUNDATION	
Faculty Salary Adjustment Fund	1,000.00
ESTATE OF ARCHER E. WHEELER '95	
Archer E. Wheeler Scholarship Fund	145,411.32
C. H. WHEELER MANUFACTURING COMPANY FOUNDATION	
Faculty Salary Adjustment Fund	1,000.00
EARL C. WHEELER '26	
Faculty Salary Adjustment Fund	2,000.00
KNIGHT W. WHEELER '06	
Knight W. Wheeler Fund	16,000.00
WHIRLPOOL CORPORATION	
Thermodynamics research in mechanical engineering	4,860.00
Industrial Liaison Program	20,000.00
UNCAS A. WHITAKER '23	
Research in mathematics	3,375.00
Faculty Salary Adjustment Fund	3,000.00
JOSEPH C. WHITCOMB '28	
Faculty Salary Adjustment Fund	100.00
HARRIET E. WHITEHEAD	
Choral Society European trip	714.00
ESTATE OF JULIA P. WHITNEY	
Granger Whitney ('87) Fund	6,710.00
JAMES L. WICK, JR. '06	
Faculty Salary Adjustment Fund	250.00
WILLIAM J. WILEY '29	
Faculty Salary Adjustment Fund	257.50
WILKE BAKING COMPANY	
Undergraduate scholarship	100.00
WILKIE FOUNDATION	
Technology Press	2,000.00

ESTATE OF H. SYLVIA A. H. G. WILKS	
General purposes	$ 51.69
ESTATE OF ARTHUR WILLIAMS	
Undergraduate scholarships	3,000.00
IRVING W. WILSON '11	
General purposes	250.00
Faculty Salary Adjustment Fund	2,100.00
J. E. WILSON	
General Undergraduate Scholarship Endowment	5.00
JOHN J. WILSON '29	
John J. Wilson Scholarship Fund	5,662.50
Mary I. Wilson Scholarship Fund	5,662.50
ROBERT E. WILSON '16	
M.I.T. Club of Chicago Scholarship Fund	25.00
Faculty Salary Adjustment Fund	1,000.00
RICHARD P. WINDISCH '21	
Faculty Salary Adjustment Fund	1,125.00
S. EDWARD WININGER '24	
Faculty Salary Adjustment Fund	100.00
ESTATE OF ROBERT WINTHROP	
Undergraduate scholarships	2,000.00
ROBERT '27 AND ETHEL P. WISE	
M.I.T. Boston Stein Club — New England Scholarship Fund	200.00
ROBERT T. WISE '28	
M.I.T. Club of Chicago Scholarship Fund	25.00
GEORGE S. WITMER '09	
George S. Witmer Fund	9,287.50
George S. Witmer Second Fund	30.00
JOHN G. WOLBACH	
President's Special Fund	300.00
ROBERT E. WORDEN '36	
Faculty Salary Adjustment Fund	1,250.01
WORLD UNIVERSITY SERVICE	
Undergraduate scholarships	1,685.00
MAX WOYTHALER '15	
Faculty Salary Adjustment Fund	50.00
ESTATE OF MADELINE WRIGHT	
R. Kendrick Wright ('13) Memorial Fund	2,197.43
WYATT, INC. '18	
Faculty Salary Adjustment Fund	4,000.00
WYMAN GORDON COMPANY	
Industrial Relations Section	250.00
YALE STAMPING COMPANY	
Faculty Salary Adjustment Fund	335.00

GIFTS TO OTHER FUNDS

M.I.T. Alumni Fund	$436,590.53
Olive Barnard Memorial Fund	11,967.43
Parents' gifts	20,666.65
Proctor Portrait Fund	1,607.00

Class gifts in addition to those in the Alumni Fund total:

Class of 1907	178.12
Class of 1908	5,115.00
Class of 1909	104.60
Class of 1917	3,287.09
Class of 1921	3,270.50
Class of 1933	7,378.13
Class of 1934	1,522.50
Class of 1935	1,000.00
Class of 1937	661.18
Class of 1944	491.95
Class of 1949	542.27
Class of 1950	679.33
Class of 1952	341.32
Class of 1954	205.95
Class of 1955	322.53
Class of 1956	355.75
Other classes	205.68

SUMMARY OF GIFTS, GRANTS, AND BEQUESTS RECEIVED

	1958	*1957*	*1956*	*1955*	*1954*	*1953*	*1952*	*1951*	*1950*	*1949*
GIFTS FOR ENDOWMENT:										
Real estate	.....	.....	.....	$ 275,000	.....	.....	.....	.....	.....	$ 175,000
Funds for general purposes	$ 660,898	$ 545,710	$ 61,264	111,956	$ 82,558	$ 50,128	$ 7,740	$ 86,586	$1,030,511	193,255
Funds for designated purposes	476,719	1,834,944	2,342,351	499,495	677,230	538,077	340,532	523,599	382,069	106,114
GIFTS FOR STUDENT LOANS	8,647	250	2,200	4,550	9	905	2,973	227,756	10	115
GIFTS FOR BUILDING FUNDS	195,236	731,350	1,133,990	1,530,684	274,400	15,004	40,308	3,797,212	1,268,266	91,666
OTHER GIFTS:										
Unexpended balances of endowment fund income	1,287	1,350	6,450	6,340	7,786	5,800	5,425	5,775	2,525	9,180
Funds for general purposes — invested	78,576	180,268	191,826	765,680	391,881	1,403,533	2,850,889	2,206,364	2,066,934	482,730
Funds for designated purposes — invested	1,814,320	1,035,440	1,871,291	922,299	293,548	1,108,931	1,537,653	554,665	245,454	316,441
Funds for designated purposes — not invested	4,411,472	4,055,559	4,673,207	2,765,567	3,356,835	3,046,288	2,093,875	1,657,399	1,463,763	1,106,065
	$7,647,155	**$8,384,871**	**$10,282,579**	**$6,881,571**	**$5,084,247**	**$6,168,666**	**$6,879,395**	**$9,059,356**	**$6,459,532**	**$2,480,566**
MISCELLANEOUS GIFTS:										
Agency funds	$ 49,597	$ 52,390	$ 30,539	$ 137,598	$ 26,171	$ 38,728	$ 45,711	$ 38,751	$ 18,247	$ 22,436
Annuity funds	35,287	60,739	74,169	55,688	6,625	24,500	28,000	47,000	50,310	33,800
	$ 84,884	$ 113,129	$ 104,708	$ 193,286	$ 32,796	$ 63,228	$ 73,711	$ 85,751	$ 68,557	$ 56,236
Total	**$7,732,039**	**$8,498,000**	**$10,387,287**	**$7,074,857**	**$5,117,043**	**$6,231,894**	**$6,953,106**	**$9,145,107**	**$6,528,089**	**$2,536,802**

GENERAL INVESTMENTS
Schedule A-1

Par Value		*Book Value*	*Net Income*
	U. S. GOVERNMENT BONDS		
	Certificate of Indebtedness		
$1,037,000	4%, Series C, 8-1-58	$ 1,037,000.00	$ 19,762.72
	Treasury Notes		
1,000,000	4%, Series B, 8-15-62	1,000,000.00	15,434.78
	Treasury Bonds		
25,000	2⅛%, 11-15-60	25,000.00	(238.03)
1,200,000	2¾%, 9-15-61	1,191,875.00	33,000.00
3,018,000	2½%, 11-15-61	3,018,000.00	75,450.00
2,040,000	2½%, 8-15-63	2,040,000.00	51,000.00
1,000,000	3%, 2-15-64	1,000,000.00	(4,971.02)
1,000,000	2⅝%, 2-15-65	1,000,000.00	.....
1,500,000	2½%, 12-15-68/63	1,469,218.75	37,500.00
1,500,000	2½%, 6-15-69/64	1,456,667.00	37,500.00
1,000,000	4%, 10-1-69	1,000,000.00	20,000.00
10,000	3¼%, 6-15-83/78	10,000.00	325.00
	Small Holdings	7,398.72	185.10
	Income from bonds sold or matured	.....	85,617.66
	Total U. S. Gov't bonds...	**$14,255,159.47**	**$ 370,566.21**
	CANADIAN BONDS		
	Industrial		
$ 168,000	Aluminum Co. of Can., Ltd., Deb., 3⅞%, 5-1-70	$ 168,000.00	$ 6,510.00
192,000	Aluminum Co. of Can., Ltd., Deb., 4½%, 3-1-73	192,000.00	8,945.10
200,000	Aluminum Co. of Can., Ltd., Deb., 4½%, 4-1-80	200,000.00	9,000.00
	Public Utility		
200,000	Bell Tel. of Canada 1st J, 4½%, 12-15-67	200,000.00	9,233.43
200,000	Interprov. Pipe Line 1st C, 4%, 4-1-73	200,000.00	(2,255.56)
500[1]	Trans-Canada Pipe Lines, Ltd., Sub. Deb., 5.60%, 1-1-87	47,717.67	2,800.00
100,000	Westcoast Trans. Co., Ltd., Sub. Deb. A, 5½%, 4-1-88	48,009.71	5,500.00
176,000	Westcoast Trans. Co., Ltd., Sub. Deb. C, 5½%, 4-1-88	176,000.00	(2,330.03)

[1] Units

GENERAL INVESTMENTS *Schedule A-1 — continued*

Par Value		*Book Value*	*Net Income*
	CANADIAN BONDS — *continued*		
	Financial		
$ 500,000	Canadian Acceptance Corp., Ltd., 4½%, 11-1-68	$ 500,000.00	$ 23,301.05
500,000	G.M.A.C. of Canada Deb., 4¾%, 12-15-69	500,000.00	24,366.01
	Income from bonds sold		6,962.08
	Total Canadian bonds	**$ 2,231,727.38**	**$ 92,032.08**
	INDUSTRIAL BONDS		
$ 500,000	Aluminum Co. of America Deb., 3⅞%, 4-1-83	$ 498,000.00	$ (907.41)
112,000	Atlantic Refining Co. Sub. Conv. Deb., 4½%, 8-15-87	112,000.00	2,325.24
300,000	Caterpillar Tractor Co. Deb., 4½%, 11-1-77	298,500.00	6,010.62
100,000	Champion Paper & Fibre Co. Deb., 3¾%, 7-15-81	100,000.00	3,750.00
250,000	Commonwealth Oil Refining Co. Deb., 6%, 12-31-66	250,000.00	15,000.00
50,000	Commonwealth Oil Refining Co. Conv. Jr. Sub. Deb., 6%, 12-1-72	50,000.00	(158.34)
500,000	Douglas Aircraft Co. Deb., 5%, 4-1-78	500,000.00	(1,353.47)
40,000	Dresser Industries, Inc. Conv. Sub. Deb., 4⅛%, 3-1-77	40,000.00	1,650.00
300,000	General Electric Company Deb., 3½%, 5-1-76	300,000.00	10,500.00
300,000	Kaiser Aluminum & Chemical Corp. 1st Mtg., 4¼%, 4-1-81	300,000.00	11,277.69
300,000	Kaiser Steel Corp. 1st Mtg., 4¾%, 5-1-76	300,000.00	9,940.10
300,000	LaGloria Oil & Gas Co. Deb., 5½%, 5-1-74	290,999.00	11,504.17
300,000	Minneapolis-Honeywell Reg. Co. Deb., 3¾%, 8-1-76	298,500.00	11,250.00
208,000	Phillips Petroleum Co. Conv. Sub. Deb., 4¼%, 2-15-87	208,000.00	8,594.56
600,000	Pittston Company Sub. Deb., 6¼%, 10-1-76	600,000.00	28,819.44

GENERAL INVESTMENTS *Schedule A-1 — continued*

Par Value		*Book Value*	*Net Income*
	INDUSTRIAL BONDS — *continued*		
$ 300,000	Pittston Company 1st Mtg., 6⅛%, 10-1-82.....	$ 300,000.00	$ 5,206.24
77,000	Shamrock Oil & Gas Corp. Deb., 3½%, 4-1-67.....	77,000.00	2,695.00
200,000	Sperry Rand Corp. Deb., w/w, 5½%, 9-1-82.....	200,000.00	4,839.22
300,000	Superior Oil Company Deb., 3¾%, 7-1-81.....	300,000.00	11,250.00
250,000	Union Tank Car Company Deb., 3¾%, 10-15-75...	250,000.00	9,375.00
104,000	U. S. Steel Corp. Deb., 2.25-2.65%, 8-1-58/64.....	104,000.00	2,524.50
	Income from bonds sold, called, or matured.....	.....	32,026.50
	Total industrial bonds.....	**$ 5,376,999.00**	**$ 186,119.06**
	PUBLIC UTILITY BONDS		
	Electric and Other		
$ 200,000	American & Foreign Power Co. Deb., 5%, 3-1-2030..	$ 197,182.41	$ 10,000.00
500,000	American Tel. & Tel. Co. Deb., 4⅜%, 4-1-85.....	500,000.00	21,875.00
1,000,000	American Tel. & Tel. Co. Deb., 3⅞%, 7-1-90.....	1,000,000.00	38,750.00
200,000	Consolidated Edison Co. of N. Y. 1st, 3⅝%, 5-1-86..	200,000.00	7,250.00
200,000	Duke Power Company 1st, 3⅝%, 5-1-86.....	200,000.00	7,250.00
300,000	Florida Power & Light Co. 1st, 3⅝%, 4-1-86.....	300,000.00	10,875.00
250,000	Michigan Bell Telephone Co. Deb., 4¾%, 11-1-92....	275,000.00	(1,550.35)
200,000	Niagara Mohawk Power Corp., 3⅝%, 5-1-86.....	200,000.00	7,250.00
200,000	Pacific Tel. & Tel. Co. Deb., 5⅛%, 8-1-80.....	200,000.00	(438.11)
300,000	So. California Edison 1st G, 3⅝%, 4-15-81.....	297,318.00	10,875.00
200,000	Wisconsin Electric Power Co. 1st, 3⅞%, 4-15-86.....	200,000.00	7,750.00
250,000	Southwestern Bell Telephone Co. Deb., 4¾%, 10-1-92	275,000.00	(2,473.96)

GENERAL INVESTMENTS *Schedule A-1 — continued*

Par Value		*Book Value*	*Net Income*
	PUBLIC UTILITY BONDS — *continued*		
	Gas Transmission		
$ 200,000	Columbia Gas System, Inc., Deb. D, 3½%, 7-1-79...	$ 200,000.00	$ 7,000.00
200,000	Columbia Gas System, Inc., Deb. E, 3⅝%, 9-1-80...	200,000.00	7,250.00
200,000	Columbia Gas System, Inc., Deb. F, 3⅞%, 4-1-81...	200,000.00	7,750.00
105,000	Northern Natural Gas Co. Deb., 3⅝%, 11-1-73....	105,000.00	3,806.25
200,000	Northern Natural Gas Co. Deb., 3¼%, 11-1-74....	200,000.00	6,500.00
250,000	Oklahoma Natural Gas Co. 1st, 3½%, 5-1-81.....	250,000.00	8,750.00
82,000	Southern Natural Gas Co. 1st, 4%, 5-1-73.....	81,180.00	3,280.00
198,000	Tennessee Gas Trans. Co. Deb., 4%, 4-1-75.....	198,000.00	7,920.00
500,000	Tennessee Gas Trans. Co. 1st, 3⅞%, 2-1-76.....	500,000.00	19,375.00
200,000	Transcontinental Gas Pipe Line Corp. 1st, 5%, 4-1-77	200,000.00	10,000.00
	Income on bonds called....	.....	10,000.00
	Total public utility bonds..	**$ 5,978,680.41**	**$ 209,043.83**
	COMMON CARRIER BONDS		
$ 960,000	Blackships, Inc. Series A thru G, 5%, 4-1-73/75.....	$ 960,000.00	$ 48,000.00
539,000	Great Lakes Pipe Line Co. Deb., 4%, 2-1-74.....	539,000.00	21,560.00
500,000	Great Lakes Pipe Line Co. Deb., 4¾%, 4-1-82.....	500,000.00	23,750.00
500,000	Shell Pipe Line Corp. Note, 3.30%, 12-15-58/67.....	491,143.38	16,500.00
158,000	Southern Pacific Company, 4½%, 5-1-81.....	156,081.75	7,110.00
	Income on bonds called or matured.....	.....	5,377.50
	Total common carrier bonds	**$ 2,646,225.13**	**$ 122,297.50**
	FINANCIAL BONDS		
$1,900,000	Associates Investment Co. Note, 3%, 12-1-64.....	$ 1,900,000.00	$ 57,000.00

GENERAL INVESTMENTS *Schedule A-1 — continued*

Par Value		*Book Value*	*Net Income*
	FINANCIAL BONDS — *continued*		
$ 500,000	Associates Investment Co. Note, 4¾%, 1-15-67	$ 500,000.00	$ 22,364.58
467,000	Associates Investment Co. Sub.NoteB,4¾%,10-1-68	467,000.00	22,182.50
500,000	Associates Investment Co. Note, 3¼%, 2-15-70	500,000.00	16,250.00
500,000	C.I.T. Financial Corp. Note, 3¼%, 7-15-63	500,000.00	16,250.00
500,000	C.I.T. Financial Corp. Note, 3%, 2-15-64	500,000.00	15,000.00
100,000	C.I.T. Financial Corp. Deb., 4¾%, 7-1-66	99,000.00	2,058.33
1,000,000	G.M.A.C. Deb. 4%, 7-1-58	1,000,000.00	40,000.00
1,500,000	G.M.A.C. Sub. Note, 3%, 11-1-59	1,490,625.00	45,000.00
500,000	G.M.A.C. Deb., 3%, 4-1-60	500,000.00	15,000.00
1,752,000	G.M.A.C. Deb., 3⅞%, 9-15-61	1,752,000.00	67,890.00
250,000	G.M.A.C. Deb., 4⅜%, 5-15-62	250,000.00	(2,986.68)
1,195,000	G.M.A.C. Deb., 2¾%, 7-15-64	1,183,112.53	32,862.50
235,000	G.M.A.C.Deb.,3%,7-15-69	235,000.00	7,050.00
300,000	G.M.A.C. Deb., 3½%, 3-15-72	300,000.00	10,500.00
500,000	G.M.A.C. Jr. Sub. Note, 3¾%, 4-1-73	500,000.00	18,750.00
500,000	G.M.A.C. Deb., 3⅝%, 9-1-75	491,250.00	18,125.00
500,000	Int'l Bank for Recon. & Dev., 3¾%, 5-15-68	500,000.00	(46.89)
300,000	Int'l Bank for Recon. & Dev., 3%, 3-1-76	300,000.00	9,000.00
300,000	Int'l Bank for Recon. & Dev., 4¾%, 11-1-80	300,000.00	7,057.70
	Income from bonds sold, called, or matured	.....	41,835.31
	Total financial bonds	**$13,267,987.53**	**$ 461,142.35**
	Small holdings	**$ 2,100.00**	**$ 2.50**

GENERAL INVESTMENTS *Schedule A-1 — continued*

Shares		*Book Value*	*Net Income*
	PREFERRED STOCKS		
1,000	Anderson Pritchard Oil Corp. 4¼% Cum. Conv..	$ 51,657.52	$ 2,125.00
4,200	El Paso Natural Gas Co. $5 Cum. Conv. 2nd Pfd....	446,800.00	3,750.00
655	Kaiser Aluminum & Chemical Corp. 4⅛%, Cum. Cv.	65,500.00	2,701.88
1,422	Lennox Industries, Inc. 4% Cum.....	14,220.00	568.80
900	Arthur D. Little, Inc. 6%...	90,000.00	5,400.00
2,000	Tennessee Gas Trans. Co. 5% Cum. Conv. 2nd Pfd.	200,000.00	10,000.00
1,800	Tropical Gas Co., Inc. $5.24 Cum.....	180,000.00	9,432.00
	Small holdings.....	1,950.00	75.62
	Income from preferred stocks sold.....	.....	2,693.00
	Total preferred stocks.....	**$ 1,050,127.52**	**$ 36,746.30**
	INDUSTRIAL COMMON STOCKS		
	Agricultural Equipment		
3,000	International Harvester Co.	$ 39,956.12	$ 6,000.00
	Automobile		
5,540	Ford Motor Company.....	357,330.00	13,296.00
161,040	General Motors Corporation	2,759,030.78	322,067.00
	Building Supplies		
15,708	Johns-Manville Corporation	325,123.61	31,416.00
12,857	National Lead Company...	118,326.76	41,785.25
7,350	Pittsburgh Plate Glass Co...	138,604.46	20,212.50
	Chemical and Drugs		
4,434	Allied Chemical & Dye Corporation.....	181,087.03	13,302.00
360	Christiana Securities Co....	1,825,474.35	174,600.00
562	Diamond Alkali Company..	21,784.75	996.30
4,560	Dow Chemical Company...	84,106.09	5,417.70
2,875	E. I. du Pont de Nemours & Company.....	446,847.08	16,788.50
21,035	Hercules Powder Company.	346,311.82	23,107.00
19,540	Merck & Company, Inc....	139,688.72	25,402.00
13,331	Monsanto Chemical Co....	105,078.81	13,171.75
14,463	Union Carbide Corporation	337,088.17	52,010.10
500	Victor Chemical Works....	14,531.25	175.00

GENERAL INVESTMENTS *Schedule A-1 — continued*

Shares		*Book Value*	*Net Income*
	INDUSTRIAL COMMON STOCKS — *continued*		
	Containers		
15,060	American Can Company...	$ 418,577.13	$ 30,000.00
10,086	Owens-Illinois Glass Co....	292,701.89	25,152.52
	Electrical Equipment		
31,577	General Electric Company.	479,655.54	59,544.00
6,440	General Radio Co., Conv...	74,830.00	.....
7,030	McGraw-Edison Company.	75,687.64	9,831.50
625	Sprague Electric Company.	34,487.50	705.00
8,053	Westinghouse Electric Corp.	225,462.65	16,106.00
	Food and Beverages		
5,000	United Fruit Company....	87,570.20	15,000.00
	Machinery		
8,653	Caterpillar Tractor Co.....	92,204.43	20,767.20
6,167	Draper Corporation.....	100,327.98	8,017.10
	Non-Ferrous Metal		
432	Anaconda Company.....	6,680.00	216.00
4,000	International Nickel Co. of Canada.....	134,488.60	15,000.00
4,136	Kennecott Copper Corp....	265,632.42	24,516.00
	Office Equipment		
4,776	International Business Machines Corporation.....	252,434.88	11,794.15
13,040	National Cash Register Co..	231,199.23	13,246.20
	Oil		
18,750	Commonwealth Oil Refining Company, Inc.....	4,500.00	.....
726	Continental Oil Company..	25,828.60	1,137.60
9,667	Gulf Oil Corporation.....	236,926.76	23,591.26
10,970	Ohio Oil Company.....	221,282.75	17,552.00
21,574	Phillips Petroleum Co.....	482,292.92	36,675.80
22,465	Socony Mobil Oil Co., Inc.	396,279.16	56,162.50
25,230	Standard Oil Co. of Calif...	353,570.15	50,360.00
14,615	Standard Oil Co. (Indiana).	303,798.70	30,730.55
107,586	Standard Oil Co. (N. J.)...	1,194,887.00	237,290.40
11,726	Texas Company.....	242,613.01	25,810.10
27,405	Tropical Gas Company, Inc.	6,475.00	.....
	Paper		
12,935	International Paper Co.....	186,569.82	38,522.05
	Retail Trade		
5,125	J. C. Penney Company....	165,618.55	21,781.25
23,459	Sears, Roebuck & Company	222,592.30	25,722.50

GENERAL INVESTMENTS *Schedule A-1 — continued*

Shares		*Book Value*	*Net Income*
	INDUSTRIAL COMMON STOCKS — *continued*		
	Rubber		
300	B. F. Goodrich Company..	$ 14,325.00	$ 660.00
738	Goodyear Tire & Rubber Company.....	54,896.89	1,492.80
	Soap		
15,304	Procter & Gamble Co.....	274,196.10	30,608.00
	Steel		
6,000	Inland Steel Company.....	198,474.49	27,000.00
6,600	National Steel Corporation.	149,488.34	23,100.00
	Miscellaneous		
33,492	Eastman Kodak Company.	391,333.91	92,046.10
3,150	General Dynamics Corp....	53,551.11	6,300.00
521	Halliburton Oil Well Cementing Company.....	30,282.38	1,048.80
875	Minneapolis-Honeywell Regulator Company.....	57,867.31	1,531.25
10,608	Minnesota Mining & Manufacturing Company.....	151,558.00	12,729.60
2,000	Texas Instruments, Inc.....	24,922.57	.....
	Income on stocks sold.....	.....	1,584.05
	Total industrial stocks.....	**$15,456,440.71**	**$1,773,079.38**
	PUBLIC UTILITY COMMON STOCKS		
28,816	American Electric Power Co.	$ 358,540.75	$ 44,418.68
1,415	American Tel. & Tel. Co...	177,179.93	12,361.50
4,240	Boston Edison Company...	155,396.99	11,872.00
525	Central Maine Power Co.. .	13,059.38	735.00
7,000	Commonwealth Edison Co.	172,198.06	14,000.00
4,500	Florida Power & Light Co.	161,613.60	6,300.00
6,953	General Public Utilities Corporation.....	200,583.54	13,906.00
5,000	Idaho Power Company....	206,861.93	.....
10,080	Illinois Power Company...	202,166.83	15,120.00
1,000	Kansas Gas & Electric Co..	31,562.50	525.00
10,600	Middle South Utilities, Inc.	293,301.33	18,020.00
5,000	Montana Power Company..	169,075.59	10,000.00
6,000	Northern Illinois Gas Co.. ..	117,494.40	.....
6,000	Northern Indiana Public Service Company.....	246,290.00	2,500.00
5,623	Ohio Edison Company....	274,503.56	14,844.72
9,190	Public Service Co. of N. H..	162,642.62	8,945.00

GENERAL INVESTMENTS *Schedule A-1 — continued*

Shares		*Book Value*	*Net Income*
	PUBLIC UTILITY COMMON STOCKS — *continued*		
4,000	Southern Calif. Edison Co..	$ 138,089.14	$ 9,600.00
4,050	Southern Company.....	81,582.50	3,297.50
6,000	Utah Power & Light Co....	145,750.00	7,200.00
39,432	Virginia Elec. & Power Co..	463,251.02	39,432.00
4,100	Texas Eastern Trans. Corp.	1.00	5,740.00
6,622	Texas Gas Trans. Corp....	102,699.20	6,557.50
1,500	Trans-Canada Pipe Lines, Ltd.....	30,282.33	.....
14,025	Transcontinental Gas Pipe Line Corporation.....	219,934.67	13,387.50
3,000	Westcoast Trans. Co., Ltd..	66,990.29	.....
	Income on stocks sold.....	.....	363.00
	Total public utility stocks..	**$ 4,191,051.16**	**$ 259,125.40**
	RAILROAD COMMON STOCKS		
21,630	Atchison, Topeka & Santa Fe Railway.....	$ 211,196.11	$ 30,282.00
2,062	Great Northern Railway Co.	51,195.56	6,186.00
	Income on stocks sold.....	.....	1.80
	Total railroad stocks.....	**$ 262,391.67**	**$ 36,469.80**
	BANK COMMON STOCKS		
3,790	Bankers Trust Co., N. Y....	$ 192,230.30	$ 11,370.00
4,109	Continental Illinois Nat'l Bk. & Trust Co., Chicago....	179,986.40	15,203.00
5,549	First Nat'l Bank of Boston..	307,790.41	18,589.15
7,194	First Nat'l City Bank of N.Y.	295,092.35	21,582.00
7,287	Guaranty Trust Co., N. Y...	344,108.61	29,138.40
7,622	Hanover Bank, New York..	233,813.88	14,099.50
	Income on stocks sold.....	.....	12.20
	Total bank stocks.....	**$ 1,553,021.95**	**$ 109,994.25**
	INSURANCE COMMON STOCKS		
8,334	Boston Insurance Company	$ 197,914.51	$ 15,001.20
4,436	Continental Insurance Co. of New York.....	76,753.05	8,686.00
8,676	Fireman's Fund of Calif....	210,583.69	15,606.00
3,828	Hartford Fire Ins. Co.....	143,838.44	11,468.25
9,302	Ins. Co. of North America	169,698.05	23,255.00
	Total insurance stocks.....	**$ 798,787.74**	**$ 74,016.45**

GENERAL INVESTMENTS *Schedule A-1 — continued*

Shares		*Book Value*	*Net Income*
	OTHER COMMON STOCKS		
10,640	Bond Investment Trust of America	$ 193,002.60	$ 10,427.20
13,423	Century Shares Trust	192,456.78	6,872.23
64,306	Colonial Fund, Inc.	201,318.61	25,156.80
1,000	National Research Corp.	30,000.00	.....
806	Photon, Inc.	12,976.28	.....
541	Rockwell Mfg. Company	10,007.60	1,167.10
735	J. P. Stevens & Co., Inc.	25,325.00	1,102.52
1,015	Stone & Webster, Inc.	30,087.85	3,045.00
	Small holdings	46,998.30	1,582.37
	Income from stocks sold	.....	664.00
	Total other common stocks.	**$ 742,173.02**	**$ 50,017.22**
	MORTGAGE NOTES		
	Dover	$ 29,483.51	$ 1,201.47
	Goldfinch Street, San Diego, California	6,729.33	305.40
	Collincote Street, Stoneham	500.00	20.00
	Maude Terrace, Watertown	1,055.77	53.64
	Summer Street, Watertown.	3,386.13	146.40
	Beta Theta Pi	10,000.00	550.00
	Delta Kappa Epsilon	4,500.00	269.25
	Kappa Sigma	6,000.00	320.00
	Lambda Chi Alpha	1,365.50	196.87
	Phi Kappa	7,375.00	409.38
	450 Beacon Street, Inc.	6,000.00	412.50
	Sigma Chi	3,500.00	218.75
	Income on paid up mortgages	.....	31.25
	Total mortgage notes.	**$ 79,895.24**	**$ 4,134.91**
	REAL ESTATE DEVOTED TO INSTITUTE USE		
	Dormitories and Housing		
	120 Bay State Road, Boston.	$ 26,000.00	$ 780.00
	Graduate House	647,951.94	19,440.00
	Baker House	2,064,180.53	61,926.00
	Burton House	1,453,380.37	43,602.00
	Burton House (mtg.)	187,400.00	7,696.00
	Westgate veterans' housing.	459,492.60	13,784.78
	Total dormitories and housing	**$ 4,838,405.44**	**$ 147,228.78**

GENERAL INVESTMENTS *Schedule A-1 — continued*

Par Value		*Book Value*	*Net Income*
	REAL ESTATE DEVOTED TO INSTITUTE USE — *continued*		
	Research		
	565 Memorial Drive, Camb.	$ 200,560.50	$ 11,030.83
	209 Mass. Ave., Cambridge.	100,000.00	5,500.00
	Wood Street, Lexington....	66,714.04	3,669.27
	68-92 Albany Street, Camb.	100,000.00	5,500.00
	I.B.M. Computation Center	360,000.00	.....
	Total for research.....	**$ 827,274.54**	**$ 25,700.10**
	OTHER REAL ESTATE		
	10 Albany St., Cambridge..	$ 25,000.00	.....
	180–194 Main St., Camb.. .	183,537.15	$ 3,798.34
	36–44 Memorial Dr., Camb.	873,932.99	41,396.41
	80 Memorial Drive, Camb..	824,035.70	41,172.48
	100 Memorial Drive, Camb.	153,510.85	6,399.96
	333 Memorial Drive, Camb.	40,000.00	.....
	500 Memorial Drive, Camb.	28,013.20	1,541.56
	540–550 Memorial Drive, Cambridge.....	351,524.51	13,217.92
	628 Memorial Drive, Cambridge (land).....	9,211.94	.....
	640 Memorial Drive, Camb.	1,130,482.88	(14,253.42)
	76–94 Mass. Ave., Camb...	408,678.74	6,298.61
	Bexley Hall, Cambridge...	115,280.61	7,450.36
	Gloversville, New York....	215,282.99	10,806.07
	New London, Connecticut..	197,731.41	9,552.65
	Plattsburg, New York.....	127,120.73	5,936.76
	Taunton, Massachusetts....	161,654.81	7,398.38
	Waltham, Massachusetts...	623,331.18	31,263.38
	Willimantic, Connecticut...	133,269.78	6,093.63
	Worcester, Massachusetts..	285,132.63	13,977.32
	Canadian Petrofina, Ltd., leases.....	232,809.32	9,586.01
	Royalite Oil Co., Ltd., leases.....	221,971.04	9,193.86
	Income from real estate sold	.....	908.25
	Total other real estate.....	**$ 6,341,512.46**	**$ 211,738.53**

GENERAL INVESTMENTS *Schedule A-1 — continued*

Par Value		*Book Value*	*Net Income*
	COMMERCIAL PAPER		
$ 500,000	Continental Can Company, 2¾%, 8-15-58.....	$ 492,895.83	.....
500,000	Dow Chemical Company, 1⅝%, 11-17-58.....	496,411.46	.....
500,000	Industrial Acceptance Corp., 3⅞%, 7-7-58.....	490,258.68	.....
500,000	Owens-Illinois Glass Co., 2⅜%, 8-21-58.....	494,854.16	.....
500,000	J. P. Stevens & Company, 1¾%, 9-15-58.....	496,840.28	.....
	Income from maturities....	.....	$ 78,897.58
	Total commercial paper....	**$ 2,471,260.41**	**$ 78,897.58**
	Total general investments..	**$82,371,220.78** (Schedule A)	**$4,248,352.23**

INVESTMENTS OF FUNDS SEPARATELY INVESTED

Schedule A-2

Par Value or Shares		*Book Value*	*Net Income*
	ANONYMOUS R.S. FUND		
200	Mico Instrument Company 5% Cum. Pfd..	$ 20,000.00	.....
	AVOCA FUND		
7,200	General Radio Company.....	$ 76,200.00	.....
	BABSON FUND		
	U. S. Government Bonds		
$ 2,000	Treasury, 2¼%, 9-15-59/56...	$ 2,000.00	$ 45.00
2,000	Treasury, 2½%, 8-15-63.....	2,000.00	50.00
1,950	Treasury, 2½%, 9-15-72/67...	1,906.13	48.75
1,000	Savings Bonds, 2½%, 7-1-61...	1,000.00	25.00
1,000	Savings Bonds, 2½%, 1-1-63...	1,000.00	25.00
	Preferred Stocks		
80	United Stores Corporation $6 Cum. Conv.....	8,034.54	480.00
80	United Stores Corporation $4.20 2nd Conv.....	1,284.62	48.00
	Common Stocks		
30	E. I. du Pont de Nemours & Co.	3,565.36	130.00
100	Standard Oil Company (Indiana)	3,258.36	125.40
	Total of the Babson Fund.....	$ 24,049.01	$ 977.15
	GORDON Y. BILLARD FUND		
520	Nortex Oil & Gas Corp.....	$ 1,560.00	.....
	DENNISON K. BULLENS FUND		
	Bonds		
$ 100	Neapco Products, Inc. 1st K, 4%, 9-1-60.....	$ 100.00	.....
700	Neapco Products, Inc. 1st L, 4%, 9-1-61.....	700.00	.....
1,700	Neapco Products, Inc. 1st M, 4%, 9-1-62.....	1,700.00	.....
1,700	Neapco Products, Inc. 1st N, 4%, 9-1-63.....	1,700.00	.....
1,700	Neapco Products, Inc. 1st O, 4%, 9-1-64.....	1,700.00	.....
100	Neapco Products, Inc. 1st P, 4%, 9-1-65.....	100.00	.....
	Total of the Bullens Fund.....	$ 6,000.00	.....

FUNDS SEPARATELY INVESTED *Schedule A-2 — continued*

Par Value or Shares		*Book Value*	*Net Income*
	CLASS OF 1908 — OSBORNE FUND		
	Paid up life insurance policy....	**$ 10,702.38**	.....
	CLASS OF 1919		
	Income from bonds matured...	.....	$ 13.00
	CLASS OF 1920		
	Income from bonds matured...	.....	$ 780.00
	EBEN S. DRAPER FUND		
	U. S. Government Bonds		
$ 24,000	Cert. of Indebt. C, 4%, 8-1-58..	$ 24,000.00	$ 480.00
10,000	Savings Bonds, 2½%, 9-1-59...	10,000.00	250.00
21,000	Savings Bonds, 2½%, 2-1-60...	21,000.00	525.00
	Other Bonds		
30,000	G.M.A.C. of Canada, 4¾%, 12-15-69.....	30,000.00	1,257.95
5,000	Northern Pacific R.R., 4%, 1-1-97	4,598.31	200.00
5,000	Southern Pacific Company, 4½%, 5-1-81.....	5,000.00	225.00
	Common Stocks		
100	E. I. du Pont de Nemours & Co.	4,731.05	650.00
186	Standard Oil Company (N. J.)..	2,274.78	411.60
240	Tennessee Gas Transmission Co.	6,162.50	84.00
	Income from bonds matured...	.....	221.43
	Total of the Draper Fund.....	**$ 107,766.64**	**$ 4,304.98**
	JOSEPH HEWETT FUND		
	U. S. Government Bonds		
$ 15,500	Treasury Bonds, 2¼%, 6-15-59/62	$ 15,355.47	$ 348.75
5,000	Savings Bonds, 2½%, 9-1-60...	5,000.00	125.00
2,000	Savings Bonds, 2½%, 7-1-61...	2,000.00	50.00
	Other Bonds		
15,000	Alabama Power Company, 3½%, 1-1-72.....	15,000.00	525.00
50,000	G.M.A.C. of Canada, 4¾%, 12-15-69.....	50,000.00	2,179.92
10,000	Northern Pacific RR., 4%, 1-1-97	10,000.00	400.00
10,000	Southern Pacific Company, 4½%, 5-1-81.....	10,000.00	450.00
12,000	Texas & New Orleans R.R., 3⅜%, 4-1-90.....	12,000.00	405.00

FUNDS SEPARATELY INVESTED *Schedule A-2 — continued*

Par Value or Shares		*Book Value*	*Net Income*
	JOSEPH HEWETT FUND — *continued*		
	Industrial Common Stocks		
440	American Can Company.....	$ 8,570.00	$ 880.00
200	E. I. du Pont de Nemours & Co.	8,271.55	1,300.00
900	General Electric Company.....	8,107.50	1,800.00
630	National Cash Register Company	5,195.75	756.00
400	Standard Oil Company (Indiana)	9,392.40	842.94
1,425	Standard Oil Company (N. J.).	12,672.31	3,147.60
300	Union Carbide Corporation....	6,944.20	1,080.00
	Public Utility Common Stocks		
300	Central Louisiana Electric Co...	11,625.00	.....
1,100	Transcontinental Gas Pipe Line Corporation.....	18,975.00	275.00
	Bank Common Stocks		
120	Bankers Trust Co., New York..	4,775.00	360.00
132	Guaranty Trust Co., New York.	5,078.70	528.00
	Insurance Common Stock		
230	St. Paul Fire & Marine Insurance Company.....	4,812.50	267.00
	Income from stocks and bonds sold or matured.....	.....	700.00
	Total of the Hewett Fund.....	**$ 223,775.38**	**$ 16,420.21**
	INDUSTRIAL MANAGEMENT RESEARCH FUND		
	Bonds		
$ 500,000	G.M.A.C., 3%, 11-1-59.....	$ 491,269.07	$ 15,000.00
200,000	G.M.A.C., 3%, 4-1-60.....	197,000.00	6,000.00
150,000	G.M.A.C., 2¾%, 7-15-64.....	145,875.00	4,125.00
200,000	G.M.A.C., 4%, 3-1-79.....	197,000.00	(88.88)
	Common Stocks		
40,000	General Motors Corporation...	682,539.69	80,000.00
	Income from bonds matured...	.....	2,026.98
	Total of Industrial Management Research Fund.....	**$1,713,683.76**	**$107,063.10**
	GUSTAV R. LINDBERG FUND		
400	General Drafting Co., 6% non-cum. Pfd. A.....	**$ 40,000.00**	**$ 1,200.00**

FUNDS SEPARATELY INVESTED *Schedule A-2 — continued*

Par Value or Shares		*Book Value*	*Net Income*
	MUSEUM OF SCIENCE COOPERATIVE FUND		
500	Textron, Inc.	**$ 12,343.75**	**$ 500.00**
	RICHARD LEE RUSSEL FUND		
	Mortgage		
	111 Bay State Road, Boston.	$ 2,000.00	$ 100.00
	Common Stocks		
20	General Electric Company.	930.00	40.00
50	General Public Utilities Corp.	1,732.75	100.00
40	Standard Oil Company (N. J.).	1,626.13	68.60
	Total of the Russel Fund.	**$ 6,288.88**	**$ 308.60**
	SOLAR ENERGY FUND		
	U. S. Government Bonds		
$ 25,000	Treasury Bonds, 2⅛%, 11-15-60	$ 25,000.00	$ 531.25
	Common Stocks		
30	Amerada Petroleum Company.	2,848.13	.....
5,000	Godfrey L. Cabot, Inc.	647,700.00	38,204.51
80	El Paso Natural Gas Co.	2,570.00	26.00
1,950	General Electric Company.	32,468.22	3,900.00
20	Gulf Oil Corporation.	2,330.00	12.50
324	Mission Corporation.	6,291.00	495.21
	Income from bonds and stocks matured and sold.	.....	1,645.44
	Total of the Solar Energy Fund.	**$ 719,207.35**	**$ 44,814.91**
	TECHNOLOGY LOAN FUND		
	U. S. Government Bonds		
$ 96,000	TreasuryBonds,2¼%,6-15-62/59	$ 96,000.00	$ 2,160.00
50,000	Savings Bonds, 2.76%, 7-1-66.	50,000.00	1,380.00
100,000	Savings Bonds, 2½%, 2-1-60.	100,000.00	2,500.00
	Other Bonds		
35,000	American Tel. & Tel. Co., 2¾%, 8-1-80.	35,000.00	962.50
15,000	Pacific Gas & Electric Company, 3%, 6-1-74.	15,000.00	450.00

FUNDS SEPARATELY INVESTED *Schedule A-2 — continued*

Par Value or Shares		*Book Value*	*Net Income*
	TECHNOLOGY LOAN FUND — *continued*		
	Industrial Common Stocks		
1,980	American Can Company.....	$ 40,814.83	$ 3,960.00
2,000	Burroughs Corporation.....	39,049.69	2,000.00
800	E. I. du Pont de Nemours & Co.	29,304.00	5,200.00
3,000	General Electric Company.....	25,813.25	6,000.00
1,614	Gulf Oil Corporation.....	32,786.97	3,938.76
1,593	Monsanto Chemical Company..	46,388.16	1,577.00
2,192	National Cash Register Company	19,168.26	2,630.40
1,050	Pittsburgh Plate Glass Company	53,780.85	2,887.50
1,500	Procter & Gamble Company...	29,511.45	3,000.00
1,375	Socony-Mobil Oil Company...	49,843.96	3,437.50
3,858	Standard Oil Company (N. J.).	24,261.62	8,680.50
1,200	Union Carbide Corporation....	27,726.00	4,320.00
	Public Utility Common Stocks		
2,250	Public Service Co. of Indiana..	61,233.06	4,500.00
	Bank Common Stocks		
1,302	First Nat'l City Bank of New York	46,023.19	3,906.00
1,062	Guaranty Trust Company, New York.....	50,333.82	4,248.00
	Insurance Common Stocks		
835	Hartford Fire Insurance Co....	44,879.08	2,505.00
322	St. Paul Fire & Marine Insurance Company.....	6,737.50	373.80
	Income from securities matured or sold.....	.....	5,983.33
	Total of Technology Loan Fund	**$ 923,655.69**	**$ 76,600.29**
	JAMES E. TURNER FUND		
$ 2,500	Meadville Community Hotel, 4% Due 7-1-86.....	**$ 2,500.00**	.....
	WAYNE FUND		
22	International Paper Company..	**$ 2,047.41**	**$ 64.97**
	H. K. WEBSTER COMPANY FUND		
250	H. K. Webster Co. 5% Pfd.....	**$ 25,000.00**	**$ 1,250.00**
	JONATHAN WHITNEY FUND		
	U. S. Government Bonds		
$ 90,000	Cert. of Indebt. C, 4%, 8-1-58..	$ 90,000.00	$ 1,800.00
100,000	Treasury Bonds, 2⅝%, 2-15-65.	100,000.00	.....
50,000	Savings Bonds, 2.76%, 7-1-66..	50,000.00	1,380.00

FUNDS SEPARATELY INVESTED *Schedule A-2 — continued*

Par Value or Shares		*Book Value*	*Net Income*
	JONATHAN WHITNEY FUND — *continued*		
	Other Bonds		
$ 40,000	American Tel. & Tel. Co. Deb., 3¼%, 9-15-84	$ 40,600.00	$ 1,200.00
40,000	G.M.A.C. of Canada, 4¾%, 12-15-69	40,200.00	1,743.94
40,000	Pacific Gas & Electric Company, 3%, 6-1-74	40,000.00	1,200.00
	Industrial Common Stocks		
400	E. I. du Pont de Nemours & Co.	15,279.10	2,600.00
1,500	General Electric Company	13,188.05	3,000.00
400	Inland Steel Company	16,120.12	1,800.00
968	International Paper Company	14,926.51	2,881.63
500	Socony Mobil Oil Company	24,082.11	500.00
1,997	Standard Oil Company (N. J.)	15,174.41	4,418.50
	Public Utility Common Stocks		
1,200	Idaho Power Company	49,071.00	.....
1,200	Northern Indiana Public Service Company	52,200.00	.....
1,600	Southern Company	50,516.37	.....
	Bank and Insurance Common Stocks		
410	Bankers Trust Company, N. Y.	18,937.50	1,230.00
748	Boston Insurance Company	19,145.78	1,346.40
270	First National Bank of Boston	11,465.90	904.50
468	First Nat'l. City Bank of New York	20,567.75	1,404.00
396	Guaranty Trust Company, N. Y.	18,087.30	1,584.00
	Income from bonds and stocks matured and sold	.....	5,575.39
	Total of the Whitney Fund	**$ 699,561.90**	**$ 34,568.36**
	GEORGE S. WITMER FUND		
	U. S. Government Bonds		
$ 4,000	Savings Bonds, 2½%, 9-1-59	$ 4,000.00	$ 100.00
4,000	Savings Bonds, 2½%, 9-1-60	4,000.00	100.00
4,000	Savings Bonds, 2½%, 7-1-61	4,000.00	100.00
	Other Bonds		
5,000	Am. Tel. & Tel. Co., 2¾%, 2-1-71	4,949.55	137.50
5,000	G.M.A.C. of Canada, 4¾%, 12-15-69	5,000.00	242.99
5,000	Northern Pacific Railway, 4%, 1-1-97	4,903.79	200.00
4,000	Southern Pacific Company, 4½%, 5-1-81	3,942.68	180.00

FUNDS SEPARATELY INVESTED *Schedule A-2 — continued*

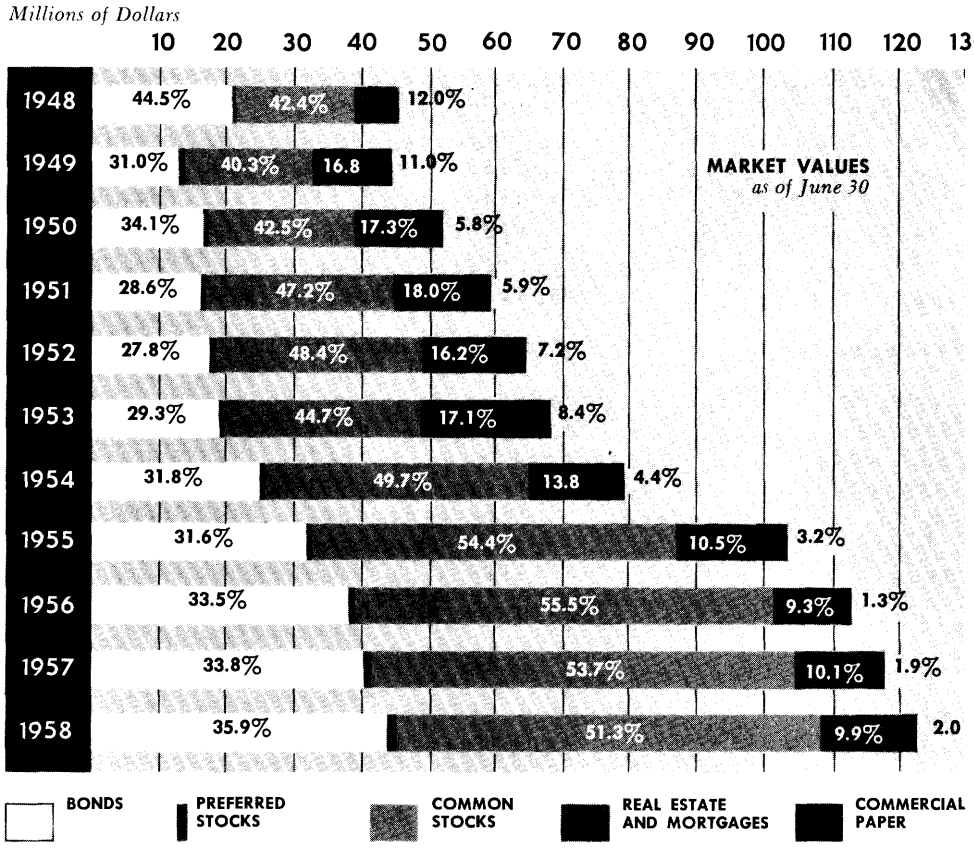
Par Value or Shares		*Book Value*	*Net Income*
	GEORGE S. WITMER FUND — *continued*		
	Industrial Common Stocks		
200	American Home Products Corp.	$ 5,468.00	$ 630.00
210	General Electric Company.....	3,235.75	420.00
285	General Motors Corporation...	2,890.86	570.00
210	Minneapolis-Honeywell Regulator Company.....	6,344.69	367.50
100	Parke, Davis & Company.....	4,412.50	295.00
110	Shell Oil Company.....	5,928.54	220.00
138	Socony-Mobil Oil Company, Inc.	6,761.18	345.00
752	Sperry Rand Corporation.....	3,930.88	601.60
310	Standard Oil Company (N. J.).	3,124.08	686.00
100	Union Carbide Corporation....	2,713.10	360.00
	Public Utility Common Stocks		
155	American Electric Power Co....	5,501.66	238.76
150	Commonwealth Edison Company	4,388.57	300.00
214	General Public Utilities Corp..	7,398.00	428.00
269	Middle South Utilities Company	3,241.58	457.31
100	Niagara Mohawk Power Corp..	2,850.00	135.00
200	Pacific Gas & Electric Company	7,648.00	456.00
100	Pacific Lighting Corporation...	3,262.50	150.00
300	United Gas Corporation.....	2,125.01	450.00
	Railroad Common Stocks		
225	Denver & Rio Grande Western Railroad.....	4,500.00	562.52
	Bank Common Stocks		
65	Bankers Trust Company, N. Y..	3,071.50	195.00
132	Guaranty Trust Company, N. Y.	5,920.20	528.00
102	Irving Trust Company, N. Y....	3,175.00	80.80
	Insurance Common Stocks		
138	St. Paul Fire & Marine Insurance Co.....	2,887.50	160.20
	Other Common Stocks		
100	C.I.T. Financial Corporation...	3,300.00	240.00
	Mortgage		
	539 South Atlantic Ave., Ormond Beach, Florida.....	16,377.08	842.11
	Total of the Witmer Fund.....	**$ 151,252.20**	**$ 10,779.29**
	Total of funds separately invested	**$4,765,594.35** (Schedule A)	**$299,644.86**

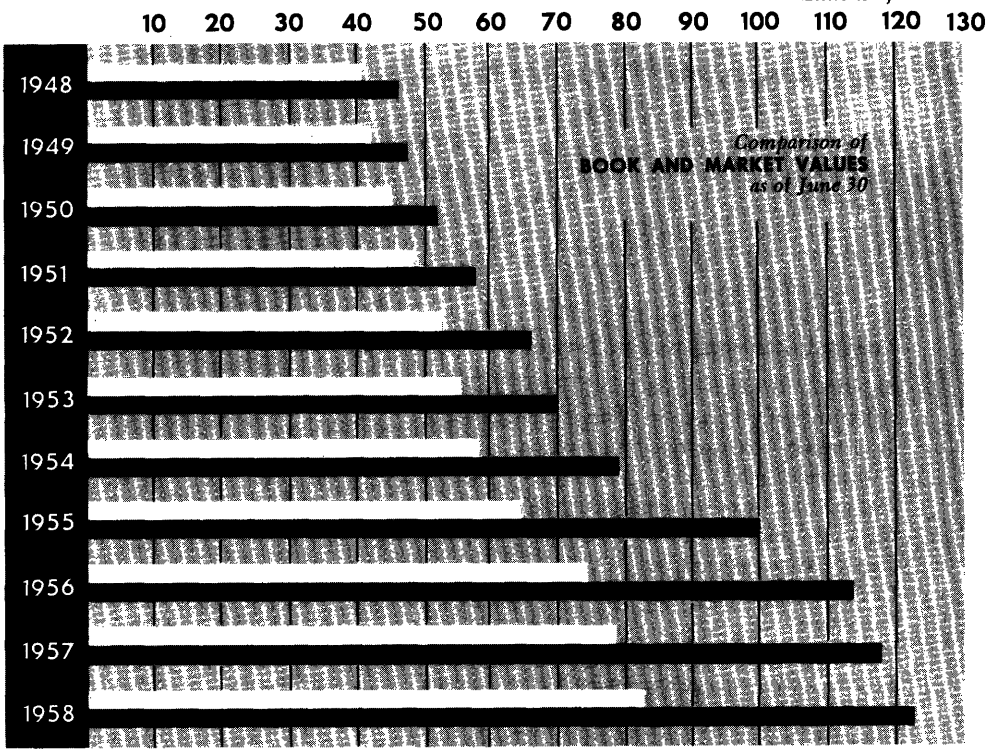
SUMMARY OF INVESTMENTS — JUNE 30, 1958

	Book Value	*Market Value*		*Net Income*	
		Amount	*Per Cent*	*Amount*	*Per Cent*
GENERAL INVESTMENTS					
Bonds					
U. S. Government	$14,255,160	$ 14,388,282	11.8	370,566	8.7
Canadian	2,231,727	2,261,170	1.8	92,032	2.2
Industrial	5,376,999	5,480,946	4.5	186,119	4.4
Public utility	5,978,680	5,868,825	4.8	209,044	4.9
Common carrier	2,646,225	2,724,630	2.2	122,298	2.9
Financial	13,267,988	13,145,432	10.8	461,143	10.8
Other	2,100	.....	....	2	....
Total	**$43,758,879**	**$ 43,869,285**	**35.9**	**$1,441,204**	**33.9**
Preferred Stocks	**$ 1,050,128**	**$ 1,052,505**	**0.9**	**36,746**	**0.9**
Common Stocks					
Industrial	$15,456,441	$ 48,681,072	39.8	1,773,079	41.7
Public utility	4,191,051	7,267,278	5.9	259,125	6.1
Railroad	262,391	547,646	0.4	36,470	0.9
Bank	1,553,022	2,385,956	2.0	109,994	2.6
Insurance	798,788	2,529,013	2.1	74,017	1.7
Other	742,173	1,289,952	1.1	50,017	1.2
Total	**$23,003,866**	**$ 62,700,917**	**51.3**	**$2,302,702**	**54.2**
Mortgage Notes	**$ 79,895**	**79,895**	**0.1**	**4,135**	**0.1**
Real Estate					
For Institute use	$ 5,665,680	$ 5,665,680[1]	4.6	172,929	4.1
Other property	6,341,513	6,341,513[1]	5.2	211,738	5.0
Total	**$12,007,193**	**$ 12,007,193**	**9.8**	**$ 384,667**	**9.1**
Commercial paper	**$ 2,471,260**	**$ 2,471,260**	**2.0**	**$ 78,898**	**1.8**
Total general investments	**$82,371,221**	**$122,181,055**	**100.0**	**$4,248,352**	**100.0**
OTHER INVESTMENTS					
Separately invested funds	$ 4,765,594	$ 7,839,115		$ 299,645	
Students' notes receivable	2,129,889	2,129,889		†	
Total investments	**$89,266,704**	**$132,150,059**		**$4,547,997**	
Less: Temporary investment of general purpose cash	$ 892,010				
Investments (Schedule A)	**$88,374,694**				

[1] Book value used in lieu of market appraisal. † Interest credited directly to student loan funds.

GENERAL INVESTMENTS, 1948-1958





INCOME ON THE GENERAL INVESTMENTS, 1948-1958

	Income	*Per cent yield on market value*[1]	*Per cent yield on book value*[1]
1948	$1,492,068	3.66%	4.09%
1949	1,656,903	3.83	4.19
1950	1,802,440	3.82	4.21
1951	2,362,941	4.18	4.86
1952	2,411,222	3.82	4.69
1953	2,507,522	3.81	4.76
1954	2,681,229	3.69	4.78
1955	3,007,868	3.59	5.14
1956	3,732,597	3.49	5.38
1957	3,961,964	3.42	5.22
1958	4,248,352	3.54	5.27

[1] Based on the average of the book or market values at the beginning and end of each year.

RESEARCH CONTRACTS

Schedule B-3

	Lincoln Laboratory	*Other government research*	*Industrial and other sponsors*	*Total*
DIRECT COSTS CHARGED TO RESEARCH CONTRACTS				
Salaries and wages	$13,882,800	$12,166,012	$1,281,566	$27,330,378
Materials and services	12,516,947	5,885,057	1,019,339	19,421,343
Subcontracts	1,924,211	2,789,072	43,309	4,756,592
Travel	713,187	462,906	110,228	1,286,321
	$29,037,145	$21,303,047	$2,454,442	$52,794,634

CONTRACT ADMINISTRATION EXPENSES		
Salaries and wages		$ 659,706
Allowances for vacations of hourly employees		373,000
Allowances for extended sick leave, industrial accidents and severance pay		68,625
Research services — Computation Center		65,868
Materials and services		65,726
Depreciation on equipment		62,959
Occupational medical service		61,979
Insurance		31,994
Unclaimed contract expenses		31,575
Professional meetings expenses		26,745
Travel		16,953
Other		83,949
		$ 1,549,079
Total direct costs and expenses (Schedule B)		**$54,343,713**

ALLOWANCES FOR INDIRECT EXPENSES		
Appropriations added to invested funds (Schedule A-8):		
Reserve for use of facilities	$642,312	
Industrial fund	125,812	
Investment income for use of funds	25,700	
Research reserve	200,000	
Provision for variation of allowances	300,000	$ 1,293,824
General and administration and plant operation expenses		6,211,252
Total contract revenues		**$61,848,789** (Schedule B)

Dean of Students

Most students entering M.I.T. believe it to be the finest scientific and engineering institution in the world. Quite naturally they tend to have over-romantic ideas of the processes of scientific education and of life at a scientific institution. They are very proud of having come to the Institute, and I believe the great majority of them are intensely loyal to it, however vocal their criticisms may be during their undergraduate days. Furthermore, they have a very strong desire to feel that they belong to the Institute and to participate in its activities. In addition, they soon acquire an intense pride in their independence at the Institute and in being treated as mature young men rather than as boys.

Difficulties of student morale at the Institute are influenced by all these factors, especially by the intensity of the students' desire to have the school conform to their ideal. Their criticisms are usually an expression of this.

With these features in mind, the most notable efforts of the Dean's Office during the past year have been aimed at clarifying the terms of student participation in Institute life and in improving that participation in order to enrich student life and to improve student morale.

The chief step taken towards this end has been the decision to establish a system of housemasters in the dormitories. The proposed system is intended to improve the educational opportunities of each dormitory resident. We hope that each housemaster and his staff will be a focus for loyalty and will create a living unit which is stimulating and rewarding.

When faculty residents were placed in the various dormitories in 1950, many students seemed suspicious — without justification — that the Institute, through the Dean's Office, was attempting to reduce the independence so prized by the students by reducing the degree to which they govern themselves. The housemaster proposal would seem again to bring in conflict the student's desire to belong and his desire for independence. During the past year it was thoroughly discussed with the students. It is noteworthy that the residents of Burton House, where the first housemaster is to be installed this fall, became quite enthusiastic for the plan. Thus their desire to participate proved stronger than their fears of loss of independence. This indicates a great improvement in their understanding of Institute motives over the previous years.

Professor Howard R. Bartlett, Head of the Department of Humanities, has accepted the post of Master of the House at Burton House. Assistant Professor Theodore R. Madden of the Department of Geology and Geophysics and Assistant Professor George O. Totten of the Department of Economics and Social Science have agreed to be his Senior Tutors. Six graduate students will also live in the House and act as Tutors in Residence. Remodelling necessitated by the program is being done this summer.

All of us are confident that Professor Bartlett, his staff, and the students in the House will be able to develop a pattern of living which will greatly enrich the residents' lives at the Institute. If the experiment proves as successful as we hope, it will be extended to the other dormitories in future years.

Extensive discussions also took place between the Dean of Students and the Institute Committee of the Undergraduate Association, clarifying the position of student government in the Institute and its relation to the operation of the Dean's Office. A realistic understanding of the functions of student government was clearly demonstrated by the students. Furthermore, the students came to realize, I believe, that the Dean's Office must retain authority on all matters which affect the Institute's educational policies and the students' welfare, but that at the same time the office is in fact desirous of having maximum student participation and independence in managing student affairs.

A third development during the year was a complete review of the parietal rules governing the dormitories. A student committee, under the able leadership of Gerald Stephenson '59, made a study of the existing rules and presented recommendations to the

Dean of Students. As a result, the Dean established a new set of rules which provide for some changes of hours and require a system of registration of guests. These are to be put in effect in September, 1958.

These changes, all achieved through cooperation with students, have gone a long way toward increasing the students' sense of participation in the affairs of the Institute.

At the beginning of the school year, the Dean of Students appointed a committee of faculty and parents of students, under the chairmanship of Professor Samuel Goldblith of the Department of Food Technology, to eat occasional meals in all of the Institute's dining halls. The committee made valuable recommendations and will be continued.

Through decisions taken in the early summer of 1957, plans for the termination of housing for married students in Westgate West and Westgate came into operation in the spring. No additional assignments to these units had been made for a year, and the normal attrition had markedly reduced the population. It was therefore possible to begin the demolition of a number of the temporary structures which had been erected in 1945 and 1946 under waiver of the provisions of the Building Code by the City of Cambridge, the waiver having been extended by the city a number of times with final termination date set for April 1, 1959. At its conclusion, the project will have afforded homes to 3,261 student families. The cooperation of the Westgate Council in consolidating vacancies to simplify the problem of demolition has been most helpful.

Freshman Advisory Council

During the past year the Freshman Advisory Council continued to modify its program and innovate changes in its operations, as experience suggested ways in which it could be more effective in its program of counseling freshmen. Each of the seventy advisers (representing every academic department of the Institute) was assigned twelve to fourteen freshmen. He met them for the first time at a group meeting during Freshman Weekend, then had an individual conference with each, and finally took his group to dinner during the first week of the term.

New members of the Council were invited to a luncheon at the Faculty Club in May. William Perry of the Bureau of Study Council at Harvard discussed counseling and presented a brief and interesting series of recordings, taken by the Bureau, of comments

made by students in their freshman year at Harvard. Dr. Lemoyne White, chief psychiatrist at the Institute, spoke at another meeting.

To help new members, a "Freshman Advisory Council Handbook" was published with the help of Professor Charles N. Satterfield, Chairman of the Council. It contains suggestions concerning counseling in general and specific information to help answer the questions most frequently raised by freshmen. An enlarged and revised edition is in preparation for issuance in the fall of 1958.

As the Executive Officer of the Council, Professor Prescott A. Smith, for the third year, took responsibility for the Course Orientation Program. Following a morning convocation, for which first-year classes were cancelled, various departments arranged open houses, smokers, exhibits, and tours. Professor Peter Eagleson has consented to relieve Professor Smith this year.

The Orientation Program can be strengthened in future years, it seems to me, by improving the opening meeting and perhaps seeking the cooperation of the Placement Bureau in providing speakers or exhibits from industry. Few freshmen have any realization of career opportunities and of the problems involved in choosing a professional field. So often students seem to consider a choice of Course to be final, when in reality it is but the beginning. We may be able to change the emphasis from specific Courses by furnishing more information about scientific and engineering fields and their place in the modern world.

At the end of the second term, members of the Freshman Advisory Council who had advisees in academic difficulty met for the first time to discuss each case and prepare recommendations before the usual combined meeting with the Committee on Academic Performance. This preliminary meeting will be repeated in the future, as it clearly allowed more time for free discussion and thoughtful consideration of borderline cases.

Women Students

For the first time, the women's dormitory at 120 Bay State Road was operated as a freshman house. Only fourteen women students were admitted as freshmen, and all resided at the house with three upperclass counselors and a housemother.

The physical condition of the house was considerably improved. The housemother's quarters were redecorated and refurnished. Mrs. Alvord — who had been housemother of "120" for

many years — retired, and Mrs. Helen Cahill replaced her last September.

The upperclass counselors and four of the freshmen formed a House Council. The constitution and house policies were revised with the excellent help of the students, and the new policies went into effect at the beginning of the year. Definite closing hours were put into practice for the first time in many years.

In addition to 120 Bay State, a section of Bexley Hall was opened to women students. This facility provided living quarters for thirty-three upperclass and graduate women. A faculty resident and his wife, Professor and Mrs. William F. Bottiglia of the Department of Modern Languages, occupied an apartment on the first floor. A House Council (with a representative from each floor and one at large) was elected by the residents. The Council set up a constitution and policies which were later revised and adopted by all members of the house.

This experiment in living has been accepted most happily by the women students themselves and seems to those of us most closely concerned to be an admirable solution, for the present, to the basic problems of housing women students.

Miss Ruth L. Bean, Assistant Dean of Students in charge of women students, reports, "In some ways this year has meant progress with respect to women students and their place in the community. Socially, they adjust quite easily and well to the environment; but their academic records do not compare at all favorably with those of the men. Once more I should like to recommend strongly some thoughtful study and research on the whole subject of women at M.I.T. We have much to learn before we should invest money and facilities in the special education of women at the Institute. Personally, I should like very much to see a women's college here, dedicated to scholarly pursuits for superior women, but I realize that we are not ready to attempt such a project without careful study."

Counseling

To say that counseling consists of what any person says or does (or does not say or do) to help a student achieve meaning, purpose, and a true sense of accomplishment, may be too broad a definition. Good counseling is, perhaps, more of an attitude than an activity, a readiness to see things not only as they are but also as the student feels them to be.

The front line of counseling continues to be those members of the faculty who serve as advisers under the Freshman Advisory Council or as Registration Officers in the different departments. Dean William Speer, in charge of counseling, and other members of the Dean's staff share in this responsibility at the invitation of either a student or a faculty member. The members of the psychiatric staff of the Medical Department are also available at all times when more intensive counseling is called for.

At the end of the fall term, the faculty accepted the recommendation of the Committee on Academic Performance that a special adviser be appointed for all freshmen whose low academic performance during the first term raised the question of whether continuing at the Institute would be in their best interest. M. Bryce Leggett, a member of the Freshman Advisory Council, was appointed by the President, and each student was required to consult with Mr. Leggett at regular intervals. An individual academic schedule was worked out for each and the terms of his probationary status set. Parents were informed of the purposes and the terms of the probation by a personal letter.

The procedure gave the 67 students involved more individual attention than in the past and permitted greater freedom in program planning. Ten students prepared programs in anticipation of voluntary withdrawal to attend other institutions and thus were afforded a transition that they otherwise could not have had. The following paragraph is taken from Mr. Leggett's report on the experiment:

"It is my opinion that some benefit came to some students from this program; clearly, we were able to make the transition into or away from the Institute more meaningful and positive for some of them. I believe that some parents appreciated the fact that M.I.T. did know and was concerned about their sons. Tangible proof of this may be a long time in coming, if it ever does, especially from those who have left. (There are already a few letters from such students which suggest that they do understand why they will not be back and are still glad they came.) Not all — perhaps not more than half — of those who will be permitted to continue will earn their degrees. Some will be disqualified, some will not return for the next term."

Kresge Auditorium

It is not feasible to detail here the many and varied cultural programs of excellence that have been offered in Kresge Auditorium.

A rough measure of the growing use of the building can be obtained from the number of formally scheduled events. The totals from July 1, 1957, to June 30, 1958, were: 366 in the large auditorium, 277 in the Little Theatre, and 407 in the two large rehearsal rooms — a total of 1,050.

These events have been sponsored in the main by the Department of Humanities; the several musical clubs, under the direction of Professor Klaus Liepmann and John Corley; the Drama Shop, under the direction of Joseph Everingham; the Community Players; the M.I.T. Matrons; the M.I.T. Dames; the religious groups; the Lecture Series Committee; and Tech Show. The programs increasingly have afforded at-home opportunities for students and staff to attend films, lectures, and musical and theatrical programs and — in the case of music and drama — to participate in their planning and production. Judged simply on the basis of attendance, these programs have been unusually successful and have drawn support from all segments of the Institute family.

Although first priority in scheduling is given to culturally related programs, it has been possible to accommodate several technical conferences and seminars and a few non-Institute functions of a type consistent with the aims and objectives of the Institute.

James Murphy and his staff, through personal devotion, understanding, and warm human regard, have infused Kresge Auditorium, the Chapel, and 317 Memorial Drive with a spirit magnificently appropriate to the meaning and purpose of these structures.

Religious Activities

The acquisition of new quarters for the religious counselors at 317 Memorial Drive is a significant development in the religious program. This attractive house, located in the dormitory area adjacent to the Chapel, has been a decisive factor in increasing the counselors' contact with students. The presence in the building of seminar facilities has given a physical unity to the counseling-seminar program; in a similar manner, the location of the counselors' secretaries within the building has resulted in a more unified working arrangement. The Technology Christian Advisory Board contributed a total of $8,000 to provide suitable furnishings for this new building.

Reverend Robert C. Holtzapple, Jr., Reverend J. Edward Nugent, and Rabbi Herman Pollack, as full-time counselors, have been associated together as guests of the Institute for six years. These men have met weekly for luncheon with members of the

faculty, staff, and administration, and they are thoroughly at home at the Institute. The Reverend Myron Bloy, Episcopalian, will join them full-time as of August 15, 1958.

Representatives of the other religious traditions, approximately ten in number, who also conduct religious services and hold office hours and yet give only a partial portion of their time to student work, have met together and with the full-time men once a month.

In addition to the formal religious services in the Chapel, the Chapel is being used increasingly by students for personal meditation and prayer. Because of the frequency of this use, it has been necessary this year to restrict the use of the Chapel organ for practice by students to sixteen hours a week. During the year there were 662 religious services and 430 other scheduled events, including organ practices — a total of 1,092.

The Student Center

The Student Center Committee held four full committee meetings during the year, and there were many meetings of sub-committees, including the excellent Student Center Committee of the Institute Committee, under the able leadership of Richard Solo '58 and John Beynon '59.

The formal report of the Committee was transmitted in June to the Dean for submission to the Long Range Planning Committee. It included a general guide to the philosophy of the building and the activities it should house, a description of possible functional relationships, and priority lists of preliminary space requirements.

Student Government and Activities

Student government at the moment is in transition toward a more creative program focusing around the positive aspects of student life and traditions. This transition has not been easy. Nevertheless, it is my judgment that the Institute Committee of the Undergraduate Association realizes that it must have positive programs of substance if it is to maintain status with its own constituents.

During the year the Institute Committee, believing that its effectiveness could be greatly increased, examined its organization, concluded that it was too large a body for maximum efficiency, and voted to reduce its membership from twenty-one to thirteen.

A Freshman Study, initiated and partly financed by the student body, is one indication of positive program planning during the past year. This study is being made by Dr. Leila Sussmann under the direction of David B. Gleicher of the Center for International Studies. As conceived by the Institute Committee, the study is intended to explore the changes in attitudes which occur in freshmen during their first year and to isolate the factors causing these changes. The results of the study will not be available until the end of 1958. It is, however, a remarkable undertaking on the part of student government.

The musical organizations had an exceptionally good year and look forward to more occasions like the very delightful joint concert with Vassar, sponsored by the Glee Club. The Concert Band made several recordings of exceptional merit, as did the Logarythms.

Recognition this year of the exceptional caliber of the Lecture Series Committee program by the award of a Compton Prize is a general indication of the quality of leadership now being given to most of our student activities.

The Activities Development Board, created a year ago under the chairmanship of Associate Professor Robert Mann of the Department of Mechanical Engineering, has been exceedingly helpful in tidying up the financial relationships between the Institute and Institute Committee, with the indirect result that the affairs of the Finance Board of the Institute Committee are in excellent condition.

The Activities Audit Committee, with Professor Thomas M. Hill of the School of Industrial Management as chairman, has added a needed audit on student activity finances. It is agreeably accepted as a source of recommendations.

This past year was the first full year in which commuters have had the use of quarters on the second floor of Walker Memorial. These facilities have made more of an impression on the entering freshmen than has been the case of other facilities in former years. Consequently, a larger percentage of freshmen have related themselves with the interests and programs of the Commuters Association than has been the case previously.

At the moment, an unresolved problem is the relationship between the structure of the 5:15 Club and the Commuters Association. This question, I believe, can be resolved during the coming year.

JOHN T. RULE

DIRECTOR OF ATHLETICS

Through careful review by the faculty, the Athletic Board, and the student Athletic Association, M.I.T.'s athletic program continues to develop in a manner consistent with the Institute's educational goals. Our purpose remains unchanged: to promote recreational opportunities and to teach new skills in the physical education classes, as well as through intercollegiate sports.

Members of the athletic staff have been selected for their potential contribution to recreation as a part of education. New members come to us with the understanding that they are teachers and will be judged on their ability to work with individuals as well as groups. The staff seeks to know each individual student, his capabilities and his limitations, in the light of his academic achievement. The contributions made by undergraduates in their extra-class life have frequently been summarized in brief statements to deans, department heads, and registration officers.

Staff Changes

Arthur E. Farnham, Jr. joined the staff in September as Assistant Track Coach, coming to the Institute from Springfield College and Tarrytown High School. His appointment as Head Track Coach was announced in May, at a testimonial dinner for Oscar F. Hedlund, retiring Track Coach.

Frank S. DuBois, Jr., who in 1956–57 divided his time between the Student Personnel Office and coaching, this year assumed full-time the responsibilities of Crew Coach. His personal knowledge of students and their individual problems has been of immeasurable help to members of the faculty and the Dean's Office.

Charles Batterman helped to establish M.I.T.'s soccer team as the third finest in the United States. His enthusiasm carried over to the freshman swimming team and the freshman lacrosse team. Mr. Batterman's new responsibility will be that of Head Swimming Coach, to succeed Gordon H. Smith. Mr. Smith has taken on the responsibility of Director of the Physical Education Swimming Program — the largest single athletic program at M.I.T.

At the request of the student Athletic Association and the Athletic Board, John S. Merriman was selected in May, 1958, as Adviser to Intramurals. As former Director of Athletics at the U. S. Coast Guard Academy, Mr. Merriman brings a wealth of background from an institution in which he established an athletic policy similar to that at M.I.T.

Intercollegiate Participation

Participation in intercollegiate sports was shared in by 840 undergraduates. Of this number, 22 received awards for cross country and 41 for soccer in the fall. During the winter, 36 received awards in swimming, 13 in pistol, 35 in hockey, 19 in wrestling, 8 in skiing, 31 in basketball, 21 in squash, 21 in rifle, 13 in weightlifting, and 27 in fencing. Of the spring participants, 10 men received awards in golf, 54 in heavyweight crew, 44 in lightweight crew, 43 in baseball, 39 in track, 20 in sailing, 48 in lacrosse, and 25 in tennis.

The M.I.T. "international" intercollegiate soccer team (thirteen different nations were represented) set a new record for M.I.T. in competition. The team won seven games, tied one, and lost one. The U. S. State Department thought so well of the efforts of this squad that each individual was interviewed and the interview rebroadcast in his native tongue by the Voice of America. The lacrosse team also established a new record in competition by winning the U. S. Championship in the Taylor Division, with a record of nine contests won and two lost.

Huber R. Warner '58 was the recipient of the Compton Award for his contribution as one of the outstanding soccer players and as co-captain of lacrosse. In addition to his athletic accomplishments, Mr. Warner maintained a superior average in his academic work.

Intramural Participation

With a program of fourteen different activities providing organized recreation for approximately 2,600 participants, the intramural program had a successful year. Some sports were curtailed due to lack of space; but with added space available for the coming year, the intramural program can be expanded to permit greater participation. The aim of this program is to provide diversified athletic activities for students not of varsity calibre. The steady increase in interest is a healthy indication of its value.

Physical Education Program

The Athletic Board continued its study and review of the required physical education program during the first semester. At the December faculty meeting, the Athletic Board presented two recommendations on the physical education requirement:

1. That the present two-year limit for the completion of the physical education requirement should be retained.

2. That the Director of Athletics or the Director of Physical Education should be permitted to grant waivers under exceptional circumstances, with the concurrence of the Dean of Students.

The faculty voted to accept the recommendations of the Athletic Board.

During the school year, there were 3,406 individual student registrations in 26 physical education class activities — carry-over activities that may be enjoyed in college and in later life. Sailing, tennis, golf, swimming, bowling, and skating led in popularity. The tennis program was enhanced by the introduction of beginning and intermediate levels of tennis instruction.

Approximately 54 per cent of the Class of 1961 completed the physical education requirement during the freshman year, the highest percentage since the inauguration of the two-year physical education program.

The policy established by the Faculty Committee on Second, Third, and Fourth Year Records of referring to the Dean's Office all students who are delinquent in fulfilling their athletic requirement has met with considerable success.

With the completion of the new David Flett du Pont Athletic Center scheduled for the spring of 1959, the facilities for physical recreation activities will soon be greatly increased.

Miscellaneous

The M.I.T. Athletic Board, under the chairmanship of Professor Thomas F. Jones, Jr., has taken an active part in policy decisions throughout the year. Problems involving the final design of the du Pont Athletic Center, the extent of the intercollegiate program, and the organization of the sailing program have all come to the attention of this Board. For the second year, the sharing of policy decisions with the four students, three faculty, and three alumni has provided a cross-section of judgment and has been most worthwhile. Thanks should be noted here for the services of the three alumni — Arthur L. Bryant, Jr., Stewart Edgerly, Jr., and Chenery Salmon — who have given so generously of their time.

On May 16, a testimonial dinner was given for Oscar F. Hedlund to express the gratitude of the Institute community for thirty-five years of service rendered as Head Track Coach at M.I.T. Approximately 150 alumni and students attended the dinner, and more than 250 sent letters expressing their sincere appreciation for Mr. Hedlund's contribution.

The Athletic Association, under the leadership of Daniel J. Holland '58 and Paul H. Ekberg '59, has continued to provide thoughtful cooperation with the Athletic Board and the Director of Athletics.

The acquisition of the Cambridge Armory added needed indoor facilities in a very generous form. The old drill floor, reconditioned, provides two tennis courts, eight badminton courts, and four volleyball courts. This has served to increase the opportunity for intramurals as well as intercollegiate athletics.

With the completion of the David Flett du Pont Tennis Courts, Edward A. Crocker, coach of tennis and squash, has the opportunity to work with approximately one hundred boys interested in intercollegiate tennis. With the physical education class program and intramural competition, tennis has become one of the more popular activities on the M.I.T. campus. The thoughtful interest of several faculty members, particularly Professor Irving H. Bartlett as freshman tennis coach, has aided Mr. Crocker in his accomplishments for the year.

All Sports Day, planned by the Athletic Association, proved to be a worthy replacement for Field Day and gave a large cross-section of the undergraduate student body the opportunity for competition in swimming, track, soccer, rugby, and touch football. The contests were preceded by an all-Institute luncheon, with approximately 1,100 students and faculty in attendance.

Classes for faculty were made available to those interested. Golf instruction by John H. Burke, Jr., proved most popular. In addition, a faculty tennis tournament, skating classes for faculty children, and swimming classes created more demand than we could accommodate.

Unlike many other athletic directors in the United States, I can close this report by saying that we have again worked toward the improvement of recreational facilities and activities for students without an eye on the turnstiles as a means of financing the opportunities afforded. We are grateful for the cooperation of the many faculty members who served as team advisers and for the helpful planning and cooperation of Physical Plant, the Medical Department, the Registrar's Office, and the Dean of Students.

RICHARD L. BALCH

DIRECTOR OF STUDENT AID

New levels were reached during the academic year 1957–58 in the amount of student aid furnished to our undergraduate student body. The sum of financial assistance to undergraduates through scholarships, loans, and campus jobs totaled almost $1,600,000, 15 per cent above the recorded help for 1956–57. Nearly one-half (45 per cent) of the total is represented in scholarship awards of $710,530; the balance is made up of $397,087 in loans and $482,000 earned in campus jobs.

Scholarships

At the close of the fiscal year on June 30, 1958, the capital of the undergraduate scholarship funds totaled $5,425,000, showing an 8 per cent gain of almost $400,000, made up of more than twenty bequests and gifts during the fiscal year. New capital funds were established through bequests from Evert W. Freeman '20, Humphrey M. Haley '04, Bancroft Hill '11, William E. Stevens '98, Archer E. Wheeler '95, and George H. Rand, and through the gift of Gustaf R. Lindberg. Additional gifts to previously established permanent funds were made by Paul W. Litchfield '96 and John J. Wilson '29. Ten years ago the capital of these funds was $2,731,000; thus in a decade the capital has doubled and apparently kept pace with the tuition changes. Actually, however, in the past five years there has been an increase in the size of the undergraduate body so that the incremental gain in both capital and income per undergraduate has not kept abreast of tuition increases. In 1953 the capital funds for this purpose were $4,000,000, equivalent to $1,270 per undergraduate; currently this amount has risen to $1,480, an 18 per cent gain in this five-year period. Our need for augmenting our scholarship endowment funds continues to be urgent.

A review of the comparative statistics emphasizes the cumulative effect of the substantial financial support from seventy-six different sources outside the Institute, including the M.I.T. Alumni Fund, the Alfred P. Sloan Foundation, Inc., National Merit Scholarship Corporation, General Motors Corporation, Lockheed Leadership Fund, Procter & Gamble Company, and Union Carbide Corporation, as well as a number of other private companies, foundations, charitable organizations, and individuals. In addition to supplying funds for the scholar, a number of organizations make a contribution to the Institute "to help cover the cost of education"; $155,000 for this purpose was received during the year, a five-fold increase over the amount contributed three years ago.

While it is gratifying to report these increases in support of student aid from these outside sources, in the not-too-distant future we must expect a levelling off or even a regression in the amount of this assistance. One immediate cause is the change in the national economic picture; several organizations which have been affected by this change or are very sensitive to it have notified the Institute that they will not be able to continue their scholarship programs beyond a specified date and have asked that no scholars be selected after this year. The forecasted entrance of the federal government with funds for scholarships for higher education has begun to raise doubts in some areas as to the wisdom of continued support of this activity by private philanthropy.

Loan Funds

For the first time in the history of our student loan fund operations, the total loaned has passed the half million dollar mark. Loans totaling $510,919 were made to both graduates and undergraduates during the academic year; of this amount, $113,112 represents loans to 203 graduate students. During the year, 866 loan applications were received; of this number, 810 were presented to the Technology Loan Fund and 706, or 87 per cent, were acted on favorably, totaling $472,119. For 1956–57 the corresponding figures were 686, 614, 90 per cent, and $407,562. Fifty applicants were assisted from the George J. Mead Fund in the amount of $36,000; six others were helped from other student loan funds to the extent of $2,800, making a total of 762 loans granted for $510,919.

The Executive Committee of the Corporation has approved new terms for the Technology Loan Fund, which will become effective on July 1, 1958. The original terms adopted in 1930 have been in effect without alteration, except for the waiver of the collection of interest above 1 per cent per annum established in 1949. The current changes were made to provide the repayment schedule consonant with the current economy, to accelerate the rate of rotation of capital required for the fund, to insure the complete repayment (for maximum amount loaned) within a twenty-year period, and to have loans available to entering freshmen.

The new terms are:

1. The maximum loan in any one year shall not exceed tuition for a student for that year, except in unusual circumstances.
2. The total loaned to any one student shall not exceed four years' tuition.
3. Undergraduates who enter as transfer students, in general, shall complete one term of residence before they become eligible for loan consideration.

4. Recipients of loans will sign notes to be repaid at the rate of $300 annually (principal and interest) beginning six months after graduation or termination at the Institute. Increased payments will be required after a ten-year period, depending on the total loaned.
5. All loans will carry interest at one per cent per annum from the date of issue and during enrollment; on leaving the Institute the interest will be increased to two per cent per annum.
6. Notice will be given to all borrowers not in attendance that the interest rate will be increased from one to two per cent per annum on all unpaid and outstanding notes beginning January 1, 1959.
7. Entering freshmen will be eligible for assistance from the Loan Fund up to amounts less than full tuition.

Student Employment

The Manager of Student Personnel reports that during the twelve-month period of 1957–58, a total of 1,250 students were employed in various capacities. This represents a decrease in numbers of about 8 per cent over the previous year. However, the earnings increased by 20 per cent, to a total earned of $482,000.

Other Benefits

It has been customary to include in this report as a matter of record the number of students (graduate and undergraduate) who have received financial benefits due them under Public Law 550 for service in the military forces. A number of these veterans receive some supplemental assistance from the Institute. The following table summarizes the number who received funds directly from the Veterans Administration during the past year.

	Number receiving benefits	*Per cent of total registration*
First term 1957–58	393	6.3%
Second term 1957–58	361	6.2
Summer term 1958	108	6.7

Tuition Exchange Plan

Nineteen faculty children were certified to twenty-one colleges and universities as being eligible for benefits under this plan. Only four children were placed, representing 20 per cent success in placement. This is the lowest average of "exports" we have experienced since joining the plan five years ago.

The Institute quota for "imports" has never been filled, and we are able to accept every "import" that qualifies for admission to the Institute. This year, fourteen certifications were received;

Undergraduate Scholarships and Loans, 1956–58

	1957–58			*1956–57*		
	Number	*Awards*	*Total*	*Number*	*Awards*	*Total*
UNDERGRADUATE SCHOLARSHIPS						
From M.I.T. endowment funds:						
Freshman scholarships	144	$120,686.25		203	$164,255.00	
Other undergraduate scholarships	201	132,221.30	$252,907.55	315	206,981.00	$371,236.00
From outside sources:						
Freshman scholarships	142	159,816.00		88	102,180.00	
Other undergraduate scholarships	302	297,807.00	457,623.00	173	155,772.50	257,952.50
	789		**$710,530.55**	**779**		**$629,188.50**
UNDERGRADUATE LOANS						
Technology Loan Fund	521	$365,977.00		454	$317,317.00	
Mead Fund	39	29,210.00		57	39,435.00	
Other student loan funds	4	1,900.00	$397,087.00	5	1,500.00	$358,252.00
	1,174*		**$1,107,617.55**	**1,093***		**$987,440.50**

* This total is modified to allow for individuals receiving both scholarships and loans.

nine failed to qualify for entrance. Two of the five admitted changed their college plans after admission, making three new imports receiving this benefit in 1958–59.

A five-year summary of "export" and "import" totals is given in the following table.

Export	*Certified*	*Accepted in the Plan*	*Rejected in the Plan*
1954–59	99	31	69
Import	*Certified and Admitted*		
1954–59	26	23	0

Nine faculty children receiving full-tuition benefits attending the Institute as undergraduates are not included in this summary.

It is obvious that after five years' membership in the Tuition Exchange Plan the efficacy of this system as a faculty benefit has failed to materialize, and our continued membership in this plan should be most carefully weighed. It should also be noted that several colleges and universities have withdrawn from membership in this plan during the last year.

T. P. PITRÉ

Other Administrative Officers

VICE PRESIDENT

The beginning of the 1957–58 year found the country still in a period of sharp pressure to reduce the expenditures for government-sponsored research, especially in projects supported by Department of Defense funds. Then, in October, the dramatic event of the first Russian Sputnik ushered in the beginning of the end of the period — indeed, of an era. There followed some three months of considerable administrative confusion as the national defense program was recast and began to expand. Finally, our tally at the year's end showed a larger dollar volume of such work at M.I.T. than the total of the preceding year.

Research in Campus Laboratories

Dollar volume:

	1956–57	*1957–58*
Government	$10,592,351	$11,354,009
Industrial and foundations	1,908,326	2,434,575
Total	**$12,500,677**	**$13,788,584**

Personnel employed:

	June 30, 1957	*June 30, 1958*
D.S.R. staff	277	285
Academic staff devoting time to research projects	805	861
Supporting personnel (includes part-time help)	635	567
Total	**1,717**	**1,713**

Research in Defense Laboratories

	1956–57	*1957–58*
Dollar volume	**$43,069,574**	**$47,615,199**
Personnel employed:	*June 30, 1957*	*June 30, 1958*
Defense research staff	998	1,082
M.I.T. staff	15	30
Supporting personnel	1,976	2,002
Total	**2,989**	**3,114**

This unusually severe change of pace was taken in stride, more or less, as a concomitant of the times; but the attendant difficulties have pointedly emphasized the long-existent need for a greatly improved method of funding the government's sponsored research programs with universities. The amount of time, talent, and money that could be saved by a system of long-term funding, tuned to the nature and natural cycles of educational institutions, can hardly be exaggerated. If there is to continue an urgent need for academic contribution to national security research, then surely there is an equally urgent need for review of this problem by the government.

The larger numbers of academic staff devoting time this year to research projects in campus laboratories and participating in research in the defense laboratories together indicate the closer integration of such research into the faculty and the academic program of the Institute. A major organizational move during the year, designed to promote this trend, has been the cooperative effort of M.I.T. and the Department of Defense toward the formation of a new, independent, nonprofit corporation to undertake a major advisory role in the systems engineering of the country's air defenses. Much of this responsibility, relating to the electronic ground environment of air defense, has previously rested on the Lincoln Laboratory. One objective of this organizational move is to permit the Lincoln Laboratory to devote more of its time toward the sort of advanced research which fits most naturally and productively into the scheme of an educational institution.

Though the Acoustics Laboratory and the Dynamic Analysis and Control Laboratory were disbanded as administrative units during the year, several of the programs of research in these two laboratories have been continued as departmental projects; the other discontinued programs have been more than compensated for by an

increase in the number of smaller research projects sponsored throughout the departments of the Institute.

Instrumentation Laboratory

The Instrumentation Laboratory of the Department of Aeronautical Engineering is moving steadily into the "space age," accelerating its research and development work in guidance and control systems for ballistic missiles and satellites. The Laboratory has a major role in the development of guidance systems both for Air Force ballistic missiles and for the Navy's Polaris missile, designed for launching from ships and submarines.

In addition, there is a vigorous basic research program directed toward future needs in this field. A wide range of astronautical navigation problems are being explored. Meanwhile, work on inertial guidance of aircraft has been reduced in accordance with emphasis now being placed in the more advanced fields. The Laboratory's last major aircraft guidance program concluded with transcontinental flight testing of "Spire, Jr.," an experimental prototype inertial navigation system publicized by CBS Television in April on its program "Conquest."

Lincoln Laboratory

At the Lincoln Laboratory, the year was marked by provocative new advances in fundamental research and by the accomplishment of important engineering objectives arising from earlier Lincoln research.

The existence of two kinds of excitons in germanium has been established, and the magnitude of their exceedingly small binding energies (of the order of 2×10^{-3} electron volts) at liquid helium temperatures has been accurately determined for the first time, using infrared measuring techniques and very powerful magnetic fields. These new techniques can be applied to broad classes of substances, including semiconductors, metals, and magnetic materials, to measure the basic properties of electrons in solids, and may well serve to open up a new field in solid state spectroscopy.

In one application of modern computer techniques to a new class of problems, the Lincoln research computer TX-2 recognized the digits zero through nine, as spoken by ten different voices both male and female, with 98 per cent accuracy. This promising method is not restricted to use with numbers but is applicable to much larger vocabularies; and the success of this initial experiment not only demonstrates the value of digital computers for speech analysis but

points the road to increased flexibility in communication between man and machine. The Lincoln computer TX-0, predecessor of the TX-2, has been moved to the Karl Taylor Compton Laboratories to augment teaching and research in advanced computer technology in the Department of Electrical Engineering.

A notable advance in airborne radar performance has been realized in a new system designed by Lincoln engineers to single out moving aircraft targets and to suppress extraneous echoes from ships, storm clouds, and the rough surface of the sea. Coupled with more powerful radar transmitters and larger airborne antennas for increased range, resolution, and accuracy, this system is an important contribution to the seaward extension of our continental air defense.

The experimental long-range radar built last year at Millstone Hill in Westford, Massachusetts, has proved to be a powerful tool for the solution of pressing problems in missile defense. A high-speed computer, in which vacuum tubes have been completely displaced by reliable solid-state transistors and diodes, is now operating in conjunction with this radar. Target trajectories can be determined in small fractions of a second, points of origin and impact areas can be ascertained from the radar data, and missiles can thus be distinguished from satellites and stray meteors. Since last November this radar has successfully tracked various earth satellites, making essentially continuous measurements of range, elevation, bearing, and Doppler frequency.

Rigid radomes of glass-reinforced plastic up to 55 feet in diameter, pioneered by Lincoln Laboratory and first realistically tested on Mount Washington prior to installation in the DEW Line, are now in service at sites from Okinawa to Greenland, affording positive protection to radar antennas from tropical typhoons and arctic gales. Designs are now being studied for radomes with even larger diameters.

A power tropospheric forward-scatter communications circuit has been set up between Millstone Hill, Westford, Massachusetts, and Winston-Salem, North Carolina, a single jump of 640 miles, to serve as a prototype for installations in the arctic DEW Line and at other critical locations throughout the world. This system provides exceedingly reliable broad-band communication over long distances without intermediate relay stations. Using two 120-foot antennas at each terminal, with an effective radiated power of more than

200 million watts, the circuit is designed to carry up to 24 voice and teletype channels simultaneously.

Personnel

On campus, an M.I.T. Security Force has replaced the Cambridge Police, who had performed campus patrol duty for many years. The new force, recruited and trained under the staff supervision of Harvey Burstein and operating under the direction of Captain Norman S. Sydney, has carried out its duties expeditiously and has been well accepted by staff and students.

Under the Institute's new organization, the staff personnel functions, long performed by the Division of Sponsored Research, were transferred to the Institute's Personnel Office. Thomas Harrington, who had capably supervised this function in the Division of Sponsored Research, became the Institute's Placement Officer.

GENERAL JAMES MCCORMACK

SECRETARY OF THE INSTITUTE

Total gifts for the year were $7,732,039. While this ranks well with the totals of recent years, we are still hard pressed to meet the needs which are evident in many quarters and which visiting committees quite properly call to our attention. But science itself is a kind of fission process, and in an institution as active as M.I.T. it is both difficult and in many ways undesirable to moderate or control the imaginations of an enterprising faculty. The challenge to obtain more funds is clear; to achieve it will require all the energy and imagination that every segment of our constituency can muster.

Corporation Activity

The fact that two-thirds of the active membership of the Corporation attended each of the four regular meetings is one significant measure of the interest of the Institute's trustee group in M.I.T.'s affairs. Considering the group's other commitments and its geographical spread, such a high degree of interest and participation is especially reassuring. In addition, twenty of the twenty-six visiting committees met during the year to investigate and discuss the affairs of the several academic and service departments; in some cases, the full complement of Corporation, alumni, and presidentially appointed members were present at the meetings.

The business sessions of the Corporation were changed from afternoons to mornings; a variety of informal afternoon meetings were held to acquaint the membership with current activities of special interest. These included a discussion of digital computers as they relate to problems of industrial management, and a presentation by the Physical Science Study Committee of its work toward the improvement of secondary school science teaching.

Development Activities

The principal effort during the year has been to obtain a $5,000,000 Faculty Salary Adjustment Fund. Under the leadership of Walter J. Beadle and with the active support of many members of the Corporation and alumni leaders across the country, the objective was clearly in sight at year's end. The job would not have been possible without the generous and challenging matching grant of Alfred P. Sloan, Jr. '95, through his foundation, and without his wise counsel throughout the whole program. The financial support of the Institute's alumni and friends is heartening; the spirit of our entire constituency and their willingness to work as volunteers provides even stronger evidence that the Institute can move forward with confidence.

A good share of the support for the Salary Adjustment Fund came from industry. Heads of companies have been quick to recognize their stake in helping M.I.T. remain strong. Several companies have provided their support through the Industrial Liaison Program by pledging continuing annual grants. We have not felt the effects of the current turndown in business to the extent that seemed probable a year ago. In part, at least, this is an acknowledgment by business leaders of the need to maintain the flow of well-trained professional men into industry and the desirability of encouraging continuing fundamental research in pure and applied science.

Some members of the Corporation have expressed the conviction that the current effort to bring faculty salaries into a more reasonable relationship with industrial salaries is not going to solve the problem, even for the next five years. The possibility of further inflation and the continuing competition for the best scientific manpower may well push industrial salaries to higher levels.

This year has marked even closer collaboration and cooperation with the Alumni Fund organization. Effective last fall, every gift from an alumnus, whether to the Alumni Fund or directly to

the Institute, has been credited to the man's class for reporting purposes. The previous method of compartmentalizing gifts, depending on how they were given, led to unfortunate misunderstandings with major alumni donors and to unnecessary confusion in reporting. The Alumni Association has made substantial progress in encouraging wider alumni participation through a network of regional campaigns. In addition, special gift committees have been organized in certain of the classes to seek larger annual contributions from selected individuals. Especially in the special gift area, there is opportunity for a further joining of forces between the alumni and the Institute's development groups.

Regional conferences — this year in Pittsburgh and in Washington, D.C. — are directed primarily toward helping M.I.T.'s public relations; nonetheless, they help bring into focus the kinds of opportunities the Institute has in dedicating its resources to the national needs.

R. M. KIMBALL

DEAN OF THE GRADUATE SCHOOL

During this past year our Graduate School enjoyed a significant development in scope, apart from its consciously restrained but seemingly inevitable steady growth in size. In March, the Corporation authorized two new fields of award for the degree Doctor of Philosophy: the fields of political science (Department of Economics and Social Science), and city and regional planning (Department of City and Regional Planning). These new authorizations exemplify one of M.I.T.'s ideals: to grow increasingly liberal in its character, while remaining polarized about science. Moreover, they are regarded as important new opportunities for the Institute to contribute to the national welfare.

Our objectives in political science are a thorough competence in all major aspects of government and politics combined with a firm grasp of the interaction between government, science, and engineering. The vital role that science and engineering play in the formation and execution of government policy is now obvious. Equally important today is government's responsibility for encouraging, nurturing, and providing a congenial climate for science and

technology. This applies with acute urgency to national defense and is equally important in the long run to civilian economy and culture. With its strong faculty group in the Political Science Section and its internationally recognized research group in the Center for International Studies, M.I.T. enjoys unique resources for bringing political theory and practice into more intimate working relation with science and technology at the scholarly level.

Similarly, the resources of engineering, science, economics, politics, and management have yet to be fully exploited in their relation to city and regional planning. The planner who is to achieve a well-thought-out solution to a local or regional problem has an increasing need to enlarge his understanding of the contributions that other disciplines, many of them well represented at M.I.T., can make to the concepts and to the practice of planning. Thus what has been primarily a designing function is now growing to need the type of research and scholarship which are naturally associated with a doctoral program.

The steps leading to the approval of new graduate degrees are worth mentioning, since they illustrate the working processes concerning graduate programs at the Institute. As a consequence of a period of growth and encouragement of advanced, scholarly work and of research in the areas concerned, a department reaches the decision to ask for Corporation authorization. This authorization requires two conditions. The first is the administrative decision that the area concerned justifies and can be provided with adequate support in faculty, facilities, and budget to sustain a high-quality doctoral activity. The second is recommendation from the faculty that the existing resources in faculty and facilities are adequate academically to assure doctoral standards acceptable to the faculty as a whole. The faculty acts upon recommendations from the Committee on Graduate School Policy which, in considering the two latest degrees, based its recommendations upon the findings of an *ad hoc* committee. In each case the committee was carefully selected by the Dean of the Graduate School in collaboration with the dean of the school and head of the department or division concerned. Two nationally known persons without close Institute connections were included on each committee, as were two or three members from the Institute faculty selected for their recognized insight and judgment rather than for specific competence in the field. After study of preliminary material from the department, each committee met for a day's session in Cambridge for personal

review and examination of program, faculty, and facilities. The chairman of each *ad hoc* committee subsequently presented its report to the Committee on Graduate School Policy, leading in both these cases to favorable recommendations from the Committee to the faculty and then from the faculty to the Corporation. There has been uniform agreement that this *ad hoc* process provides critical appraisal and opportunity for the faculty to assure itself that the new degrees will meet its standards.

Of a more nominal character is the faculty approval of a doctor of philosophy in the engineering departments. While the official actions of both Corporation and faculty have in no way excluded the award of a Ph.D. in engineering, only the Sc.D. has been given, except in two special and specially approved cases. There had thus developed a sort of common law principle of not awarding the Ph.D. in engineering. But the increasingly scientific character of the engineering doctoral programs often makes doctoral researches in engineering merge indistinguishably into doctoral researches in science; and the Ph.D. in engineering is used almost without exception by other institutions throughout the country. Hence the faculty approved the Graduate Committee recommendation affirming the existing faculty regulation that provides for award of either Ph.D. or Sc.D. in all fields of science and engineering. This resolution was accepted without question by the faculty.

In February the Committee on the Future of the Graduate School, initially under the chairmanship of Professor John A. Hrones, completed its work and report under the chairmanship of Professor Philip M. Morse. This report has far-reaching insights and suggestions concerning both future physical facilities for the Graduate School, especially its living facilities, and its growth, evolution, administration, and leadership. The Committee's recommendations are influencing our long-term thinking, and a continued, broadened consideration of its findings is anticipated in the coming months. Major future changes in policy are at least as likely to come out of such special studies as out of continuing, established faculty "policy" committees.

In March the subject of Graduate School quotas was again reviewed, in recognition of the demand for growth in many departments, represented by very attractive applicants in numbers beyond our reasonable capacity. The result was to establish quotas by schools, leaving the allocation of the quotas within each school to its dean, working with his department heads and faculty. Over-all

registrations for the fall and spring terms average remarkably close to assigned quotas, bearing testimony to the care and the skill exercised by the departmental officers both in making admissions and in estimating the actual registration of new graduate students resulting from these admissions.

Total numbers of graduate applications received have shown a steady growth since the postwar bulge of 1950; as of July 1, 1958, they were 21 per cent above those of July 1, 1957. There is indication that applications came in earlier this year than last, in that the January 1 figure was 30 per cent above 1957, while the March figure was only 10 per cent above that of last year.

Not only the number but the quality of applicants was exceptionally high this year. In March, 1957, we announced 39 Whitney Fellowships for new graduate students from other institutions. In March, 1958, the field of applicants was so strong — 70 appeared highly qualified for this award — that the Scholarship Committee felt impelled to dip into reserves to make 56 offers. The income on general funds is sufficient to cover only about 20 such fellowships on a roughly half-and-half division of the available funds between fellowships and tuition scholarships. We are eating seriously into our interest-earning income balances accumulated during the war years. Substantial new financing for first-year graduate fellowships is a critical need.

A list of those students who held fellowships for graduate study during 1957–58 is given at the end of this report. In publishing this list, we pay tribute to the generosity of the donors of these important funds and to the talents of the students who successfully competed for them.

The Graduate Student Council continues to provide both an excellent medium of communication with graduate students and a stimulus to extracurricular activities especially congenial to graduate students. One of the major new contributions this past year was the preparation of an information booklet for new graduate students at M.I.T., available for Registration Day in September, 1958. By conscious design the administration has kept aloof officially from this "Guide to Graduate Student Life at M.I.T.," thereby enabling the students to adopt a completely informal style and to make personal helpful hints and statements for which official M.I.T. endorsement is not appropriate. It is my prediction that this will be a very popular and valuable booklet.

Among our routine operations, the registration of one-or-two-subject special graduate students in the School of Science has been undertaken by the Secretary of the Graduate School to relieve most of the science departments of this task, which seems to bear little relation to their *bona fide* graduate activity. The engineering departments, on the other hand, have retained such registration responsibility within the departments, since in their pattern of operation the ultimate transfer of special graduate students to regular graduate student status is frequent, and departmental acquaintance is of real value as a basis for intelligent counseling.

The following are significant statistics of the past year:

Graduate School Registration, 1957–58

	Summer, 1957	*Fall, 1957*	*Spring, 1958*
School of Engineering	601	1,470	1,383
School of Science	210	717	667
School of Architecture and Planning	25	74	70
School of Humanities and Social Studies	9	82	76
School of Industrial Management	54	167	162
	899	**2,510**	**2,358**
U.S. or Canadian citizens	752	2,112	1,970
Others	147	398	388
	899	**2,510**	**2,358**
Regular students	820	2,034	1,970
Special students	79	476	388
	899	**2,510**	**2,358**
Civilian students	—	2,428	2,214
Military students	—	82	144
		2,510	**2,358**

Advanced Degrees Conferred, 1957–58

	S.M.	*Engineer*	*Sc.D.*	*Ph.D.*	*Total*
September, 1957	151	4	15	22	192
February, 1958	115	7	15	24	161
June, 1958	370	51	38	39	498
	636	**62**	**68**	**85**	**851**

Fellowships, Scholarships, and Staff Awards, 1957–58

	Number of Awardees	*Amount*
Fellowships	206	$385,988
Scholarships	93	126,987
Staff awards	359	187,384
	678	**$700,359**

Graduate Fellowships, 1957–58

The following list shows recipients of fellowships in the Graduate School for 1957–58.

AC Spark Plug Fellowship
JAMES LEE STOCKARD, in the Department of Aeronautical Engineering
Allegheny-Ludlum Fellowship
PETER JOSEPH MICHAEL KOROS, in the Department of Metallurgy
JOHN ROUGHLES RAWLING, in the Department of Metallurgy
Allied Chemical and Dye Corporation Fellowship
OREST POPOVYCH, in the Department of Chemistry
Aluminum Company of America Fellowship
THOMAS HYDE ALDEN, in the Department of Metallurgy
ALFRED ROBERT COOPER, in the Department of Metallurgy
BARTON ROESSLER, in the Department of Metallurgy
American Bosch Arma Corporation Fellowship
WOLF HABERMAN, in the Department of Aeronautical Engineering
American Brake Shoe Fellowship
CARL ARTHUR WESTON, in the Department of Metallurgy
American Chicle Company Fellowship
GERALD MATTHEW SAPERS, in the Department of Food Technology
American Cyanamide Company Fellowship
DONALD L. MARICLE, in the Department of Chemistry
American Lithium Institute Fellowship
RICHARD ANTHONY RAWE, in the Department of Metallurgy
American Oil Company Practice School Fellowship
JAMES CABLE BURNS, in the Department of Chemical Engineering
SHELDON WILLIAMS DEAN, JR., in the Department of Chemical Engineering
American Society of Metals Fellowship
GEORGE WILBUR PEARSALL, in the Department of Metallurgy
American Viscose Corporation Practice School Fellowship
ALLEN HERBERT BERGMAN, in the Department of Chemical Engineering
Armco Steel Foundation Fellowship
MATTHEW JOHN DONACHIE, JR., in the Department of Metallurgy
Aviation Week Fellowship
LAWRENCE SCHWARTZ, in the Department of Aeronautical Engineering
Bell Telephone Laboratories Fellowship
PHILLIP ABRAHAM BELLO, in the Department of Electrical Engineering
Bendix Aviation Corporation Fellowship
ROBERT ERIC NELSON, in the Department of Electrical Engineering
Boeing Airplane Company Fellowship
EUGENE JOHN BRUNELLE, JR., in the Department of Aeronautical Engineering
Carbide and Carbon Chemicals Company Fellowship
HERBERT H. ENGEL, in the Department of Chemical Engineering
Carbide and Carbon Chemicals Company Practice School Fellowship
NICHOLAS JAMES STEVENS, JR., in the Department of Chemical Engineering
R. R. M. Carpenter Fellowship
IRVEN HORTON RINARD, in the Department of Chemical Engineering

Continental Can Company Fellowship
JOHN RICHARD HUTCHINS, III, in the Department of Metallurgy

Crane Company Fellowship in Foundry Research
JOHN EDGAR NIESSE, in the Department of Metallurgy

Douglas Aircraft Company Fellowship
HERBERT WILLIAM GEWEHR, in the Department of Aeronautical Engineering

Dow Chemical Company Fellowship
DANIEL LEONARD BROWN, in the Department of Chemical Engineering
LAWRENCE ISRAEL, in the Department of Chemical Engineering

du Pont Company Fellowship
THOMAS CHARLES ROBINSON, in the Department of Mechanical Engineering
ROBERT STONE TIMMINS, in the Department of Chemical Engineering

Richard C. du Pont Memorial Fellowship
SAUL SIGMOND ABARBANEL, in the Department of Aeronautical Engineering
KENTON JOHN IDE, in the Department of Aeronautical Engineering

Eastman Kodak Company Fellowship
JOHN WILLIAM MEADER, in the Department of Chemical Engineering
ARNOLD TUBIS, in the Department of Physics

Eastman Kodak Company Practice School Fellowship
JOHN ELY MARSLAND, JR., in the Department of Chemical Engineering

Ethyl Corporation Fellowship
FRANK WILBUR DOBBS, in the Department of Chemistry

Fluor Foundation Fellowship
WILLIAM STANLEY GRIFFIN, in the Department of Mechanical Engineering

Foundry Fellowship
THOMAS JOSEPH MC LEER, in the Department of Metallurgy

Lester D. Gardner Graduate Fellowship
RICHARD HOWLAND ADAMS, in the Department of Aeronautical Engineering

General Dynamics Corporation Fellowship
OTIS COLLINS MYERS, JR., in the Department of Electrical Engineering
MAURICE ABRAHAM ROBKIN, in the Department of Chemical Engineering

General Electric Fellowship
ARTHUR JAY LEARN, in the Department of Physics
VICTOR GREGORY MACRES, in the Department of Metallurgy
WILLIAM WENDELL REES, in the Department of Chemistry

General Motors Automotive Fellowship
DONALD ALAN GALL, in the Department of Mechanical Engineering

Goodyear Tire and Rubber Company and Goodyear Aircraft Corporation Fellowship
CHARLES P. GODBILLE, in the Department of Aeronautical Engineering

Goodyear Tire and Rubber Company Fellowship
GEORGE THOMAS WEINER, in the Department of Economics and Social Science

Gulf Research and Development Company Fellowship
GEORGE JANSEN, JR., in the Department of Chemical Engineering

Humble Oil and Refining Company Fellowship
GERALD ARTHUR GORDON, in the Department of Chemical Engineering

International Business Machines Corporation Competitive Fellowship
IRWIN S. BERNSTEIN, in the Department of Mathematics

International Business Machines Corporation Fellowship in Electrical Engineering
WAYNE GEORGE KELLNER, in the Department of Electrical Engineering

International Business Machines Corporation Fellowship in Physics
RICHARD EMERY WATSON, in the Department of Physics

Kennecott Copper Corporation Fellowship
PETER TARASSOFF, in the Department of Metallurgy

Kimberly-Clark Fellowship
ANTHONY TURANO, JR., in the Department of Chemistry

Arthur Dehon Little Fellowship
JACK JAY DUFFIELD, in the Department of Chemistry

Lockheed Leadership Fellowship
JOHN ALVIN DECKER, JR., in the Department of Aeronautical Engineering

McClintic Fellowship
NAFTALI C. RODRIGUEZ, in the Department of Civil Engineering

Melpar, Incorporated, Fellowship
GEORGE STEPHEN SEBESTYEN, in the Department of Electrical Engineering

Minneapolis-Honeywell Fellowship
CARLISLE MARTIN STICKLEY, in the Department of Electrical Engineering

Monsanto Chemical Company Fellowship
DALE WILSON RICE, in the Department of Chemistry

Forris Jewett Moore Memorial Fellowship
ROBERT LEE CARGILL, in the Department of Chemistry

National Institutes of Health Fellowship
SIMON DAVID SILVER, in the Department of Biology
DONALD JOSEPH PLOCKE, in the Department of Biology

National Steel Corporation Fellowship
STUART PHILIP KEELER, in the Department of Metallurgy

Newcom Scholarship
PAUL GEORGE ADLER, in the Department of Geology and Geophysics

James Flack Norris Memorial Fellowship
ANESTIS LEONIDAS LOGOTHETIS, in the Department of Chemistry

Karl Taylor Compton Fellowship of the Nutrition Foundation
GERALD WALTER CAMIENER, in the Department of Biology
GERALD LOWELL CARLSON, in the Department of Biology
MANUEL VALERIO ORTEGA ORTEGA, in the Department of Biology

Procter and Gamble Company Fellowship
WILLIAM C. BEHRMANN, in the Department of Chemical Engineering
MARION DOUGLAS MEYERS, in the Department of Chemistry
JOHN JACQUES RINDE, in the Department of Mechanical Engineering

Ramo-Wooldridge Fellowships
PETER L. DUREN, in the Department of Mathematics
RONALD A. HOWARD, in the Department of Electrical Engineering

Research Laboratory of Electronics Fellowships
WILLIAM EDMUND BICKNELL, in the Department of Electrical Engineering
ROBERT GRAY GALLAGHER, in the Department of Electrical Engineering
DONALD THOMAS HESS, in the Department of Electrical Engineering
IRWIN MARK JACOBS, in the Department of Electrical Engineering
ROBERT B. LEES, in the Department of Electrical Engineering

Schlumberger Foundation Fellowship
ROBERT J. GOAD, in the Department of Electrical Engineering

School of Industrial Management Fellowships

ERIC EDWARD BAKER
RICHARD HAROLD BERNHARD
RAYMOND WALKER CRAIG
HOWARD SPENCER KRASNOW
ROBERT PIERS NICHOLSON

Scientific Design Fellowship

CHAI YANG CHOO, in the Department of Chemical Engineering

Shell Fellowship

STEPHEN JOSEF NETTEL, in the Department of Physics
DAVID RODMAN VAUGHAN, in the Department of Mechanical Engineering

Sloan Fellowships (all in the School of Industrial Management)

JOHN BURWELL BECKWITH
ROBERT HALL BLISS
WAYNE HARPER BURT
THOMAS JAMES CARROLL
DAVID CHRISTISON
SAMUEL JACKSON DAVY
JOHN MICHAEL DUICH
GUILFORD WHITNEY FORBES
EDWARD SMITH GILL
THOMAS ALLAN HARVIE
CYRUS VARD HELM
EARL FULTON HOGAN
EUGENE JOSEPH HYNES, JR.
STANLEY WARREN JOHNSON
ABRAHAM KATZ
JOHN LEO KELLY
VICTOR JOSEPH LOMBARDI
WILLIAM PATRICK MC GUIRE, JR.
CHARLES COPELAND MARTIN
LOUIS LEONARD MRACHEK
FRANK TROWBRIDGE MURRAY
JOHN TANNER PETTIT
EUGENE JOHN POPMA
JOSEPH FLETCHER REX
VIRGAL LEONARD SCHAD, JR.
WILLIAM E. SEHN
WILLIAM ELMER SNYDER
ROBERT CHAPMAN SPRAGUE, JR.
GEORGE BAILEY STONE
WILLIS SHERIDAN WHITE, JR.
ROBERT EARL WORKMAN
WILLIAM MICHAEL ZARKOWSKY

Solar Energy Fellowships

ROBERT PIERCE ALLINGHAM, in the Department of Chemistry
LOUIS ALFRED KAMINSKI, in the Department of Chemistry
THOMAS ALFRED UNGER, in the Department of Chemical Engineering

Sperry Gyroscope Company Fellowship

MYRON KAYTON, in the Department of Aeronautical Engineering
ROBERT GOTTLIEB STERN, in the Department of Aeronautical Engineering

Standard Oil of California Fellowship

DONALD JAMES MARSHALL, in the Department of Geology and Geophysics

Standard Oil Foundation, Incorporated, Fellowship

DOMINICK ANTHONY SAMA, in the Department of Chemical Engineering

Union Carbide Chemicals Company Fellowship

GORDON EDWARD AGAR, in the Department of Metallurgy
CHESTER EUGENE GLEIT, in the Department of Chemistry
GILBERT ROBERT SPEICH, in the Department of Metallurgy

United States Rubber Company Fellowship

ROBERT WADE PARSONS, JR., in the Department of Chemistry

United States Steel Foundation Fellowship

WILLIAM GEORGE RHOADES, in the Department of Economics and Social Science

Universal Cyclops Foundation Fellowship

PETER GRUT WINCHILL, in the Department of Metallurgy

Visking Fellowship

ARTHUR EDWARD BERGLES, in the Department of Mechanical Engineering

Voorhees, Walker, Smith and Smith Fellowship

DONALD SIDNEY APPLEYARD, in the Department of City Planning

Westinghouse Fellowship in Industrial Relations
WARREN PHILLIP SAUNDERS, in the Department of Economics and Social Science
Jonathan Whitney Fellowships
WALTER GEORGE CLARKE, in the Department of City Planning
EDWARD LEWIS COHEN, in the Department of Mathematics
DAVID CLARENCE COLL, in the Department of Electrical Engineering
WILLIAM MURDOCK COWAN, JR., in the Department of Electrical Engineering
JAMES HARVIE CROCKET, in the Department of Geology and Geophysics
LOREN DARREL FELTEN, in the Department of Chemical Engineering
HENRY KENNETH FISHER, in the School of Industrial Management
RALPH MURRAY GIFFORD, in the Department of Chemical Engineering
KARL RICHARD GOLLER, in the Department of Chemical Engineering
STANLEY LAWRENCE GROTCH, in the Department of Chemical Engineering
DONALD RUSSELL HARING, in the Department of Electrical Engineering
HERBERT HENRY HASSIS, in the Department of Sanitary Engineering
NEAL POWELL JEFFRIES, in the Department of Mechanical Engineering
ALBERT WELSH KARNATH, in the Department of Chemical Engineering
ROBERT EDWARD KELLY, in the Department of Aeronautical Engineering
WALERIAN KIPINIAK, in the Department of Electrical Engineering
ALLAN ROGER LARRABEE, in the Department of Biology
ANDRE F. LE ROY, in the Department of Chemical Engineering
ROBERT CARL LUMMIS, in the Department of Chemical Engineering
HIRONORI ONISHI, in the Department of Mathematics
DONALD JAMES PATTERSON, in the Department of Mechanical Engineering
CHARLES J. RENSCHLER, in the Department of Food Technology
MAURICE BRUCE STEWART, in the Department of Geology and Geophysics
RICHARD PHILLIP WISHNER, in the Department of Electrical Engineering
ALLYN JAMES ZIEGENHAGEN, in the Department of Chemical Engineering

HAROLD L. HAZEN

DIRECTOR OF ADMISSIONS

This report, following the precedent of other years, covers the twelve-month period ending with the opening of the new academic year in September, 1958, which date marks the natural termination of the Admissions Office year.

The following table compares, for this year and last, applications for admission to the freshman year and those for transfer from other colleges at the undergraduate level.

First-year class	*September, 1957*	*September, 1958*
Total applications	5,904	6,858
Admissions granted	1,822	1,814
Actual registration*	907	941
Registration as per cent of admissions	49.8%	51.9%
Number of secondary schools represented	645	712

* Includes former students returning (3) and college transfer students who entered the first year (17), the latter also included in the table below.

College Transfers	*Academic year 1957–1958*	*For First Term 1958–1959*
Total applications	805	829
Applications completed	411	331
Admissions granted	217	182
Actual registrations	146	143
Combined Plan (included above)	23	30
Registrations as per cent of admissions	67.2%	78.4%

As indicated by the above statistics, freshman applications again show a marked increase, this being the seventh successive year in which this has occurred; and it should be noted that all of this antedates the "population wave," the oldest individuals of which will reach college age only in 1960. What we are seeing is the cumulative effect of (1) an increase in the proportion of high school graduates seeking higher education, (2) an increase in the proportion of these students attracted to fields related to science, and (3) an increase in the proportion who are specifically attracted to M.I.T. At the same time, the marked year-to-year growth in the proportion of students who were offered admission here but went elsewhere appears to have halted. This suggests that the phenomenon of "multiple applications" on a national scale may have completed its phase of most rapid growth. With the spread of college guidance practices in high schools, students are encouraged to make fewer and wiser applications, rather than blindly to multiply applications to institutions possibly ill-suited to their needs, or with standards beyond their probable norms of accomplishment.

College Transfers

The above data on college transfer students are presented in slightly revised form this year as a result of an analysis by M. Bryce Leggett, who is in charge of this category of applications. The first column gives the final figures for the academic year 1957–1958, including the transfer applications considered specifically for the second term. The second column gives the figures for the term beginning on September 22, 1958, and are lower by about 5 per cent than those expected to be final for the year.

Over the past five years the number of preliminary applications for transfer students has been relatively constant at 750 to 800. Not all, probably not more than 60 per cent, of the initial inquiries about the possibility and feasibility of transfer result in preliminary applications. The student's consideration of our policies (College Board examinations, awarding of academic credits, financial aid

restrictions) and the guidance offered in response to inquiry and preliminary application make a further reduction to about 400 completed final applications in each of the last five years. Admissions granted in this period ranged from 267 in 1953–54 to 207 in 1956–57. The percentage of formal applicants found acceptable has been about 54 per cent in the past three years and about 68 per cent in the two years before that. This change reflects, in part at least, the same tightening of standards for transfer applicants as is found in the entering classes and an attempt to have the transfer students meet qualitatively the performance of prospective classmates already here. Registrations were 147 and 146 students in 1956 and 1957 and were 202, 203, and 209 in the three preceding years. There was a drop in "yield" from the admitted students from about 87 per cent to about 69 per cent between 1955 and 1956. This decrease may have been due to an increase in the multiple application practice among transfers, a problem augmented by the fact that almost all of these students have the alternative choice of continuing where they are.

Factors which may lead to a decreasing number of transfer students in the future are: better guidance toward college selection at the secondary school level, the increasing cost of an M.I.T. education, especially when financial aid is not available in the first year for the transfer, and the revisions in our curriculum which may mean less transfer credit for studies pursued under the more traditional programs. This last factor may, on the other hand, lead to more applications from students seeking our type of program. An increase in transfer applications can also be expected from graduates of the two-year community and junior colleges, which are growing in number and in the strength of their programs. The revision in the two-degree plan procedure (below) may result in a modest increase in the number of transfer students.

The 146 students who entered M.I.T. as transfers for part or all of the academic year 1957–58 were enrolled in all undergraduate departments, with the largest numbers in electrical engineering (34), mechanical engineering (23), physics (20), and architecture (12). At the end of the second term, 88 per cent were in good academic standing, 6 per cent were on probation, and 6 per cent had been disqualified. This is a somewhat better showing than for the first-year class in the same year (7.5 per cent disqualifications), but not much better as to suggest that the evaluation of transfer applicants is too stringent.

The Two-Degree Plan Revision

Each year in the past twenty, a small but significant number of transfer students have come to M.I.T. under the arrangements of what was originally called a Cooperative Plan, later named the Combined Plan of Study, and is now more accurately known as the Two-Degree Plan, established by the Institute and seventeen cooperating liberal arts colleges. About 15 per cent of the undergraduate transfers to M.I.T. each year were in this program. About 12 per cent of the students who had filed Combined Plan preliminary applications through their colleges actually transferred to M.I.T. Despite the small numbers involved, it was apparent that this plan for three years of study at another college followed by two years at M.I.T. leading to both the A.B. and the S.B. degrees offered advantages for some students, but that the highly defined agreements in effect might work to the disadvantage of others. Those who did come to M.I.T. were carefully selected, were required to meet high standards at their colleges before receiving the admitting recommendation, and almost invariably did well here.

As an extension of the original plan, it was decided by M.I.T. that a two-college, two-degree program including the Institute should be available to the students of any college that wished to offer it. The revised procedure includes (1) cooperation by M.I.T. with the college in selecting the student's course of studies there with the view to keeping his academic program at M.I.T. within the older, two-year limit; (2) acceptance to be at discretion of M.I.T.; and (3) the extension of eligibility to apply for financial aid during his first year here to a transfer student certified by his college to be a participant in such a plan and to have been receiving financial aid from that college. Several colleges other than the original seventeen have initiated inquiries about the new plan, and some of these have indicated that they intend to offer it to their students.

Advanced Placement

Our participation in the advanced placement program for freshmen who have taken courses of college grade in high schools has grown rapidly under the direction of Eugene R. Chamberlain. The number of these students who entered after taking examinations under the auspices of the College Entrance Examination Board Advanced Placement Program has risen from a modest 2.2 per cent of the admitted registered class in 1954 to 13.8 per cent in September, 1958.

This sound, long-range program is now an established and vital influence in American secondary school education.

Sixty-two students entering in September, 1957, representing 34 schools in 17 states, took 110 college level 3-hour examinations under the Advanced Placement Program in mathematics (calculus), physics, chemistry, English composition, English literature, American history, German, and biology.

Thirty-three students received credit for freshman-required subjects and electives. They were permitted to register, in most cases, in the next highest sequential subject. The amount of credit and the advanced subject placement which fits the scholastic development of the student is determined in consultation with the appropriate department examiner and the student's faculty adviser after a careful review of the student's test grades, examination papers, and the course descriptions and recommendations supplied by the secondary school teachers.

Credit for freshman subjects was granted in mathematics, physics, chemistry, English composition, and literature. For most of these students it meant advancement in one subject for one term; however, a few registered for advanced placement in second-year first term subjects.

The first term average grades for the Advanced Placement students was 3.7 as against a 3.2 for all U.S. registered students. The 33 students who received credit and took advanced courses had an average of 4.0; those without credit, a 3.3 average. Twenty-seven of the entire group of 62 students were on the Dean's List for the term ending January, 1958.

During the year 1957–58, the Advanced Placement Program has been directed at the College Entrance Examination Board by Professor David A. Dudley, formerly associated with this office. In his address to the Administrators Conference at Yale University he reported that the Program has nearly doubled in number for each year of operation. In May, 1958, 3,700 students, representing 360 secondary schools, took 6,900 Advanced Placement examinations. These students will attend nearly 280 colleges this fall.

The Broad Admissions Effort

We have an increasing problem of selection among applicants for the freshman class, with the corresponding opportunity for a strengthening of the student body which can follow a wise use of the selection

privilege. Nevertheless, as indicated in my report a year ago, the amount of selectivity which we can exercise is small compared with that which the student himself can and does exercise among the numerous institutions to which he may apply. Consequently the greater part of our admissions effort goes, not to selection among applicants, important as this is, but rather to the broader educational effort of providing information and guidance to potential applicants, their parents, and the schools from which they come. In addition to our publications, which are an indispensable aid, this effort takes three main forms: first, the faculty school visiting program; second, the work of the Educational Council; and third, the annual fall conference for high school guidance counselors. These are reported upon, in this order, below.

Most of the secondary school visiting program was, as usual, completed during the fall months. A total of 24 members of the faculty and administrative staff and 6 members of the Admissions Office staff participated in this activity for periods ranging from 1 day to 3 weeks. Typically, each participant devotes one full week to this work. During the year, 553 schools in 39 states and 2 Canadian provinces were visited, and a total of 6,264 students were seen, usually in small, informal groups preselected by the schools for the purpose of meeting with the M.I.T. representative.

School visiting is an arduous task, though an interesting one: great credit is due to the following participants for the energy and enthusiasm which they brought to this work. Professors E. Eugene Allmendinger, George A. Brown, Frank B. Cuff, Norman C. Dahl, William H. Dennen, Peter S. Eagleson, Robley D. Evans, Freddie D. Ezekiel, Daniel F. Fairbanks, John Granlund, Donald R. F. Harleman, Frank J. Heger, Hoyt C. Hottel, Delbar P. Keily, and James W. Marr; also the following: Dean Thomas P. Pitré, Samuel Jones, Walter L. Milne, and Robert K. Weatherall.

D. Hugh Darden was appointed Executive Secretary of the Educational Council and Assistant Director of Admissions on December 1, 1957. He succeeds Bruce F. Kingsbury, who resigned to participate in the Physical Science Study Project. During the year the Admissions Office referred 6,675 students to members of the Council in their respective areas, suggesting a personal conference upon the initiative of the student (the Council member being simultaneously informed). A total of 3,197 applicants followed up these invitations, and reports about them were in each case then forwarded to this office. In addition, 1,245 interviews held in the

Admissions Office were recorded and the reports filed as part of each applicant's record. We received 220 invitations to attend high school "college nights," "college conferences," or "career days." The members of the Educational Council performed an indispensable service in representing M.I.T. locally at 159 of these events, few of which can be reached by a representative from Cambridge because of scheduling difficulties. A total of 1,988 students, many of them accompanied by parents, were seen in these conferences. Fuller details of the Educational Council's operations are included in the report of its Executive Secretary.

Our October conference for secondary school guidance counselors has now become established as an annual event. In 1957 a total of 90 people (of whom 21 were women) attended this two-day event. They came from 36 states, the District of Columbia, and Canada, and represented 66 public and 19 independent schools. In view of the widespread misconceptions which exist about M.I.T., the program, organized by Professor Paul M. Chalmers and Mr. Chamberlain, laid stress on the explication of our institutional objectives and characteristics. At the same time, an effort was made to encourage discussion and interchange of opinion. A third conference is planned for October, 1958.

Two important secondary school groups convened at M.I.T. in June, 1958. Seventy members of the Country Day School Headmasters Association of the United States met here for three days, their last previous visit here having taken place in 1942. The Executive Committee of the National Council of Independent Schools continued its practice, now dating back several years, of holding its annual two-day June meeting here. The presence here of such representative groups in secondary education is of the first importance in spreading a knowledge of M.I.T. as it is today.

The student guide service, under the direction of Mr. Chamberlain, employed 20 students and escorted a total of 4,109 visitors on tours of the campus during the year.

Professor David A. Dudley, Associate Director of Admissions, resigned on June 30, 1958, following a year's leave of absence spent on the staff of the College Entrance Examination Board. Willard W. Dickerson, Jr., Assistant to the Director of Admissions, has exchanged places for the current year with Robert K. Weatherall, Assistant to the Dean of Students.

B. ALDEN THRESHER

ADVISER TO FOREIGN STUDENTS

This report covers the calendar year beginning on July 1, 1957, and the following figures, therefore, are for the academic year beginning in September, 1957. Requests for admission were received from 2,536 foreign students from nearly every country in the world. Most of these inquiries were made on the initiative of the student himself. Many were made by organizations with scholarship programs, including several branches of the American government, a number of foreign governments, and industries and foundations here and abroad.

These 2,536 inquirers were sent catalogues and special brochures about M.I.T. so that they might become informed about courses of instruction, costs, financial aid (usually none), and application procedures. About half of them persisted and requested application material. Of these nearly 1,300 applications sent out, 866 were returned in complete form so that action could be taken on them.

Of the 866, 342 were granted admission. This number was purposely inflated, because there is always a considerable shrinkage before the first day of term. Some graduate students will have more attractive scholarship offers than ours; some students will be unable to find the funds they had hoped for. Of these 342 admitted, 279 registered at M.I.T. for the first time in September, 1957, for a shrinkage of a little over 18 per cent. Fifty-three new registrants were freshmen, 34 were undergraduate students with advanced standing, and 192 were graduate students.

The total foreign student population at M.I.T. in 1957–58 was 732. This was about 12 per cent of the total student body. They were citizens of sixty-eight different countries.

Dr. James G. Kelso, Executive Assistant to the President, has assumed the responsibility, earlier located in the Registry of Guests, for processing the appointment of all aliens other than students to positions at M.I.T. In most cases this involves admission as well to the Exchange-Visitor's Program; this means that the alien visitor holds a special type of visa and that the Institute is sponsor for him and responsible for his program while he is in the United States.

There were ninety-four aliens other than students attached to the Institute in some capacity during the academic year 1957–58. They were concerned with many aspects of study, research, teaching, and observation; and their functions and titles were quite

varied. They may be subsumed conveniently under the following general headings:

1. Visiting Professors, eight. These are teaching staff of different grades who have been appointed for one or two terms. Occasionally one of them will represent an exchange with an opposite number abroad.

2. Guests, twenty-nine. These are people, usually from teaching or research staffs, who wish to spend time in one of our laboratories doing research or observing it. They are accepted on a no-fee, no-remuneration basis. Many are recipients of grants from the U.S. government, some from their own governments or foundations or industry in the home countries.

3. Postdoctoral fellows, seventeen. These are advanced students who have been awarded fellowships for study and research. Some of these fellowships are awarded by M.I.T.; others, by foundations.

4. Research associates, twenty-six. Under this heading are listed all those who are employed, under one name or another, by the Institute's departments or special laboratories to assist in research projects. They are usually young people just starting on professional careers. Their stay at M.I.T. is temporary, of one or two years, and is planned as an extension of their formal academic training.

5. Research assistants, fourteen. These also are employees, but their training and their status are not so advanced as those of the research associates. They are probably better described as technical assistants.

Of the ninety-four "non-student" aliens at M.I.T. last year, fifteen were holders of U.S. government awards. They had been chosen by the Fulbright Educational Commission in their own countries for maintenance grants and for Fulbright Travel Grants and were placed at M.I.T. under the aegis of the Conference Board of Associated Research Councils, which acts as agent of the U.S. State Department for this purpose.

These ninety-four foreign visitors came to M.I.T. from twenty-four different countries. The leading countries of origin are the United Kingdom, nineteen; Germany, thirteen; Japan, twelve; Italy, seven; India, six; and Australia, six.

Professor Philip Franklin of the Department of Mathematics, who has served for one year as Fulbright Adviser, reports that sixteen M.I.T. students have been granted awards for study abroad

next year. The following list of grantees gives some idea of the extraordinary mobility of American students; they have come from all over the United States to study at M.I.T., and, thanks to the Fulbright Program, they will scatter to other countries for specialized studies.

PETER LEE ABELES of New York City: to study city and regional planning. Placement to be arranged by the Educational Foundation in Israel.

ARTHUR E. BERGLES of Rhinebeck, New York: to study mechanical engineering at Technische Hochschule, Munich, Germany.

BERNARD BRENNER of Los Angeles, California: to study city planning at University of Rome, Rome, Italy.

M. MICHAEL BRADY of Chicago, Illinois: to study electrical engineering at the University of Bergen, Bergen, Norway.

JOSEPH N. FEIL of Cuyahoga Falls, Ohio: to study chemical engineering — high polymers, at Max Planck Institute, Muehlheim (Ruhr), Germany.

THOMAS J. GOBLICK, JR. of Old Forge, Pennsylvania: to study electrical engineering at the Imperial College, University of London.

SAMUEL C. GOLDMAN of Jersey City, New Jersey: to study electrical engineering at Technische Hoogeschool, Delft, the Netherlands.

ROBERT J. HECHT of Highland, New York: to study electrical engineering — sensory perception, at Technische Hochschule, Stuttgart, Germany.

CHARLES F. HOWELL of Champaign, Illinois: to study organic chemistry at Australian National University, Canberra, Australia.

HENRY P. JOLLY, JR. of Richmond, Virginia: to study solid state physics at Technische Hochschule, Stuttgart, Germany.

ROBERT E. SCOTT of Los Angeles, California: to study X-ray diffraction physics at the University of Paris, Paris, France.

HAROLD P. SMITH, JR. of Glenshaw, Pennsylvania: to study nuclear engineering, applied mathematics, and computers at Technische Hochschule, Munich, Germany.

MARCIA LEE STIGUM (MRS.) of East Norwich, New York: to study French economy at the University of Paris, Paris, France.

RICHARD A. P. THOFT of Stevensville, Montana: to study chemistry at Philipps University, Marburg a.d. Lahn, Germany.

JOHN T. WASSON of Springtown, Arkansas: to study nuclear chemistry at Technische Hochschule, Munich, Germany.

JAMES A. WEDBERG of Claremont, California: to study city planning at University of Oslo, Norway.

Three of the above are seniors and thirteen are graduate students. Most will presumably return to M.I.T. to continue their graduate studies and in this way make available to others the fruits of their experience. In addition to these students, two members of the faculty have been granted Fulbright awards. Robert B. Newman, Associate Professor of Architecture, will lecture at the Royal Academy of Fine Arts, Copenhagen, Denmark. Chadwick Haberstroh, Assistant Professor of Industrial Management, will lecture on statistics at the University of Cuenca, Ecuador.

Professor Isador Amdur of the Department of Chemistry has been appointed Fulbright Adviser to succeed Professor Franklin.

Eugene R. Chamberlain and J. Peter Anderson, both of the Admissions Office staff, have continued to act as Associate Advisers to Foreign Students. They have specialized in admitting and counselling undergraduate foreign students. Mr. Anderson was on the program of the annual conference of the National Association of Foreign Student Advisers in April, 1957, and Mr. Chamberlain was responsible for two New England regional conferences of the Association. Another participant in the annual conference was Professor Joseph R. Applegate, who teaches a subject in English for Foreign Students. The undersigned was elected to the Board of the National Association of Foreign Student Advisers.

PAUL M. CHALMERS

DIRECTOR OF THE INDUSTRIAL LIAISON OFFICE

The year 1957–58 fills out an even ten years since the establishment of the Industrial Liaison Program as a formal mechanism for providing industrial concerns with convenience of access to the Institute's professional activities. A number of special features mark this year of activity, all leading to the impression that the Program has reached a state of healthy maturity. With the Program continuing to follow its well-established pattern, a number of innovations have been tried this year, and noticeable improvements have been made in the organization and management of certain aspects of the Program. A good year of liaison activity has been experienced, even though the business recession created some uncertainties and difficulties of operation. This performance has been possible because the Office has been adequately manned by people of top quality who have demonstrated a high order of initiative, energy, and harmonious cooperation.

On the financial side, the amount of income has held to within 7 per cent of last year's all-time high figure, with over $250,000 of the Faculty Salary Adjustment Fund resulting from the Liaison Program. This success has been achieved in spite of the generally unfavorable economic outlook, a fact that may be attributed in part to industry's satisfaction with the liaison services and in part to the energetic cooperation of the Office of the Secretary

of the Institute in seeking additional support. It may also indicate industry's growing acceptance of the importance of research and growing sense of responsibility in regard to support of technological education.

Three companies increased the level of their support, while four companies found it necessary to reduce the level of theirs. Twelve new companies joined the Program, and three withdrew for financial reasons, bringing the number of companies on the list to an all-time high of ninety. It may be significant that five of the twelve new companies are located on the Pacific Coast. During the year, plans were put into effect to bring the formal agreements covering companies' participation in the Program in line with modifications of policy approved in January, 1957. The current standard form of agreement is simpler in format and content than earlier ones.

Planning and conducting individual visits to the campus by key people from each company has continued to occupy a major portion of the attention of the Liaison Office. An innovation along this line has been tried twice this year, whereby the Office arranges for a number of the key technical people of a company to make a collective visit to the campus. This type of visit has required careful planning and a greater degree of formalization and preparation than is customary for individual visits. At the same time, faculty response has been favorable, and the company representatives have unquestionably benefited from the mutual stimulation and group support that is involved. This plan will be continued on a selective basis. Visitor activity as a whole has shown a slight decrease of 4 per cent over the previous year, in spite of the increase in the number of participating companies. The decrease seems to be due to a general tightening of company travel budgets. Efforts have continued to broaden the base of faculty members participating in this industrial visitor activity. A natural result has been a shift in the center of impact of the visits toward the younger faculty members, with a significant decrease in the percentage handled by persons of full professor rank.

Symposium activity has continued as an important and highly efficient aspect of the Program. Twelve private symposia were held, with an average attendance of about fifty visitors. Seventy-seven companies sent representatives, and a total of eighty-two staff members and graduate students and eight speakers from outside organizations contributed to the symposia. Four of the Institute's

five schools were represented in the series. Most of the meetings dealt with areas in engineering, while two were in science and one each in industrial management and humanities (Center for International Studies).

During the year, the methods of handling publications distribution were overhauled, and a staff member was, for the first time, assigned to supervise this function as a major part of his duty. This change has already resulted in several improvements, including better control of this aspect of the Liaison Program and several decisions regarding areas for new emphasis. These decisions are calculated to produce a more effective representation of the publications from certain academic departments and a reduction in the number of mailing points for some of the companies. During the year there was an increase in the distribution of preprints of articles by faculty members, the most valuable part of the publications activity. This change was accompanied by a deliberate decrease in the number of reprints distributed. The over-all effect is an improvement in the liaison service to the companies and a net decrease of about 10 per cent in the total number of titles distributed. The quantity of each title distributed has continued to rise, averaging 221 for the year; this represents a percentage increase over last year slightly greater than the increase in the number of companies.

Among the activities receiving special attention during the year has been the transmission of information concerning Special Summer Session opportunities. The Directory of Current Research grew from last year's 682 projects to a total listing of 825, indicative of more thorough coverage and of increased faculty interest. Emphasis continued on faculty visits to companies, but results were disappointing. Records show that twelve M.I.T. staff members paid eighteen visits to fifteen different companies. Improvement in this area would be extremely beneficial to the Program.

Numerous occurrences during the year illustrate the two-way nature of the Industrial Liaison Program. One example is the participation by ten company representatives as judges in the annual machine design panels of the Mechanical Engineering Department. Other examples include opportunities offered to faculty members to obtain industrial cooperation, both financial and technical, on their particular research activities. A specific case was the arrangement for an industrial guest to work in the nuclear reactor project for a period of months, thereby benefiting the Institute while also benefiting the company through the experience gained. Many of the

contacts made by faculty members through the Program have also resulted in private consulting arrangements of a desirable character.

Under the planned turnover policy of the Industrial Liaison Office, Kendall B. Randolph joined in September, 1957, as replacement for Ralph L. Wentworth, who had completed his term as Industrial Liaison Officer and accepted a position in industry. In January, 1958, the staff was augmented by the addition of Winston R. Hindle, Jr. Vincent A. Fulmer served throughout the year as Assistant Director and also assisted the Secretary of the Institute on a part-time basis. Effective July 1, 1957, the Industrial Liaison Office was made directly responsible to the Office of the Chancellor, reporting through Dr. Carl F. Floe, Vice Chancellor.

WILLIAM R. WEEMS

DIRECTOR OF LIBRARIES

Last year I reported that most of the changes in the Libraries and their operations had been made to remedy past defects, at a time when the present and future were clamoring for attention. This year it is a pleasure to be able to move from history into present time. Many of the solutions of today have been for today's problems. We have also looked ahead; plans have been made for remodeling Dewey Library early next year, and this should take the pressure off its bursting seams for another five years. In nearly every sector of the Libraries there has been forward-looking experiment and improvement.

Science Library

A thorough reorganization of materials and services has been accomplished in the Science Library this year. Ryburn Ross, appointed at the end of last year as Executive Officer, has worked with the Faculty Advisory Committee and with his staff to eliminate most of the criticisms of previous years. The handling of reserve books has been simplified by putting them on open shelves, and the clerical operations have been systematized and speeded up.

An important factor in the improved service of the Science Library has been the inauguration of an information and reference desk in the middle of the reading room, where a professional librarian is available throughout the day to answer questions and help the readers find what they need.

A new service was made possible by the generosity of the Air Information Division of the Library of Congress. It provides English abstracts of articles appearing in all the major Russian science journals. Also, through the kindness of Lincoln Laboratory, a rapid copying machine was provided. Lincoln Laboratory has stationed a librarian in the Science Library, to do research and make copies of book pages and journal articles unavailable in the Lincoln Library, sending them by courier to Lincoln.

The purchase of a photoelectric counter has made it possible to get more accurate figures than previously for traffic in the Science, Engineering, and Dewey Libraries. The count in Science during the month of November showed a weekday average of 1,108, an extraordinarily high figure. The average on Saturday was 624; and on Sunday, 539 — though Sunday hours are only 1 to 9 p.m.

The total circulation of books is about the same as last year. A 10 per cent increase in the borrowing of one- and two-week books was equalized by a drop in overnight loans, resulting from restrictions which academic departments placed on reserve books.

Since book checkers were placed at the doors of Science and Engineering, the number of books which have disappeared has been reduced. Still, of 659 volumes placed on reserve in Science in the fall term, 15 disappeared; and of 705 in the spring, 12 cannot be found.

Regular monthly lists of new books added to the various collections were prepared by Miss Marguerite Chamberlain (Physical Sciences), Miss Anne-Marie Hartmere (Earth Sciences), and Miss Eileen Kibrick (Life Sciences). These lists were mailed to Institute faculty, research staff, and others requesting them. A guide, "The Science Library," was produced by the staff.

Engineering Library

The load on facilities of the Engineering Library was steady, with an average traffic count of 523 on weekdays, 176 on Saturdays, and 133 on Sundays, throughout the months of February and March. Figures for the circulation of one- and two-week books show a considerable increase over last year — 19,867 against 17,203 a year ago. Reserve book circulation was also up this year: 5,854 vs. 3,693 last year. Book losses, in spite of checking at the door, show ten volumes gone from the Electrical Engineering reserve section and eighty from the stacks; some of the latter may have disappeared before book checking was started. A half-dozen serious cases of mutilation of

books and bound journals by cutting out pages, articles, or chapters have been discovered. We hope that, with the assistance of the faculty and vigilance on the part of the library staff, this vicious practice may be stopped.

During the summer, Engineering Library journals prior to 1935 were moved to the seventh floor; at the same time, later numbers were arranged into a single alphabetical sequence around the reading room.

As in the Science Library, English abstracts for Russian journals in engineering fields have been provided by the Air Information Division of the Library of Congress.

A series of lectures were given this year by Ralph McNay and by Miss Pearl Lewis, Vail Librarian, to engineering graduate students to assist them in using the literature of their fields. Exhibits were prepared in connection with seminars, and lectures and longer-term exhibits were arranged in the lobby of the Library. The addition of Miss Arlene Kupis to the staff has greatly assisted in the preparation of the monthly "Have You Read," consisting of abstracts of outstanding articles on engineering, which is mailed to those requesting it, as are the regular lists of new accessions.

As part of the long-term program to modernize facilities, new washrooms were added this year. Improved lighting is needed in the reserve book room, better furniture is needed for both reading room and library working quarters; faster automatic elevators should be installed. We hope for all of these in the near future.

Dewey Library

Dewey's critical space problem is on the way to an early solution. The Faculty Advisory Committee and Miss Barbara Klingenhagen, the Librarian, have finished plans, and work will begin soon on alterations incorporating nearly 500 square feet of previously unused floor space. About half of this will be put into stacks for growth and to house important files of periodicals heretofore stored on the seventh floor of the Engineering Library for lack of room in Dewey; the other half will provide additional reader space and a new entrance with larger circulation desk and shelving for reserve books. The latter facility is particularly urgent, for reserve books have shown a rapid increase again this year, going from 2,936 volumes in 1956–57 to 3,571 this year. This rate of increase has been maintained for several years, paralleling the growth of the School of Industrial Management.

Since it moved to the Sloan Building six years ago, the Dewey Library has had a phenomenal growth in use. Total circulation has more than doubled in that time. Overnight circulation of reserve books has tripled. In total circulation, Dewey is rapidly approaching the Science Library and even the General and Humanities Library with its much larger collections. Comparative figures for material taken out this year are: Dewey 41,231, General and Humanities 45,041, Science 43,863, and Engineering 25,895. Its room use of books exceeded that of the Reserve Book Room by 5,000.

A traffic count at Dewey during April and May showed a weekday average of 719, Saturday 199, Sunday (4 hours only) 98.

Dewey is badly understaffed. Until the new construction is completed, there is no room for additional personnel, but another professional staff member is clearly indicated for the near future.

A Thermofax copying machine was installed in March, 1957. It is heavily used and relieves some of the borrowing load which, in Dewey as elsewhere, is partly attributable to users not connected with M.I.T. A measure of the interest of outsiders in Dewey's collections is the fact that 320 of the 660 addresses on the mailing list for the monthly accessions list are from outside the Institute.

Use of our facilities by members of the industrial community around Boston is on the increase, at a time when use by M.I.T. people is also becoming heavier. The Corporation Visiting Committee on the Libraries has recommended the imposition of a more substantial fee for outsiders, in order to protect our facilities and to pay for the additional load. The total number of outside borrowers for all libraries is small: 380 cards issued, 240 complimentary and 140 at $10; but some individuals from industry make very heavy use of the Libraries, including one who "practically lives here."

General and Humanities Library

This library is composed of the Humanities collections, shelved in the second-floor reading room and the basement stacks. It is under dual administration, with the Humanities collections, the Reserve Book Room, the Music Library, and the organization of exhibits under the direction of Mr. Burton A. Robie, Humanities Librarian. Supervision of the basement stacks and the circulation of all material are the province of Miss Louise Trainor.

The Library's exhibit program has been extensively developed during the year, and 43 exhibits have been shown. The Libraries

extend their appreciation to the Rare Book Department of the Boston Public Library, to the Museum of Fine Arts, the Fogg Museum, the Smithsonian Institution, the National Collection of Fine Arts, and the many other generous friends outside and inside the Institute who by loans, advice, and assistance made the exhibit program an outstanding success.

Circulation figures for the Humanities collections showed a large jump this year over last for one- and two-week books, to 46,616 from 33,748. The Music Library was up, with a circulation of books, records, and scores of 19,836 vs. 18,054 last year; the Reserve Book Room showed a decrease from 13,891 to 12,693 volumes going out, but an increase from 14,564 to 16,207 volumes used in the room; more books were put on reserve for courses this year: 8,318 vs. 4,675 last year. Twenty-six books disappeared from the Reserve Book Room, which has no book checker, as contrasted to two in 1956–57.

Rotch Library

This year Miss Caroline Shillaber, Rotch Librarian, has completed an inventory of her entire collection. It shows 19,273 volumes. Work has also proceeded on cataloguing slides, making them accessible for study and for illustrating lectures. A large group of slides, numbering 15,000 two years ago, is now nearly catalogued and growing into a first-rate working collection.

During the summer new lighting was installed, giving good illumination on even the darkest days, and new shelving was erected in the alcove in the northeast corner.

Aeronautics Library

Added activity is reported this year by the Aeronautics branch of the Engineering Library directed by Miss Barbara C. Darling, Associate Engineering Librarian. A small decrease in the circulation of one- and two-week books, from 8,757 last year to 8,718 this year, is more than offset by the growing overnight circulation of reserve books, which nearly doubled: 670 last year, 1,202 this year.

The steady influx of technical reports has necessitated the addition of extra shelving and file cabinets. The catalog is full. A small discarded case of catalog drawers has been pressed back into service temporarily, but a new catalog will be provided in the near future. Extra tables and chairs must also be added, though floor space is already at a premium.

The Aeronautics Library is currently receiving about fifteen different large report series, probably the best part of its collection. In the N.A.C.A. series, 1,050 reports have been received in the past year, not counting duplicates; and 7,000 index cards have been cut, fixed, and filed for them. Aeronautical reports from NATO, Great Britain, and the U.S. Air Force are received in quantities, and more space will have to be found for them before long.

Library Administration

The administration of the Library has been much preoccupied with Russian material again this year. On August 5, 1957, a grant of $70,000 was received to subsidize the translation of three Russian electronics journals into English, the English titles being: *Radio Engineering*, *Radio Engineering and Electronics*, and *Telecommunications*. The entire job was contracted to the Pergamon Institute of New York and London. The appearance of the translations has been subject to long delay. As of June 30, only four of the thirty-six numbers for 1957 had appeared in the English edition. The balance is promised — but hardly expected — within sixty days.

During the fall, negotiations were started with the Instrument Society of America to sponsor jointly the publication of another Russian journal, *Automation and Remote Control*, in English translation. Permission was received from the National Science Foundation to use the unexpended balance of the previous grant. Arrangements were concluded in the spring with Consultants Bureau, which had been offering this journal at $185 a year, to bring the price down to $15 for libraries of nonprofit institutions and $30 for others. Eight numbers for 1957 have appeared, with the balance expected by the end of August.

It would be unfair to Pergamon Institute not to mention that the speed with which *Automation and Remote Control* has appeared is due to the fact that it was already in production at a higher price. Pergamon has been greatly hampered by a shortage of competent translators in England, where the work is being done. The problem of finding translators and putting three journals into production might have been even more difficult in the United States.

Russian scientific literature is most accessible to Americans if it is translated, but the cost is so high that American scientists are going to have to learn Russian. A 300 per cent increase in the number of students and faculty taking scientific Russian this spring term indicates that the movement is underway. A system of ex-

changes with various Russian libraries and academies seems to be the best way to acquire their publications. This material can be purchased here only through official Soviet book stores, whose service is poor and whose stock is small. Our operation of such an exchange is seriously hampered by the lack of an appropriately trained staff member to take charge and by the need for funds to purchase American publications to send in exchange. As an example of the expense involved, we are, as of June 30, purchasing 180 subscriptions to the *Journal of Mathematics and Physics*, which is edited at M.I.T., for exchange all over the world.

The National Science Foundation has made a grant to permit Professor Secor D. Browne of the Department of Modern Languages, who has been acting as Special Adviser to the Director of Libraries for Russian literature, to visit Moscow and other Russian cities. He plans to go to Russia in October, and will discuss exchanges as well as other aspects of the collection, organization, and dissemination of scientific information inside the Soviet Union.

Records of our holdings of current journals and other serial publications, of which some 3,200 are received, have this year been entered on punched cards, under the direction of Miss Natalie N. Nicholson, Executive Assistant to the Director, and with the cooperation of the Catalog Department. While this project has clearly improved our service in handling serials, it has also attracted considerable interest from the technical point of view. Several other libraries are considering putting their records on punched cards, now that our experience shows the desirability and feasibility of the application of this method to small collections.

Cataloguing

The Catalog Department has done its best to keep abreast of the flood of incoming materials, and in addition has carried out two major projects.

As to the regular work, 11,360 new titles were catalogued (including 396 records and scores); 42,059 catalog cards were typed; 16,719 other cards typed for offset reproduction; and 14,983 cards were bought from the Library of Congress. Of these, somewhat more than half (39,298) were filed in the Union Catalog, while 34,463 were sent to divisional libraries for their catalogs. (These do not include shelf list cards, temporary cards, and thousands of other special cards typed by the Catalog Department.) In this regular work Miss Hildegarde Ziegler, Catalog Librarian, is assisted by

Miss Cecile Barsky, specializing in cataloguing books in engineering; by Miss Jessie Howes, in science; and by Mrs. Gladys Neary, in economics and industrial management.

The language distribution of the new titles was as follows:

English	9,530*
German	441
Russian	402
French	318
Spanish	126
Italian	53
Polish	21
Swedish	20
Dutch	18
Others	35
	10,964
Records and scores	396
	11,360

* Including 1,004 M.I.T. theses.

The principal extra project of the Catalog Department was directed by Mrs. Margaret de Le Vin, Senior Cataloger, and Miss Muriel Lewis, Cataloger. It involved the preparation of data for the punched card record of serials, described above. The department's other project was the completion of recataloguing records and scores in the Music Library.

The shift of emphasis in science toward material in Russian has made especially heavy demands upon Miss Ziegler's time. She has now been joined by Mrs. Milda Kalnins, who knows several Slavic languages and who will assist in processing iron-curtain materials more quickly.

During the year, 144 entries were reported to new "Serial Titles" of the Library of Congress; 620 entries were sent to the National Union Catalog; and in January we started reporting Russian acquisitions to the Slavic Union Catalog of the Library of Congress, with 98 titles since then.

Circulation

The Circulation Department, under the leadership of Miss Trainor, handles materials from the General and Humanities reading room and from the Hayden stacks. It also controls admission to the basement stacks. This year 5,412 people were admitted to the stacks.

Circulation of one- and two-week books was 44,615 (overnight books 426) vs. 40,640 for one- and two-week books (350 for overnight) last year. The periodical collection received heavy use: 6,855 journals and serials were borrowed during the year, including bound and unbound journals and also the Atomic Energy Reports.

The basement stacks are still sufficient to hold several years of growth, but a move is planned for next year to free some twenty ranges of stacks for expansion of the periodical collection, which now completely fills the ranges originally assigned to it.

Microreproduction Service

The demands on the Microreproduction Service continued to increase this year. There were fewer large orders from individual firms, but these were more than offset by an increase in orders from new companies and from M.I.T. staff and students. Orders for photoprints and negative and positive microfilm were up nearly 20 per cent. Increased cost of film and photographic paper, along with increased salaries, offset the savings from greater volume; the income from the entire operation remained adequate to offset depreciation and replacement of equipment. Increased volume next year will result from an agreement recently reached with the Library of Boston University. Under this arrangement the Microreproduction Service will process Boston University orders, making photoprints and microfilm available to users of Boston University Library facilities for the first time.

We have agreed to make a three-year trial of a plan to microfilm all doctoral theses as soon as they are received, before theses are sent to be bound.

Important research is under way in the laboratory. Peter Scott, Head of the Microreproduction Service, has made tests of a new microfilm process, in cooperation with the Kalvar Corporation. He has developed new tests for the permanence of microfilm and for the sharpness of images, both of which have aroused much interest in the industry. He has also carried out tests of quick-copying devices, and his special competence in this field has been of great value to us and to other libraries in the region.

Order and Acquisitions

Miss Eleanor Canty, Acquisitions Librarian, reports that for the first time the department is sufficiently staffed to handle the increasingly heavy work load. A net total of 13,912 volumes was added to the Libraries this past year, compared with 11,033 in 1956–57, mak-

ing the total of volumes in the Libraries 633,531. Approximately half of the accessions were placed in the Hayden building, 2,564 of these in the Science Library; the other half was divided among the Dewey, Engineering, and Rotch Libraries.

Periodicals and Binding

In all, 187 new journal subscriptions were added this year, and 5,084 volumes were sent to binderies by Miss Gertrude Perry, Periodicals and Binding Librarian. Of these, 2,962 were periodicals, 1,411 books and pamphlets, and 711 theses. The department's binding and repair section bound 330 volumes in pamphlet binders.

Reference

The Reference Department has two closely allied functions. One is to find information for people who request it; the second is to help people find information they want by introducing them to the resources of the Libraries. In the former category are telephone inquiries, up this year to 9,979, 35 per cent over last year. Mail reached 1,415 pieces this year, 1,150 last year. Requests for help by those appearing in person at the Reference and Information Desk numbered 4,746. Many of the latter, of course, involved active assistance from a reference librarian to help track down the desired information source.

Mrs. Irma Y. Johnson, Reference Librarian, reports real and continuing difficulty in identifying publications of Institute departments and laboratories. Requests for such publications, totaling 1,173, were handled by the Reference Department last year; that is, titles were identified and the requests were forwarded to the appropriate place. To quote Mrs. Johnson, "This identification is time-consuming, as the orders often cite the title only. The Institute should have a clearing office with information about all the publications of its various departments and laboratories; but until it does, the Library seems best fitted to continue to do the job. It has its rewards; we find that 10 to 15 per cent of the publications requested are titles that have not come to the Library; and we might not otherwise learn of them before they go out of print."

Interlibrary borrowing this year increased by more than one-third. We borrowed 1,158 publications and purchased 143 photographic copies of documents from 203 libraries. There was an increase of a little more than 10 per cent in interlibrary loans, with requests coming from 477 different libraries, about two-thirds of

which were in industry. The libraries of five firms made over one-third of all the requests (2,822) for loans.

Miss Margaret F. Little, Assistant Reference Librarian, has started this year a more active program of acquiring materials for the Technology Collection. The Collection should be representative of the work of Institute staff, students, and alumni.

The Reference Department has worked extensively with other departments by giving orientation lectures to new staff members and supplementing the lectures of other library staff members to graduate students. Some of the time has been spent by the staff in introducing visitors to the Libraries, especially to the Hayden building. Much satisfaction should be taken by the designers and planners of the building in the knowledge that, though it is no longer one of the newest buildings in the country, it still attracts many visitors from all over the world.

A major new addition to the reference collections this year is *Great Soviet Encyclopedia*, an indispensable source of information about the Soviet Union. Biographies of scientists unavailable elsewhere, for instance, can be found here.

Special Collections and Gifts

The Libraries have received many gifts this year, large and small; of these, over half have been added to the Library by Miss Eleanor Bartlett, Special Collections and Gifts Librarian.

It is generally estimated that acquisitioning and cataloguing any book, even a gift, costs $5. The figure of $1.50 a year is used for the cost of keeping the volume on a library shelf. It is, therefore, important that we screen all gift material carefully and add only those items which actually promise to be of value to us.

It is appropriate to express here publicly the appreciation of the Institute Libraries for the generosity of so many students, staff members, alumni, and friends of the Institute.

Student Staff

This year, for the first time, the Libraries employed a student captain to supervise its extensive student staff. The staff was composed of 60 students working regularly scheduled hours, totaling 483 hours a week. There was notably improved cooperation between student staff and regular staff, thanks to the energy, enthusiasm, and diplomacy of Stuart Uram, the student captain.

Staff Changes

There have been several appointments, promotions, resignations, and retirements this year.

Secor D. Browne, Assistant Professor of Russian, joined the staff as Special Adviser to the Director to help in the expansion of our holdings in Russian scientific and technical literature.

Mrs. Milda Kalnins was appointed Cataloger and Miss Diana Jorjorian was appointed Acting Earth Sciences Librarian to replace Miss Anne-Marie Hartmere, who was given a leave of absence for travel.

Promotions for next year are: Miss Natalie N. Nicholson, from Executive Assistant to the Director of Libraries to Associate Director; and Mr. William Presson from nonstaff to staff.

Miss Shaela Netzel, Associate Dewey Librarian, left in September to be married, and her replacement, Miss Regina A. Pichetti, resigned effective June 30.

This year brings the retirement of two librarians who have been at the Institute for many years: Mrs. Ruth McG. Lane, Vail Librarian Emerita, and Miss Miriam Smith, Reference Librarian Emerita. Mrs. Margaret de Le Vin, Senior Cataloger, becomes Emerita.

Activities

Early this spring Miss Nicholson was awarded a fellowship to participate in an advanced training program for library administrators, conducted by the Rutgers University Graduate School of Library Service under a grant from the Carnegie Foundation. For three months each of the eight participants concentrated on a different library problem. Miss Nicholson's assignment was a study of the science libraries at Johns Hopkins University.

Several members of the staff participated in the program of the New England Library Association Conference in October, 1957.

During the past year the Director has acted as Chairman of the Committee on Translations of Russian Scientific and Technical Journals of the Association of Research Libraries. In February he participated in a conference sponsored by Western Reserve University to consider the creation of a national scientific information center, and in May he represented M.I.T. at a Conference on the Communication of Scientific Information, organized by the International Business Machines Corporation. Leaders in the field discussed possible applications of computers to codes, languages, and games.

Mr. Scott presented a paper on "The Permanence of Silver Film" at a meeting of the National Microfilm Association in New Orleans. He is a member of the newly organized Copying Methods Committee of the American Library Association and of the American Standards Association Committee PH 5 on documentary reproduction. Miss Caroline Shillaber, Rotch Librarian, was chosen first Chairman of the Committee of Planning Librarians at its organizational meeting held in conjunction with the annual meeting of the American Institute of Planners in October, 1957. Mrs. Irma Johnson acted as Secretary-Treasurer of the Science-Technology Group, Boston Chapter, Special Libraries Association, and in June was elected Chairman for the coming year.

WILLIAM N. LOCKE

DIRECTOR OF PUBLIC RELATIONS

The violent awakening of the American press and public in 1957 to the importance of science and education abruptly affected the activities of the Office of Public Relations. Developments at the Institute, such as the calling of Dr. Killian to Washington and the use of Computation Center facilities for computing satellite orbits, directed attention to M.I.T. as a source of news, and we became even more conscious of our responsibility for contributing to the information of the public.

The organization of a symposium for New England newspapermen was one specific response to help fulfill this responsibility. Co-sponsored by Harvard University and supported by the Nieman Foundation, this two-day program was designed not to disseminate publicity but to give journalists some understanding of the basic motivations and methods of science, with the hope that they would search for the significant rather than the spectacular. The response was warmer than we had expected, and members of the faculty who participated felt rewarded by the interest of all who attended. One newspaperman described his experience in an article in *The American Editor* and urged a long-range program to train science reporters as well as a two-week — rather than a two-day — seminar.

Volta Torrey, Director of Television, gave strong emphasis to current subjects such as missiles, satellites, and nuclear energy, on his weekly WGBH-TV Science Reporter programs. He also recorded, for use on educational radio stations throughout the country, a series of interviews with faculty members from M.I.T., Harvard,

and Yale under the title, "The Century of Science." Miss Elizabeth A. Kelley of the Department of Meteorology became the permanent conductor of the "Weather for You" program on WGBH-TV. Our staff assisted in presenting several network television programs, including a filmed interview of Dr. Vannevar Bush by Dr. James G. Kelso in the "Wisdom" series.

Mr. Torrey was called upon for counsel in various tentative moves toward academic use of television. The first teaching by television at M.I.T. was done in six mathematics lectures given by Professor Hartley Rogers, Jr. He reports that the medium proved more satisfactory than expected, but most students prefer a large lecture hall with the professor present in person. We suggest that the Institute continue to explore possible uses of television.

Appointment of Walter L. Milne to a new position at M.I.T. would be regarded as a serious loss to the Office of Public Relations if it were not for the prospect of continued close association. His contribution to the Institute has been greater than may be generally realized. We are pleased to have George D. Wood, Jr., who has had extensive experience at Boston University and the Cambridge Air Force Research Center, join our staff.

In January the Institute was pleased to entertain more than one hundred New England members of the American College Public Relations Association at the annual district meeting. The program, planned under the direction of John I. Mattill as district director, emphasized the growing importance of science in colleges as well as the practical techniques of publicity and publications which are always of interest in this group.

Office Of Publications

Distinction in design, which has characterized the publications of M.I.T. under Mr. Mattill's supervision, continued to gain recognition during 1957–58. The *Family Guide to M.I.T.* won a gold medal in the 1957 exhibition of the Art Directors Club of Boston — the second consecutive year for an M.I.T. publication. Folders for the 1958 Special Summer Programs won the sweepstakes award at the annual exhibition of the American College Public Relations Association, and the 1958 Undergraduate Catalogue placed second in its category. In 1957–58, design work was in the capable hands of Miss Jacqueline Shepard and Ralph Coburn; Mr. Coburn joined the staff to fill a vacancy left by Miss Muriel Cooper, who

returned from a Fulbright Award for study in Italy to engage in independent designing.

For three months the staff was honored by the visit of George A. Adams, distinguished designer from the London School of Printing and Graphic Arts. In addition to assisting in the design of the 1958 Special Summer Program announcements, Mr. Adams undertook a coordinated redesign of the printing associated with Commencement. During his visit Mr. Adams collected material for an exhibition of M.I.T. publications, which was shown at the London School shortly after his return and which later travelled to other institutions in the British Isles. His fresh viewpoint on the Office's problems and activities was most stimulating, and similar arrangements for other visitors are now a definite part of our future plans.

The appointment of Frederic W. Fenerty as Purchasing Agent with special responsibility for printing has been immediately helpful in lightening some of the Office's administrative load. This centralized purchasing, working in close cooperation with the Office of Publications, will help the Institute realize more fully the advantages of coordinated planning and production of all printed matter. Already this distribution of publications responsibility between public relations and business management is being studied with interest by other institutions.

FRANCIS E. WYLIE

DIRECTOR OF THE REGISTRY OF GUESTS

The Office of Director of the Registry of Guests was headed from its inception, in 1952, until June 30, 1957, by Dean John W. M. Bunker. When the present director assumed the post, on July 1 last, he appreciated the significance of Thomas Jefferson's statement to Vergennes, the French Foreign Minister to whom he presented his diplomatic credentials. Jefferson told Vergennes that he merely succeeded Dr. Franklin; no one could replace him.

Succeeding Dean Bunker has been an easy task, since the system he installed was such an efficient one. However, some delimitation in the range of activity of the office was necessitated by circumstances. The President's office kindly consented to handle the Guests of the Institute, and the category of Visiting Fellow is now a function of the individual departments concerned and the President's office. These changes have left the Registry of Guests with

the principal objective of receiving and arranging the schedule of visits for foreign visitors who have been introduced to us by departments of the United States government, embassies or other agencies of foreign governments, foreign institutions of higher learning, overseas industrial interests or their American affiliates, and by other sources.

There are several steps in arranging and bringing to fruition a visit to M.I.T. which is channeled through this office. There is initially the preliminary correspondence. This is followed by the drawing up of a tentative schedule for the visitor. In this latter phase, faculty and staff are consulted. When this schedule has been satisfactorily completed, a list of the appointments is forwarded to the hosts here and to the visitor. Upon the arrival of the group or the individual, there is a brief reception at the Registry of Guests, where a cordial welcome to M.I.T. is extended. Following this, the visitors are then personally escorted to their first appointment.

While the function of the Registry is to save as much of the time of the faculty and staff as is possible, it is not intended as a substitute to relieve the members of their responsibilities as hosts. For both Miss Anita Fulmer, the hospitable secretary of the Registry, and myself, I am most grateful for the friendly cooperation extended to us by all we have had to call upon for assistance in arranging these appointments. The courtesies extended by faculty and staff to our visitors have been deeply appreciated, as a file of grateful letters from all parts of the world reveals. The warm spirit with which our visitors have been received has served in these many lands to identify with M.I.T. the hallmark of gracious hospitality.

During the past year, the Registry received visits from over four hundred citizens of the following fifty countries: The Argentine, Australia, Austria, Belgium, Bolivia, Canada, Chile, Costa Rica, Cuba, Denmark, Eire, Ethiopia, Finland, France, Germany, Ghana, Great Britain, Guatemala, Hong Kong, India, Indonesia, Iran, Japan, Kenya, Korea, Liberia, Libya, Mexico, Morocco, The Netherlands, New Zealand, Nicaragua, Nigeria, Pakistan, Panama, The Philippines, Poland, Portugal, Somaliland, Southern Rhodesia, Sweden, Switzerland, Taiwan, Thailand, Trinidad, Uganda, U.S.S.R., Union of South Africa, Viet Nam, and Yugoslavia.

THOMAS H. D. MAHONEY

DIRECTOR OF THE SCHOOL FOR ADVANCED STUDY

As a consequence of the rapid advances in knowledge in recent times, young scholars who already have their doctor's degrees have been coming to M.I.T. in ever-increasing numbers to pursue advanced study and research under the guidance of our faculty. To give formal recognition to this postdoctoral study, President Killian announced the establishment of M.I.T.'s School for Advanced Study on January 4, 1956.

Nominations for Fellows of the School for Advanced Study are initiated by individual faculty members. Most holders of recognized postdoctoral fellowships at the Institute are so nominated; others are nominated from among those receiving funds administered by the Institute for the support of scholarly postdoctoral research.

During the past two academic years, two groups of Fellows of the School for Advanced Study have been appointed. The countries of origin of these Fellows, and the distribution of the Fellows among the departments of the Institute, are indicated in the accompanying tables.

Nearly a dozen papers have already been published by members of the first group of Fellows, as a result of research during their stay at M.I.T.

Origins of Fellows of the School for Advanced Study

	1956–57	*1957–58*
Austria		1
Belgium	1	
Canada		1
Egypt		1
England	3	2
France	2	
Germany	3	2
Italy		3
Japan	2	2
Netherlands		1
Norway	1	1
Sweden	1	
Switzerland	1	
Turkey		1
U.S.A.	5	10
	19	**25**

Distribution of Fellows of the School for Advanced Study in M.I.T.

School	*Department*	*1956–57*	*1957–58*
Engineering	Aeronautical Engineering	1	
	Chemical Engineering	3	1
	Electrical Engineering	1	4
	Metallurgy	3	4
Humanities and Social Studies	Economics and Social Science	2	2
Science	Biology	5	5
	Chemistry		1
	Geology and Geophysics	2	2
	Mathematics	2	2
	Physics		2
Computation Center			2
		19	**25**

Alfred P. Sloan Foreign Postdoctoral Fellowships

During the past year we have been fortunate in receiving funds from the Alfred P. Sloan Foundation, Inc., for the purpose of inviting to the School for Advanced Study a limited number of young foreign scholars of unusual qualifications. Nominations for these fellowships were submitted by members of the faculty to a selection board appointed by the Chancellor. After a careful screening, seven of the nominees have been invited to come to the Institute as Alfred P. Sloan Foreign Postdoctoral Fellows.

Some Immediate Objectives

The program of inviting to M.I.T. young scholars of unusual qualifications is a promising one, and we hope that it can be continued and expanded. Under the Sloan program we are limited to inviting scholars from overseas. It is important to supplement this with offers of fellowships to American postdoctoral scholars of high qualifications.

The School has another important objective for the immediate future. Even during the planning stages of the School, it was recognized that an appropriate on-campus housing center would be needed for its Fellows. Now that the School has come into existence, the need for such housing is keenly felt. The School for Advanced Study, as an organization, seeks not only to give its Fellows a sense

of belonging to M.I.T. but also to bring them together in such a way as to encourage an interchange of ideas. This always results in stimulation and often leads to new scientific developments.

M.I.T. often has distinguished guests who come for limited visits. A housing center for the Fellows of the School for Advanced Study should also make provision for these temporary guests of the Institute. Members of the faculty may also desire to live with this group of scholars.

MARTIN J. BUERGER

DIRECTOR OF THE SUMMER SESSION

The 1957 Summer Session saw no change from the activities of the recent past; its principal components consisted of (1) a series of Special Programs, (2) professional conferences or symposia, and (3) a limited number of regular subjects for M.I.T. graduate and undergraduate students.

Special Summer Programs

Eight years ago the Institute initiated a short series of special courses designed for professional men and women in business, industry, and government. From a modest beginning, this activity has developed into the major feature of the summer operation. Each program aims to present, in the short space of one or two weeks, a significant amount of material in one professional area, of benefit to people already established in that field or a related one. Each school in the Institute participates, as indicated by these figures showing the number of programs in the 1957 Summer Session:

Architecture and City Planning	2
Engineering	21
Humanities and Social Studies	2
Industrial Management	3
Science	5

In some instances a program was conducted by faculty members of two different departments.

The total registration in the thirty-three programs of the 1957 Summer Session was 2,000, compared with a registration of 2,698 in thirty-eight programs in 1956 and 1,717 in thirty programs in

1955. These figures indicate the widespread acceptance of this specialized type of education. The 2,000 registrants were drawn from 2,598 applicants.

The popularity and the need for this training can be illustrated by the program on Technique of Infrared Spectroscopy, which has been offered under the direction of Professor Richard C. Lord every year for the past eight years. Despite the repetition, 117 men and women applied this year; from this number, 60 were admitted — the maximum number that could be accepted. Every registrant held a bachelor's degree, and 10 of the 60 held doctor's degrees, thereby illustrating that the program continues to attract well-qualified people. Other repeat programs also continue to be very popular.

A typical registrant in the summer program is a man, thirty-six years of age, who holds at least a bachelor's degree. The chances are two out of three that he is employed by a company, rather than by a government agency or educational institution, and four out of five that he is located east of the Mississippi River. It is to be noted here that a substantial number of registrants (416 in 1957) travel from the western part of the United States or from foreign countries to attend these one- and two-week sessions. In view of their short stay at the Institute, special efforts are made to make the registrants feel at home. Dinners and outings make it possible for them to become better acquainted with their fellow students and with our staff. The Summer Session Office provides recreational literature and travel information for registrants and their families, and all are acquainted on arrival with such M.I.T. facilities open to them as the sailing pavilion, the swimming pool, and the Faculty Club.

This unusual educational undertaking developed rapidly because of the need of those outside M.I.T. for this type of training. At the same time the Institute has benefited in various ways; not the least important is the stimulation which our staff receives through working with a group of men and women professionally active in industry and government. Almost without question the M.I.T. staff member is enthusiastic about his association with a Special Summer Program.

An unusual feature this year was the presentation of a summer-type program from March 25 to April 3. At the urging of the Aircraft Industries Association, Professor J. Francis Reintjes and staff members of the Servomechanisms Laboratory in the Department of Electrical Engineering conducted a course entitled Programming

for Numerically Controlled Machine Tools. Here was another example of a program which attracted more qualified engineers than we could accept.

The Science Teacher's Program was not listed in the preceding statistics because it is a distinctly different course of instruction. An evaluation of the programs of recent summers led to the adoption of a new plan this year. Twenty-four high school science teachers were selected by the Institute to receive $800 scholarships provided by the Westinghouse Educational Foundation for eight-week participation in one of the research activities within the School of Science. This intimate exposure of teachers to scientific research appears to be an appropriate way in which the Institute can assist the advancement of science teachers at the secondary school level.

Conferences

Four professional conferences took place during the 1957 session. Professor William M. Murray conducted a conference on Crack Detection on June 13 and 14; Current Problems in Crystal Physics was held from July 3 to 6 under the direction of Professor John C. Slater; a national meeting of the Hydraulic Division of the American Society of Civil Engineers took place from August 26 to 28; and finally, the Electron Microscope Society of America conducted its national meeting from September 9 to September 12.

Regular Institute Subjects

As indicated in the reports of previous years, there has been a steady reduction in the total offering of regular M.I.T. subjects for graduate and undergraduate students. For example, compared with the 235 subjects in 1952 there were only 80 in 1956. This year's total was substantially the same as that of 1956. Evidently the stage has now been reached where a further reduction is impossible as long as we continue to offer subjects for the undergraduate who needs to repeat a spring-term subject, to provide instruction for students in some cooperative plans, and to offer some subjects for graduate students. The total registration at the end of the first week of the summer session was 1,536, 17 fewer than the registration at the same time in 1956. Since 1954, even though the subject offering has decreased, the student enrollment has remained substantially the same. For example, in 1954 there were 1,546 students.

A substantial fraction (60 per cent) of the registrants are graduate students who are devoting most or all of their summer to research on a thesis problem.

Series in the Arts

The success of the 1956 plan to present a series in the arts in cooperation with Harvard University led to a repetition of the program this year. Each school presented three functions. In M.I.T.'s case, the events were held in Kresge Auditorium and consisted of a performance by our Choral Society, a play reading of Shaw's letters, and an organ recital. Students and faculty members of each institution were admitted to these performances without charge.

JAMES M. AUSTIN

DIRECTOR OF THE TECHNOLOGY PRESS

During the year the Technology Press published the following books:

Notes on Analog-Digital Conversion Techniques, edited by ALFRED K. SUSSKIND, with five contributors. August, 1957.

Statistical Theory of Information, by ROBERT M. FANO. Incomplete preliminary edition. August, 1957.

**The Economics of Communist Eastern Europe*, by NICOLAS SPULBER. September, 1957.

Coding for the MIT-IBM 704 Computer, edited by FRANK C. HELWIG, with eight contributors. Second edition. October, 1957.

**Soviet Education for Science and Technology*, by ALEXANDER G. KOROL. November, 1957.

**The Tao of Science*, by R. G. H. SIU. January, 1958.

**Ceramic Fabrication Processes*, edited by W. DAVID KINGERY, with twenty contributors. January, 1958.

***Scientific Societies in the United States*, by RALPH S. BATES. Second edition. March, 1958.

**Atmospheric Explorations*, edited by HENRY G. HOUGHTON, with five contributors. April, 1958.

**Lectures on Ordinary Differential Equations*, by WITOLD HUREWICZ. June, 1958.

Random Vibration, edited by STEPHEN H. CRANDALL, with ten contributors. June, 1958.

**The Inflationary Spiral: The Experience in China, 1939–1950*, by CHANG KIA-NGAU. June, 1958.

* Published jointly with John Wiley & Sons, Inc., New York.
** Published in cooperation with the Columbia University Press, New York.

Our most successful book was Korol's timely study of Soviet education. The books by Spulber and Kia-Ngau are economic studies originating in the Center for International Studies. *Ceramic Fabrication Processes* and *Atmospheric Explorations* are symposium volumes that grew out of conferences held at the Institute; such books are now an important part of our work. The Press is always ready to help the staff with mimeographed notes and temporary editions, such as Fano's preliminary edition and the book edited by Helwig. The summer-session notes edited by Susskind and by Crandall are a more ambitious attempt to provide such notes quickly in a more convenient and attractive form. They cost no more to print than a comparable set of mimeographed notes, and they can be converted at short notice to an informal but respectable hard-cover book to meet the demand from industry for recent technical information on special topics.

The primary function of the Press is to finance and manage the publication of books. Most of the actual work of producing and distributing the books is done elsewhere under our control. This year we have added an experienced editor to our staff, so that we are now in a position to handle some of our important technical manuscripts in our own office, with substantial improvements in speed and economy.

LYNWOOD BRYANT

EXECUTIVE SECRETARY OF THE EDUCATIONAL COUNCIL

This report on the Educational Council covers the seventh year of its operation. Council membership now stands at 660 in the United States, of whom 611 are in 138 areas organized with school assignments and 49 represent the Institute in 38 areas not fully organized. An additional 40 Council members represent the Institute in other countries. It is impossible to present adequately the sense of enthusiasm which characterizes the membership of this alumni group, but some statistics on the over-all activity of the Council may be helpful.

Basically, Council activities fall within two major categories: first, as a long-range educational guidance group, members of the Council are currently in regular active contact with 1,131 high or

preparatory schools throughout the country. In this relationship, every effort has been made to aid in any way possible the school people, students, parents, and others interested in educational and career matters. In addition, less direct relations were maintained with 267 schools.

As a part of their guidance programs, many high schools now hold college nights to direct students' attention to future education and to give them an opportunity to learn about various colleges. Invitations to 220 college nights were received in this past year, and members of the Educational Council attended 159 of these. Members of the Council found specific interest in the Institute on many occasions, and a total of 1,988 student contacts were reported from these events.

A second major category of Council activity relates to discussions and conferences with students specifically interested in M.I.T. In the relationships established and the reports submitted concerning prospective students, the Council members perform a service directly beneficial to the Institute. It is in this area that valuable aid is offered to the Admissions Office in the selection process, to the Student Aid Office in determining financial aid awards, and, ultimately, to the whole area of alumni affairs. In the past year the Admissions Office referred 6,675 students to Council Members, and 3,197 interviews were actually reported. Between 65 and 70 per cent of the class which enters in September, 1958, will have been aided by the Council.

During the past year, continuing efforts have been made to bring members of the Council up to date on Institute affairs and developments. In addition to varied and extensive printed material sent from Cambridge, a program of visits with various areas has gone on. Between the end of February and mid-May, twenty-one areas were visited on Council business. In addition, many valuable discussions took place between members of the Council and Admissions Office, faculty, and staff visitors. It has been the pleasure of the Executive Secretary to meet almost 20 per cent of the Council members over the past six months.

One additional service performed by members of the Council is that of representing the President of the Institute at local academic functions. During the past year thirteen Council members attended centennial, inaugural, or convocation ceremonies at sister institutions.

As a means of making known more widely at the local level the services of the Council, arrangements have been made with the Public Relations Office to send news releases to local papers concerning Council appointments. In addition, news releases on significant activities or achievements of undergraduates are to be made available locally. It is hoped that these methods will aid in better communications all around.

This report would not be complete without a word of thanks to the members of the Council office staff, the President's Advisory Committee on the Council, and to the many other members of the Institute family here in Cambridge with whom we have been associated. Finally, it should be noted that the continuing energy and enthusiasm of the Council members individually formed the real basis for the report.

D. HUGH DARDEN

EXECUTIVE VICE PRESIDENT OF THE ALUMNI ASSOCIATION

From the start of the Alumni Fund, in 1940, up to June 30, 1958, total alumni benefactions to the Institute amounted to $26,447,317, of which sum $3,736,954 represented contributions received directly through the Fund. For 1957–58, the corresponding totals were $2,452,043 and $445,194.

Similar progress is to be noted in the numbers of alumni "participating" in the Alumni Fund's program for "annual giving"; in 1957–58 there were 13,331 alumni contributors to the Fund, compared with 12,001 for 1956–57 and 10,698 for 1955–56.

During 1957–58 the M.I.T. Club of Colombia was organized at Bogota, thus bringing our roster of these geographical groups to 94, divided as follows: 68 within the continental United States, 14 elsewhere in the Americas, and 12 overseas in the other hemisphere.

Senior of the 94 is the M.I.T. Club of Chicago, founded in 1887; and second is that of Denver, which will pass its seventieth birthday during 1959. Among the M.I.T. clubs having notable decennial anniversaries during 1958 are: the sixtieth, of Buffalo-Niagara Falls; the fiftieth, of Detroit, Portland (Oregon), and Seattle; and the fortieth, of New Haven and Panama. During 1959, in addition to Denver's seventieth, Pittsburgh and Washington will have

their sixtieth; Milwaukee and Spokane, their fiftieth; and Portland (Maine), its fortieth.

During the 12 months ended last April, 68 members of the Institute staff and Alumni Council attended 91 meetings of 56 different clubs. Two of these meetings were regional conferences, our 11th and 12th, held, respectively, at Pittsburgh on December 7 and at Washington on March 1. Besides these regional conferences, the record of other notable alumni foregatherings during 1957–58 includes:

On September 6–7, our second Alumni Officers Conference held at the Institute; on November 18, the Silver Stein dinner of the M.I.T. Club of New York; on December 17, the sixth annual pre-Christmas joint banquet of the M.I.T. Clubs of Dallas and Fort Worth; on February 21–24, the first M.I.T. class reunion held outside the United States, when the M.I.T. Club of Cuba entertained the Class of 1921; on March 13–15, the tenth annual fiesta of the M.I.T. Club of Mexico; on April 1, the dinner of the M.I.T. Club of Chicago, honoring the Institute's Acting President; on April 12, the sixty-first anniversary dinner of the M.I.T. Club of Philadelphia; and on June 16, the twenty-fourth Alumni Day in Cambridge, the program of which included the eighty-third annual dinner of the Alumni Association.

A census of our membership rolls taken March 31 last showed a total of 62,084 names: 48,949, or 78.8 per cent, being carried in living status and 13,135, or 21.2 per cent, as deceased. Four per cent of the 48,949 living alumni — that is, a total of 1,936 — were 50 or more years out of the Institute; 23 per cent were 31 to 50 years out; 41 per cent were 11 to 30 years out; and the remaining 32 per cent were 10 years or less out. Of the 1,936 living alumni 50 or more years out, 59 were already nonagenarians — and there were 681 octogenarians.

H. E. LOBDELL

DEPARTMENTS OF AIR, MILITARY, AND NAVAL SCIENCE

Department of Air Science

During the past year the Department of Air Science continued to place a major emphasis on leadership training. The practical leadership experience given on the drill field was generally limited to the

Advanced Course cadets because of the large number of Basic cadets involved. Many Basic cadets, however, were promoted to positions of responsibility and did have an opportunity to demonstrate their leadership potential. The problem of unwieldy classes was partially solved by the faculty when they voted in January to change M.I.T.'s R.O.T.C. program from compulsory to elective. As the new policy will mean smaller classes and a better attitude on the part of the students, this Department looks forward to the elective program. The results of an anonymous poll taken among freshmen students on the last day of classes indicated that 71 will definitely take Air Science II as sophomores, 79 are not yet decided, and 152 will not take Air Science II.

The faculty vote in January also called for an examination of both the Army and Air Force R.O.T.C. programs. The purpose of this examination is to develop a curriculum and teaching program which will be acceptable both to the M.I.T. faculty and, in our particular case, to Headquarters A.F.R.O.T.C. at Maxwell Air Force Base, Alabama. To represent the faculty, an *ad hoc* committee consisting of Professors James M. Austin, Holt Ashley, and Warren M. Rohsenow was appointed. The first meeting between the Professor of Air Science and a representative of this faculty committee was held in June, 1958. At this meeting a general plan of action which outlines our objectives for the coming months was decided upon.

Another noteworthy development in this Department is the change in curriculum initiated by our headquarters. This change reorganizes the academic portion of all four years but does not affect the leadership laboratory program. A resumé of the new curriculum follows:

In Air Science I (Foundations of Air Power), first-year students study the elements of air power and basic aeronautical science in a general survey subject. Topics include an introduction to Air Force R.O.T.C., elements and potentials of air power, air vehicles and principles of flight, military instruments of national security, and professional opportunities in the United States Air Force. During the sophomore year, in Air Science II, students have a more advanced consideration of air power, as exemplified by the combat operational capabilities of the United States Air Force, including the evolution of aerial warfare, weapon system development, U.S.A.F. operations, and the future of air power.

In the junior year, members of the Advanced Course study Leadership Principles and Practices (Air Science III), including major socio-psychological principles of leadership, the leader-follower relationship in an Air Force environment, and communication theory relevant to leadership. The fourth-year subject in Global Relations (Air Science IV) deals with global relationships of special concern to the Air Force officer, with attention to such aspects as weather, navigation geography, international relations, military aspects of world political geography, and the position of the Air Force officer.

Air Science I will be put into effect in the coming academic year; Air Science II and III, in September, 1959; and Air Science IV, in September, 1960.

This year, the Department gave orientation flights to 65 cadets. When possible, cadets were allowed to sit at the controls and fly the aircraft in simple maneuvers. In addition, two visits were made during the holidays, one to the United States Military Academy at West Point and one to the Arnold Engineering Development Center at Tullahoma, Tennessee.

Starting last March, the Department sponsored the weekly showing of a variety of films available through the Air Force Film Library. These films were shown twice a week to insure viewing by all interested persons.

Colonel Harmon Lampley, Jr., Professor of Air Science, has completed his tour of duty and is being assigned to Headquarters, United States Air Force, Europe, at Wiesbaden, Germany. He is being replaced by Colonel Frederic H. Fairchild, who comes to us from Headquarters, Air Force Missile Test Center, Patrick Air Force Base, Florida. Also departing this summer is Captain Harry J. Crook, Jr., who is going to England. His replacement is Captain Robert C. Shoemaker.

COLONEL HARMON LAMPLEY, JR.

Department of Military Science

During my first year as Professor of Military Science and Tactics, the following phases of the Army R.O.T.C. program have been stressed: development of leadership in the cadets; good teaching by the Army staff; stimulating interest in Basic Course students to complete the R.O.T.C. program and to receive commissions as

Second Lieutenants in the U.S. Army Reserve; determination of the leadership potential of each sophomore cadet — the most important factor in selection for the Advanced Course; and assisting cadets with their individual problems in every way possible.

Though the Department of the Army is strongly in favor of compulsory R.O.T.C. for all freshman and sophomore students, the M.I.T. faculty voted on January 15, 1958, to drop the mandatory nature of R.O.T.C. and to make all military training at the Institute voluntary. While I look for a large initial drop in R.O.T.C. enrollment under the voluntary program, enrollment should build up again so that eventually 75 per cent of the entering students will elect one of the three programs offered at the Institute. A poll of this year's freshmen indicates that we may expect approximately half of the 304 to continue in Army R.O.T.C. next year. The voluntary program should produce a smaller but better-qualified and more enthusiastic group of reserve officers, due to the strengthening of the instructor-student ratio and the elimination from the program of disinterested captive students.

This year, the Army R.O.T.C. program started with 358 freshmen, 295 sophomores, 93 juniors, and 115 seniors; it finished with 304, 262, 94 and 111, respectively. The large attrition in the freshman and sophomore classes was mainly due to students' dropping out of the program for physical reasons. By agreement with the Medical Department, this practice was discontinued in December, 1957, except in those cases where remaining in the program would endanger the student's health.

On June 12, 1958, 89 cadet officers were commissioned Second Lieutenants in the following branches of the U.S. Army Reserve:

Corps of Engineers	15
Signal Corps	12
Ordance Corps	25
Chemical Corps	24
Quartermaster Corps	13

At the conclusion of summer camp, 15 additional cadets will be commissioned.

Of these new Second Lieutenants, 52 will enter six months' active duty for training, 15 will enter active duty for two years' service, and 22 will attend graduate schools, with active duty delayed.

Among those commissioned were 21 Distinguished Military Graduates, so designated because of their over-all excellence in

military science. Of these, two have expressed a desire for a military career and will shortly be commissioned in the regular Army, one in the Ordnance Corps and the other in the Quartermaster Corps.

The physical facilities available to the Military Science Department have been considerably improved during the year. Acquisition of the Cambridge Armory by the Institute has made it permanently available for drill. Also, the small arms are now stored in the Armory basement, a more convenient location than the arms room in Building 1, previously used. The addition of a reading room and lounge in Room 20-E-121 provides an attractive and long-needed facility.

Among the highlights of the year were the rifle firing by freshman students at Fort Devens and the Annual Military Day. One hundred and sixty-three students volunteered to participate in the rifle firing and spent a highly instructive and interesting day on two of the Fort Devens rifle ranges. On Military Day, May 6, 1958, the combined Army, Navy, and Air Force cadets were reviewed by Major General James McCormack, Vice President of M.I.T. Among the guests in the reviewing party were representatives from Army, Navy, and Air Force installations in the vicinity and from local chapters of military and patriotic societies. Seventeen Army R.O.T.C. cadets were presented awards by the visiting dignitaries at a ceremony following the review.

Lieutenant Colonel Donald S. Bowman, Executive Officer and Chief of the Signal Corps Unit; Major Warren Rogers, Adjutant and Chief of the Corps of Engineers Unit; and Captain Peter E. Hexner, Assistant Operations Officer and Common Course Instructor, have completed their tours of duty at the Institute and have been reassigned. Due to the anticipated drop in enrollment under the voluntary program, they are not being replaced.

COLONEL GILBERT G. BRINCKERHOFF, JR.

Department of Naval Science

The Naval Science Department has closed its second academic year at M.I.T. with a total enrollment of 72 N.R.O.T.C. students. Of these, 33 have completed the sophomore year and 39 the freshman year. Academic attrition accounted for two sophomores and one freshman this year. Two other freshmen were dropped by reason of physical disqualification and one at his own request.

Undergraduate interest in the program appears to be definitely on the increase. Voluntary participation in field trips to naval industrial and fleet installations has increased to better than 50 per cent of total enrollment. One student has also applied for a five-week voluntary cruise in a Fleet submarine. As a matter of additional interest, three sophomores and nine freshmen have applied for and have been placed in summer employment under Navy sponsorship at various naval technical and industrial activities throughout the United States.

Formulation of the senior course in naval industrial management and leadership is expected to take place during the coming year, to be offered for the first time in 1959–60. This will be done in close liaison with the School of Industrial Management.

A reorganization move recently approved by the Secretary of the Navy has now placed the former separate Naval Administrative Unit under the military command of the Commanding Officer, N.R.O.T.C. Unit. This means that henceforth, military administration of all Navy-sponsored postgraduate students as well as the N.R.O.T.C. undergraduate students will be centered in the office of the Head of the Naval Science Department.

There have been no staff personnel changes during the past year, and none are anticipated for the ensuing year. One additional officer is expected to report during the summer of 1959.

CAPTAIN JOSEPH S. LEWIS

MEDICAL DIRECTOR

The year has been an active one for the Medical Department. In the fall, the widely heralded epidemic of Asiatic influenza struck the M.I.T. community and severely taxed our facilities. Fortunately, it proved to be a mild form of the disease; and although there were a number of cases of pneumonia, none was desperately ill.

Another important development was the completion of the M.I.T. Reactor and the planning and promotion of its use in medical and biological research as well as organizing the radiation protection aspects of its operation.

A third item of less spectacular interest but of considerable long-range importance to the Institute has been a tightening of the

requirement that every employee complete a pre-employment physical examination before he is put on the payroll. These developments will be covered in more detail in the body of the report.

The Ambulatory Clinic

The working load of the Ambulatory Clinic shows a modest increase in visits to all of the clinics except surgery. In terms of total clinic visits per day it is an increase from 109 to 116. There is a noteworthy falling off in routine chest x-rays, which reflects an ultra-conservative attitude of the Department toward radiation in general.

Clinic Visits, 1956–1958

	1956–57	*1957–58*
Medical	7,208	7,980
Surgical	9,564	9,101
Psychiatric	2,568	2,605
Eye	1,148	1,228
Ear, nose, and throat	1,077	1,353
Dermatology	1,428	1,523
Dental	4,418	5,465
Occupational medicine	308	334
	27,719	**29,589**

For a trial period of several weeks during the year, we used an extra nurse in the clinic to screen patients, to ensure that sick patients get immediate attention, to take care of minor complaints, and to assign patients to the proper doctors. This system worked so well that we are planning to make it a permanent arrangement next year.

The Dental Clinic

The services of our two dental hygienists have not been fully utilized during the past year; and we now believe that a single dental hygienist can take care of the routine dental examination of students and of most, if not all, of the prophylaxis appointments.

Prenatal Clinic

In October, 1957, the Medical Department embarked upon a cooperative program with the Boston Lying-In Hospital for the obstetrical care of wives of M.I.T. students. The plan was designed to ensure high-quality professional care to those who could not pay for the services of a private obstetrician. In brief, it provides for complete obstetrical care, including prenatal care, all in-hospital

charges, and postpartem follow-up, for $250. There are no charges for professional fees. The total charge may be borrowed from the M.I.T. Loan Fund, if desired.

This program seems to have fulfilled a need long felt by a segment of the M.I.T. family that has heretofore received little if any attention. Of the 45 prospective mothers accepted by the Clinic, 17 have delivered babies at the Boston Lying-In Hospital since the program began.

Faculty Health Survey

The Faculty Health Survey has continued this year with what we believe to be benefit to both the individuals themselves and the Institute as a whole.

A total of 274 examinations were done, of which 32 were new to the Survey. Two-thirds of the new persons were in the thirty to thirty-nine bracket. No very startling conditions were uncovered, but a number of lesser faults were either discovered or re-evaluated.

One of the most important aspects of the Survey is the opportunity for those taking part to discuss in a leisurely fashion not only their physical symptoms, if any, but their attitudes to the stresses and strains of everyday living. The Medical Department cannot eliminate all stress, but the ventilation of these problems often diminishes some of their intensity and helps in their solution.

Employee Health

Dr. Albert O. Seeler has taken a special interest in the employee health program; and as a result of his efforts, improved liaison has been established between the Medical Department and the Office of Personnel Relations. By developing a system for prompt service and prompt reporting of pre-employment physical examinations, we have made it practicable to insist on a medical evaluation before applicants for employment are actually put on the payroll. Our experience to date in uncovering serious and often unsuspected disease in this group has convinced us of the great practical value of this policy.

The Infirmary

The storm signals of an impending pandemic of influenza were already flying when the Infirmary opened on September 3. Fortunately the problem was not as serious as we feared it might be; approximately 400 cases were handled in the Infirmary in a period

of about six weeks. There were eight cases of recognized pneumonia among the influenza cases, of which three were due to staphylococcus infection. Fortunately, the latter responded well to antibiotics.

German measles were particularly prevalent this year, a total of 90 cases being admitted to the Infirmary in the months of January, February, March, and April. This is the only contagious disease which, because of its mildness and short duration, we feel justified in not sending to a contagious disease hospital.

Patients Admitted to the Infirmary, 1956–1958

	1956–57	*1957–58*
Staff	44	37
Graduate students	114	196
Undergraduate students	521	802
Employees	55	40
Others	9	6
Total	**743**	**1,081**
Total patient days	**2,764**	**3,653**

A total of 3,241 polio shots were administered in the Infirmary during the year.

On May 1 the operation of the Infirmary kitchen was discontinued and meals were brought to the Infirmary on order from the Graduate House kitchen in a heated cart. This arrangement proved so completely satisfactory that plans have been made to dismantle the kitchen and use the space for other purposes. It is estimated that our food costs will be halved by the new program, without sacrifice of quality.

Surgical Service

Noteworthy among elective operations, major and minor, are five instances of skin cancer, including one of malignant melanoma, and a student with Hodgkins' disease with involvement of axillary lymph nodes. This is the commonest type of malignant tumor we have seen in the student body. There has been a second student with this disease at the Institute during the past year, and, during the year, two former students died of this disease, one two years and the other one year after graduating. Both of these young men knew about their affliction and both faced the unpleasant future with remarkable courage and composure.

Athletic Injuries

There has been an apparent decrease in all the major categories of athletic injury as compared to the previous year, in which the total injuries numbered 328; but it is possible that incomplete reporting distorts the picture. The total reported for 1957–58 is 308.

Psychiatric Service

The psychiatric service has operated at a high rate of activity throughout the entire year. The staff is smaller than in previous years and has worked to near capacity; the number of students coming to the Service has shown a steady increase.

The types of mental illness and emotional disorder encountered by the Service differed in no respect from those seen in previous years.

The Department has maintained its contact with the faculty and the Dean's Office. These contacts have proved extremely helpful in clarifying the kind of work to be done and in enabling us to help the students. The number of students referred by the faculty and the Dean's Office continues at its previous level. The most important figure in the yearly statistics from our point of view is that the self-referrals amount to nearly 70 per cent of the students seeking help. We are aware that many of these self-referrals are boys who have talked with fellow students or who have gained a suggestion from a faculty member. We have continued to interview the boys who were withdrawing from M.I.T.; and with the cooperation of the Dean's Office, we feel we have contributed a real service in helping boys who do not belong at M.I.T. to make the decision to leave before academic failure occurred.

In spite of the steadily shrinking staff, we now feel that the staff's time is utilized to the utmost efficiency for the Institute and that it is well equipped to handle the problems of the community. In fact, we are coming to appreciate the advantages of depending to an increasing extent on men who spend a considerable portion of their time with us and who are thoroughly familiar with the ways of the Institute.

Occupational Medicine

During the year, the Occupational Medical Service moved from the second floor of the Infirmary Building to more commodious quarters in Building 20. The change was made necessary chiefly by the

steadily increasing use of radiation and radioactive materials in the Institute with the concomitant increased demand for radio-protective services, and to a lesser extent by the increasing use of other hazardous materials, such as beryllium.

One of the major activities of the Service has been related to construction of the M.I.T. Reactor. As Reactor Protection Officer, Dr. Constantine J. Maletskos has been occupied on a full-time basis in making the Reactor as safe as possible in its construction and operation both for the public and for those who use it. A Medical Advisory Committee to the Nuclear Reactor has been organized, with representatives from the three Boston medical schools as well as from the Department of Nuclear Engineering and the Medical Department at M.I.T. The Committee will pass upon all research proposals from the point of view of hazard to patients and of feasibility. The Committee, which is broadly representative of the radio-biological interests in the community, has been useful in disseminating information and has sponsored two symposia, one in the fall entitled "Nuclear Reactors in Biomedical Research" and one in the spring entitled "Clinical Uses of Nuclear Reactors." Both were well attended.

In accordance with a regulation of the Atomic Energy Commission, Nuclear Reactor Safeguard Committee has been organized for the purpose of acting on radiation protection problems affecting both those working at the reactor and the surrounding community. Every operation involving the use of the Reactor must be reviewed by this committee, on which the Occupational Medical Service is represented by Dr. Harriet L. Hardy and Dr. Maletskos.

Although only one research proposal in biological medicine has been received to date, it is known that several medical research groups are planning to utilize the Reactor. Its research capacity is such as to accommodate a considerable number of different projects at a time, and the plan is to make it available to any responsible investigator with a worthy project and the funds to cover the cost.

The Reactor Protection Officer, Dr. Maletskos, has set up his office, and that of his now full-time assistant, and laboratory in the Nuclear Engineering Building adjoining the Reactor. He has devised and placed in operation an area-monitoring program to determine background information prior to activating the Reactor. Courses of instruction in radiation protection were given to members of the staff and to students using the facilities. In addition, a com-

prehensive course was given to the operators of the Reactor. A manual designating the local rules for radiation protection was written for use by all persons at the Nuclear Engineering facilities.

As a further safeguard in the operation of the Reactor, we consider ourselves fortunate in the appointment of Dr. Louis H. Hempelmann, Professor of Experimental Radiology at the University of Rochester School of Medicine. Dr. Hempelmann was formerly leader of the Health Division at Los Alamos, following which he was with the Director of Biology and Medicine of the Atomic Energy Commission. Dr. Hempelmann spent a day at the Reactor in June and discussed with us the formulation of a disaster plan in case of accident.

Frederick J. Viles, Industrial Safety Engineer, has continued his activities in designing new hood installations, and assisted in the ventilation and area monitoring program of the Reactor. The increasing use of beryllium in several operations has created special problems of ventilation.

On June 1 Mr. Viles began work on a National Institutes of Health Fellowship for one year on "The Application of the Membrane Filter for Aerosol Assays." Richard I. Chamberlin has been appointed to carry on the routine supervision of industrial hygiene at the Institute.

Sam Levin, Radiation Protection Officer, reports the increasing use of radioactive material at the Institute has made it necessary to enlarge and improve the facilities of the Radiological Safety Officer. A well-equipped laboratory has been completed for the preparation of samples for radioactivity analysis and for the preparation of radioisotope standard-sources. In addition, a shielded-enclosure room has been constructed for the calibration of radiation detection instruments, and a single-channel gamma-ray spectrometer system has been acquired to provide for high-sensitivity analysis of samples containing small amounts of gamma-emitting radioisotopes.

Miss Janet Walkley reports the development of new techniques for the fluorometric determination which increase sensitivity by 25 per cent, important especially in determining very small amounts of beryllium in the air of various working areas. An industrial hygiene survey of the Chemical Engineering Department was begun, and an evaluation of potential exposures in Building 12 was completed. Work has now begun on methods for determining radioisotopes in urine as a means of estimation of such materials deposited within the body by accidental inhalation or ingestion.

In the past year, an experimental study of the effects of ultra-high-frequency radiation on animals has been in progress, in cooperation with the staff of the Lincoln Laboratories. Irradiation has been carried out on rabbits and rats under conditions which permit precise measurement of dosage to the animal. Study of autopsy material from animals exposed for periods up to several months, and examination of the lens of the eye for possible cataract, has shown no damage to the animals attributable to the radiation. A study of a number of rats exposed for a six-month period is in progress to determine whether or not damage occurs after chronic irradiation.

Lincoln Laboratory Clinic

The following table summarizes activities in the Lincoln Laboratory clinic.

	1956–57	*1957–58*
First aid treatment, medical	6,859	7,022
First aid treatment, surgical	3,768	3,661
Polio inoculations	2,177	1,242
Asian influenza inoculations	0	518
	12,804	**12,443**

Sanitary Inspection

Fred E. Smith, a sanitary engineer on the staff of the Health Department of the City of Cambridge, began his duties as a part-time sanitary engineer with the Medical Department in September, 1957. One formal and one informal (unannounced) inspection of each dining facility and of the Alumni Pool are made monthly. In addition, cultures are made from eating utensils and milk and cream by G. W. Broussard of the Department of Civil and Sanitary Engineering. On the whole, the dining facilities have been maintained in excellent sanitary condition. There has been a general diminution of bacterial contamination in the course of the year.

The Student Health Fee

During the coming year the student health fee will be raised from $13 to $15 per semester. Of this fee, $5.50 represents the premium on student health insurance and $9.50 goes directly toward the support of the student health program. It is felt that this modest

increase will narrow the gap between the actual cost of this service to the Institute and what the student is charged for it. During the course of the next year we plan to carry through a cost accounting procedure which will give us a more exact picture of income and outgo in our various activities.

JAMES M. FAULKNER

PLACEMENT OFFICER

Student Placement

As the economy of the country fluctuated during the past year, so did the job market for this year's graduates. In October, employers were optimistic that the recession would not overly affect hiring plans. By January, however, the recession was having a decided effect upon hiring, and pessimism was widespread. Some employers cancelled visits to the campus because of curtailed hiring; others interviewed in the hope that the economic picture would change, as indeed it did. In March and April the effect of new defense contracts triggered by the launching of Sputnik, particularly in the missiles and electronics fields, began to be felt and was followed in May by a very rapid upswing in hiring, so that most of our graduates interested in employment had at least one job offer by graduation.

For the first time in several years, our graduating classes faced a buyer's market. Since most employers intended to hire only on an extremely selective basis, the demand for many months did not approximate the supply. The net result was that our students applied themselves vigorously to the business of job-seeking. Although a slightly smaller number of employers visited the campus than a year ago (400 compared with 442) the number of students seen by each company increased from an average of 19 in 1956–57 to 21 this past year. Students were more aggressive in reaching by letter those companies not visiting M.I.T., and imagination, initiative, and ingenuity again played an important role in job-seeking. By virtue of the students' hard work, the placement statistics for 1957–58

shown in the following table closely resemble those of last year and the year before.

	Bachelor's Degrees	*Master's Degrees*	*Professional Degrees*	*Doctor's Degrees*	*Total*	
Civilian employment	35%	49%	10%	77%	42%	(461)
Graduate study	33	19	17.5	4	26	(287)
Armed forces	6	10	45	2.5	8.5	(96)
Foreign students	1	6	10	7.5	3.5	(38)
Government service	3	3	—	2.5	3	(32)
Desire further placement assistance	2	2	—	1.5	2	(26)
Not yet reported	20	11	17.5	5	15	(172)
						(1112)

Starting salaries continued to rise. The median offer to the S.B. class was $490, compared with $465 a year ago; to the S.M. class, $585 compared with $562. The Sc.D.-Ph.D. median was $750 as against last year's $719.

A healthy aspect of the year's activities was a refreshing student attitude of hard work and perseverance. There was, however, a discouraging note: openings for professional-level summer work, growing during the past several years, were markedly reduced; with the exception of some long-standing summer programs, such jobs were scarce this year.

Alumni Placement

For the first time since 1948, more than a thousand alumni turned to us for help. We hope and believe there will not be so many next year. The following table compares our experience in the past two years.

	1956–57	*1957–58*
Number of jobs	4,967	4,382
Men who went on the available list	761	1,097
Placements	171	172

Experienced men have been at a premium for research and development in the fields of missile controls and fuels, satellites, and 'outer-space.' For the first time, industry has combed the country for theoretical mathematicians, astronomers, astrophysicists, meteorologists, and geophysicists.

In the meanwhile, men skilled in the more practical areas of engineering, manufacturing, and sales have found it difficult to locate satisfactory positions.

As the year ends there is some increase in requests for salesmen and for executives. Cut-backs in industry have almost stopped. Men registering now are simply looking for a better job or more interesting work.

THOMAS W. HARRINGTON, JR.

REGISTRAR

All statistics on registration and staff in the following tables are given as of the fifth week of the Fall Term, except: 1943–44 as of August 2, 1943; 1944–45 as of November 27, 1944; and 1945–46 as of July 30, 1945.

Table 1. Student Registration since the Founding of the Institute*

Year	*Number of Students*	*Year*	*Number of Students*	*Year*	*Number of Students*
1865–66	72	1897–98	1,198	1929–30	3,066
1866–67	137	1898–99	1,171	1930–31	3,209
1867–68	167	1899–00	1,178	1931–32	3,188
1868–69	172	1900–01	1,277	1932–33	2,831
1869–70	206	1901–02	1,415	1933–34	2,606
1870–71	224	1902–03	1,608	1934–35	2,507
1871–72	261	1903–04	1,528	1935–36	2,540
1872–73	348	1904–05	1,561	1936–37	2,793
1873–74	276	1905–06	1,466	1937–38	2,966
1874–75	248	1906–07	1,397	1938–39	3,093
1875–76	255	1907–08	1,415	1939–40	3,100
1876–77	215	1908–09	1,461	1940–41	3,138
1877–78	194	1909–10	1,479	1941–42	3,055
1878–79	188	1910–11	1,506	1942–43	3,048
1879–80	203	1911–12	1,559	1943–44	1,579
1880–81	253	1912–13	1,611	1944–45	1,198
1881–82	302	1913–14	1,685	1945–46	1,538
1882–83	368	1914–15	1,816	1946–47	5,172
1883–84	443	1915–16	1,900	1947–48	5,662
1884–85	579	1916–17	1,957	1948–49	5,433
1885–86	609	1917–18	1,698	1949–50	5,458
1886–87	637	1918–19	1,819	1950–51	5,171
1887–88	720	1919–20	3,078	1951–52	4,874
1888–89	827	1920–21	3,436	1952–53	5,074
1889–90	909	1921–22	3,505	1953–54	5,183
1890–91	937	1922–23	3,180	1954–55	5,348
1891–92	1,011	1923–24	2,949	1955–56	5,648
1892–93	1,060	1924–25	2,938	1956–57	6,000
1893–94	1,157	1925–26	2,813	1957–58	6,179
1894–95	1,183	1926–27	2,671		
1985–96	1,187	1927–28	2,712		
1896–97	1,198	1928–29	2,868		

* From 1943 to 1946 Army and Navy students are omitted (see Table 3-B in reports for 1943 to 1946).

*Table 1-A. Student Registration in the Summer Session since 1920**

Year	†*In Regular Subjects*	*In Special Subjects (not included in Regular)*	*Year*	†*In Regular Subjects*	*In Special Subjects (not included in Regular)*
1920	1,233	..	1936	1,196	..
1921	1,487	..	1937	1,291	..
1922	1,419	..	1938	1,393	..
1923	1,419	..	1939	1,555	..
1924	1,405	58	1940	1,607	..
1925	1,454	154	1941	1,532	..
1926	1,336	134	1948	2,146	..
1927	1,316	132	1949	1,875	171
1928	1,305	109	1950	1,852	259
1929	1,413	158	1951	1,861	813
1930	1,551	137	1952	1,689	832
1931	1,459	226	1953	1,672	1,289
1932	1,305	48	1954	1,675	1,398
1933	1,057	..	1955	1,619	1,653
1934	926	..	1956	1,553	2,497
1935	1,013	..	1957	1,548	1,757

* Regular academic terms were conducted during the summers of 1942 through 1947.
† Students attending regular subjects from M. I. T. curricula.

Table 2. The Corps of Instructors

	1945	*1946*	*1947*	*1948*	*1949*	*1950*	*1951*	*1952*	*1953*	*1954*	*1955*	*1956*	*1957*
Faculty members of the staff:													
Professors	113	110	118	124	131	132	136	144	152	158	169	190	201
Associate Professors	103	128	131	131	141	137	144	149	157	155	167	169	169
Assistant Professors	101	125	137	133	138	144	154	166	170	178	175	199	206
Ex-Officio	10	11	11	10	10	8	11	10	12	14	15	16	15
Professors Emeriti (Lecturers)	..	..	..	14	13	13	10	9	10	9	7	7	15
Technical Instructors	1	1	..	..	..	..	..	..	..	..	..	..	..
Research Associates	2	2	..	..	2	2	2	2	2	1	1	1	1
Library Fellows	..	2	1	1	..	..	..	..	..	..	..	..	..
Total Faculty	**330**	**379**	**398**	**413**	**435**	**436**	**457**	**480**	**503**	**515**	**534**	**582**	**607**
Other members of the staff:													
Instructors	82	119	154	142	151	145	139	141	144	129	146	134	145
Technical Instructors	8	14	17	15	15	13	12	13	12	13	11	12	12
Administrative Assistants	..	1	..	..	..	2	2	2	2	2	4	2	5
Teaching Assistants	..	..	..	..	..	..	186	208	222	214	249	273	261
Teaching Fellows	18	74	77	72	91	98	..	..	..	..	..	..	..
Fellows in Applied Math.	..	4	3	..	..	..	..	..	..	..	..	..	..
Assistants	47	127	137	116	124	122	..	..	..	..	..	..	..
Consultant	..	..	..	..	1	..	..	..	..	..	..	..	..
Lecturers	7	11	10	13	11	22	32	25	25	28	33	42	40
Research Associates	39	151	176	155	120	105	86	100	97	93	86	92	118
Research Assistants	51	193	272	311	348	433	474	517	542	529	536	586	621
Technical Assistants	..	..	..	..	..	..	46	45	48	39	40	36	47
Carnegie Fellows	..	..	..	..	..	..	2	..	..	..	..	..	..
Fellows	..	..	..	..	..	..	20	..	..	..	..	..	..
Total of other staff	**252**	**694**	**846**	**824**	**861**	**940**	**999**	**1,051**	**1,092**	**1,047**	**1,105**	**1,177**	**1,249**
Total staff	**582**	**1,073**	**1,244**	**1,237**	**1,296**	**1,376**	**1,456**	**1,531**	**1,595**	**1,562**	**1,639**	**1,759**	**1,856**
Other members of the faculty:													
Faculty and administrative officers													
Emeriti (not Lecturers)*	51	59	66	49	49	53	54	52	57	55	58	60	60
Non-Resident Professor	1	1	1	1	1	1	1	1	1	..	..	..	..
Total of other faculty	**52**	**60**	**67**	**50**	**50**	**54**	**55**	**53**	**58**	**55**	**58**	**60**	**60**

* Beginning in 1948–49.

Table 3. Classification of Students since 1955

Course	*1955–56*						*1956–57*						*1957–58*					
	1	*2*	*3*	*4*	*G*	*Total*	*1*	*2*	*3*	*4*	*G*	*Total*	*1*	*2*	*3*	*4*	*G*	*Total*
Aeronautical Engineering (XVI)	60	53	31	30	111	285	82	56	37	25	132	332	65	86	41	41	153	386
Aeronautical Engineering (Cooperative) (XVI-B)	..	..	16	14	..	30	..	..	12	15	..	27	..	..	11	13	..	24
Architecture (IV-A)	17	26	28	39	28	138	14	32	26	32	28	132	15	23	28	28	35	129
Fifth year	..	..	..	28	..	28	..	..	..	38	..	38	..	..	..	27	..	27
Biology (VII)	9	13	12	17	39	90	4	10	13	14	33	74	8	8	13	11	50	90
Building Engineering and Construction (XVII)	..	..	11	20	20	51	..	..	..	10	21	31	..	..	..	..	19	19
Chemical Engineering (X)	141	123	81	107	154	606	135	101	109	67	186	598	112	103	77	93	234	619
Chemical Engineering Practice (X-A, X-B)	..	..	..	5	30	35	..	..	..	10	48	58	..	..	..	7	17	24
Chemistry (V)	43	30	17	25	184	299	29	27	27	17	214	314	56	21	23	28	192	320
City and Regional Planning (IV-B)	..	..	..	..	22	22	..	..	..	..	31	31	..	..	..	..	39	39
Civil Engineering (I)	40	49	44	53	76	262	37	37	51	48	76	249	18	31	42	50	105	246
Army Engineer	..	..	..	..	15	15	..	..	..	..	9	9	..	..	..	..	9	9
Economics and Social Science (XIV)	1	10	17	14	63	105	4	5	10	21	83	123	1	12	14	16	82	125
Electrical Engineering (VI, VI-B)	239	250	134	100	315	1,038	229	242	151	130	353	1,105	233	236	149	144	400	1,162
Electrical Engineering (Cooperative) (VI-A)	..	..	57	66	38	161	..	..	73	62	54	189	..	..	48	76	51	175
Food Technology (XX, XX-A, XX-B)	..	14	10	8	44	76	..	1	11	9	38	59	1	4	3	9	40	57
General Engineering (IX-B)	12	3	13	13	..	41	25	2	6	13	..	46	..	..	1	5	..	6
General Science (IX-A)	6	1	7	8	..	22	4	1	1	7	..	13	..	..	1	6	..	7
Geology and Geophysics (XII, XII-A)	6	25	15	17	48	111	2	14	22	13	49	100	3	10	17	18	63	111
Humanities and Engineering (XXI-A) or Science (XXI-B)	5	10	..	..	..	15	7	8	18	..	..	33	11	25	31	12	..	79
Industrial Management (XV)	41	63	87	90	91	372	21	70	78	98	143	410	26	64	86	95	172	443
Mathematics (XVIII)	15	24	13	27	75	154	28	33	22	20	105	208	45	35	33	22	115	250
Mechanical Engineering (II)	113	114	98	113	163	601	74	107	90	103	207	581	78	72	106	91	211	558
Mechanical Engineering (Cooperative) (II-B)	..	..	33	21	..	54	..	..	21	29	..	50	..	..	4	24	..	28
Metallurgy (III)	13	25	29	27	129	223	9	42	36	30	138	255	10	27	46	35	137	255
Ceramics	..	..	..	..	12	12	..	..	..	..	11	11	..	..	..	..	17	17
Meteorology (XIX)	1	1	2	2	39	45	1	3	2	4	53	63	..	..	3	3	49	55
Naval Architecture & Marine Engineering (XIII, XIII-B)	6	8	11	20	13	58	6	6	10	13	21	56	5	10	8	17	23	63
Naval Construction and Engineering (XIII-A)	..	..	..	..	76	76	..	..	..	..	70	70	..	..	..	..	73	73
Physics (VIII)	178	109	74	44	183	588	223	129	93	68	180	693	222	137	115	79	205	758
Sanitary Engineering (XI)	..	..	..	..	23	23	..	..	..	..	26	26	..	..	..	..	23	23
Sci. Teaching (IX-C) or Sci. and Math. Teaching (XXI-C)	2	3	2	4	1	12	2	5	4	2	3	16	..	..	..	1	1	2
Totals	**948**	**954**	**842**	**912***	**1,992**	**5,648**	**936**	**931**	**923**	**898***	**2,312**	**6,000**	**909**	**904**	**900**	**951***	**2,515**	**6,179**

* These totals include the fifth year in Architecture (IV-A).

Table 4-A. Students Classified by Schools, Courses, and Years, 1957–58

Course	*Year*					
	1	*2*	*3*	*4*	*G*	*Total*
School of Architecture and Planning:						
Architecture (IV-A)	15	23	28	28	35	129
Fifth year	..	..	..	27	..	27
City and Regional Planning (IV-B)	..	..	..	..	39	39
Total	15	23	28	55	74	195
School of Engineering:						
Aeronautical Engineering (XVI)	65	86	41	41	153	386
Aeronautical Engineering (Cooperative) (XVI-B)	..	..	11	13	..	24
Building Engineering and Construction (XVII)	..	..	..	..	19	19
Chemical Engineering (X)	112	103	77	93	140	525
Chemical Engineering (Nuclear) (X)	..	..	..	..	94	94
Chemical Engineering Practice (Graduate) (X-A)	..	..	..	..	17	17
Chemical Engineering Practice (Undergraduate) (X-B)	..	..	..	7	..	7
Civil Engineering (I)	18	31	42	50	105	255
Army Engineer	..	..	..	..	9	
Electrical Engineering (VI)	233	218	126	144	400	1,121
Electrical Engineering (Cooperative Course) (VI-A)	..	..	48	76	51	175
Electrical Science and Engineering (VI-B)	..	18	23	..	..	41
General Engineering (IX-B)	..	..	1	5	..	6
Mechanical Engineering (II)	78	72	106	91	199	558
Textile Technology	..	..	..	..	12	
Mechanical Engineering (Cooperative Course) (II-B)	..	..	4	24	..	28
Metallurgy (III)	10	27	46	35	133	272
Mineral Engineering	..	..	..	..	4	
Ceramics	..	..	..	..	17	
Naval Architecture and Marine Engineering (XIII)	5	10	8	17	22	62
Naval Construction and Engineering (XIII-A)	..	..	..	..	73*	73
Sanitary Engineering (XI)	..	..	..	..	23	23
Shipping and Shipbuilding Management (XIII-B)	..	..	..	..	1	1
Total	521	565	533	596	1,472	3,687
School of Humanities and Social Studies:						
Economics, Politics, and Engineering (XIV-A)	1	10	8	11	82	125
Economics, Politics, and Science (XIV-B)	..	2	6	5		
Humanities and Engineering (XXI-A)	3	12	13	2	..	30
Humanities and Science (XXI-B)	6	8	16	10	..	40
Science and Mathematics Teaching (XXI-C)	2	5	2	..	..	9
Science Teaching (IX-C)	..	..	..	1	1	2
Total	12	37	45	29	83	206

Table 4-A — continued

School of Industrial Management:						
Business and Engineering Administration						
Based on physical sciences (XV-A)	24	50	71	71	172	443
Based on chemical sciences (XV-B)	2	14	15	24		
Total	26	64	86	95	172	443
School of Science:						
Biochemical Engineering (XX-B)	..	..	..	2	1	3
Chemistry (V)	56	21	23	28	192	320
Food Technology (XX, XX-A)	1	4	3	7	39	54
General Science (IX-A)	..	..	1	6	..	7
Geology and Geophysics (XII)	3	10	17	17	57	104
Geology and Geophysics (XII-A)	..	..	..	1	6	7
Mathematics (XVIII)	45	35	33	22	115	250
Meteorology (XIX)	..	..	3	3	49	55
Physics (VIII)	222	137	115	79	205	758
Quantitative Biology (VII)	8	8	13	11	50	90
Total	335	215	208	176	714	1,648
Grand total	909	904	900	951†	2,515	6,179

* First graduate year, 28; second graduate year, 23; and third graduate year, 22.
† This total includes the fifth year in Architecture (IV-A).

Table 4-B. Special Students Classified by Courses and Years, 1957–58*

Course	*Year*					
	1	*2*	*3*	*4*	*G*	*Total*
School of Architecture and Planning:						
Architecture (IV-A)	..	1	..	..	7	8
Fifth Year	..	..	..	1	..	1
City and Regional Planning (IV-B)	..	..	..	..	5	5
School of Engineering:						
Aeronautical Engineering (XVI)	..	..	..	1	67	68
Building Engineering and Construction (XVII)	..	..	..	..	5	5
Chemical Engineering (X, X-A, X-B)	..	..	1	..	14	15
Civil Engineering (I)	..	..	..	..	4	4
Electrical Engineering (VI, VI-A, VI-B)	..	1	4	1	132	138
Mechanical Engineering (II)	..	..	1	..	39	40
Metallurgy (III)	..	..	2	1	27	30
Naval Architecture and Marine Engineering (XIII, XIII-B)	..	..	..	1	11	12
Sanitary Engineering (XI)	..	..	..	..	1	1
School of Humanities and Social Studies:						
Economics, Politics, and Engineering or Science (XIV-A, XIV-B)	..	..	..	..	18	18
School of Industrial Management:						
Business and Engineering Administration (XV)	..	1	..	..	17	18

* These students are included in Table 4-A.

continued

Table 4-B — continued

School of Science:						
Chemistry (V)	..	..	..	2	10	12
Food Technology (XX, XX-A, XX-B)	..	..	..	1	8	9
Geology and Geophysics (XII, XII-A)	..	1	..	..	2	3
Mathematics (XVIII)	..	1	..	..	41	42
Meteorology (XIX)	..	..	..	..	26	26
Physics (VIII)	1	1	1	..	26	29
Quantitative Biology (VII)	..	..	..	1	17	18
Total	1	6	9	9	477	502

Table 4-C. Classification of Former Students Who Returned in 1957–58*

Course	*Year*					
	1	*2*	*3*	*4*	*G*	*Total*
School of Architecture and Planning:						
Architecture (IV-A)	..	1	1	..	4	6
City and Regional Planning (IV-B)	..	..	..	..	3	3
School of Engineering:						
Aeronautical Engineering (XVI)	1	2	..	1	20	24
Building Engineering and Construction (XVII)	..	..	..	..	2	2
Chemical Engineering (X, X-A, X-B)	..	..	4	4	22	30
Civil Engineering (I)	..	1	2	3	10	16
Electrical Engineering (VI, VI-A, VI-B)	..	4	10	5	45	64
General Engineering (IX-B)	..	..	..	1	..	1
Mechanical Engineering (II)	..	2	7	8	19	36
Metallurgy (III)	..	1	2	..	14	17
Naval Architecture and Marine Engineering (XIII, XIII-B)	..	..	1	..	2	3
Sanitary Engineering (XI)	..	..	..	..	1	1
School of Humanities and Social Studies:						
Economics, Politics, and Engineering or Science (XIV-A, XIV-B)	..	2	2	..	4	8
Humanities and Engineering or Science (XXI-A, XXI-B)	..	1	..	1	..	2
School of Industrial Management:						
Business and Engineering Administration(XV)	..	3	4	8	15	30
School of Science:						
Chemistry (V)	1	..	..	1	2	4
Food Technology (XX, XX-A, XX-B)	..	1	..	..	2	3
General Science (IX-A)	..	..	..	1	..	1
Geology and Geophysics (XII, XII-A)	..	1	1	..	4	6
Mathematics (XVIII)	..	2	3	..	5	10
Meteorology (XIX)	..	..	1	1	4	6
Physics (VIII)	2	2	7	4	11	26
Quantitative Biology (VII)	..	..	..	..	3	3
Total	4	23	45	38	192	302

* These students are included in Table 4-A; this listing excludes 85 special students.

Table 5. Geographical Classification of Students since 1953

	1953	*1954*	*1955*	*1956*	*1957*
United States:					
Alabama	18	13	15	19	22
Arizona	13	9	10	17	20
Arkansas	5	7	11	16	11
California	105	121	145	172	186
Colorado	23	22	30	35	32
Connecticut	161	162	172	212	180
Delaware	17	16	15	11	15
District of Columbia	45	39	44	48	40
Florida	60	72	90	97	113
Georgia	20	26	31	35	34
Idaho	5	8	11	8	10
Illinois	175	196	202	217	230
Indiana	30	29	46	41	52
Iowa	18	20	21	30	33
Kansas	23	22	24	30	31
Kentucky	21	22	26	24	28
Louisiana	25	17	19	27	25
Maine	41	43	54	47	38
Maryland	47	53	54	79	92
Massachusetts	1,466	1,447	1,241	1,121	1,387
Michigan	95	103	107	129	142
Minnesota	39	42	52	51	48
Mississippi	7	12	11	14	10
Missouri	51	53	54	61	70
Montana	10	11	16	16	13
Nebraska	23	15	18	20	19
Nevada	2	3	3	3	2
New Hampshire	39	46	42	57	47
New Jersey	291	331	346	358	358
New Mexico	14	13	9	10	12
New York	990	987	1,088	1,162	1,051
North Carolina	23	20	17	17	16
North Dakota	4	8	10	13	13
Ohio	154	140	170	201	195
Oklahoma	20	23	32	36	38
Oregon	19	15	21	21	20
Pennsylvania	209	238	287	316	315
Rhode Island	51	43	51	57	50
South Carolina	5	12	16	15	14
South Dakota	5	6	6	11	5
Tennessee	24	28	31	32	42
Texas	66	79	97	106	106
Utah	9	10	9	11	10
Vermont	26	16	17	18	18
Virginia	61	66	73	83	73
Washington	40	47	56	61	53
West Virginia	10	14	15	22	30
Wisconsin	48	40	52	62	57
Wyoming	6	5	6	8	7

continued

Table 5 — continued

U.S. Territories and Dependencies:					
Alaska	3	1	2	2	1
Canal Zone	2	2	2	1	3
Hawaii	14	16	15	21	17
Puerto Rico	6	8	11	14	11
Virgin Islands	..	..	..	..	1
Total, United States	**4,684**	**4,797**	**5,003**	**5,295**	**5,446**
Foreign countries:					
Afghanistan	1	..	..	..	..
Algeria	..	..	..	1	..
Argentina	15	17	20	20	20
Australia	6	2	5	8	5
Austria	1	..	2	2	2
Bahamas	..	1	..	2	1
Belgian Congo	..	1	..	..	..
Belgium	7	3	12	9	8
Bermuda	..	..	..	1	1
Bolivia	1	1	..	1	1
Brazil	18	19	35	38	33
British Honduras	..	..	..	1	..
British North Borneo	1	1	1	..	..
British West Indies	5	5	5	4	5
Burma	5	15	11	8	8
Cambodia	..	..	..	..	1
Canada	74	78	93	116	118
Channel Isles	..	..	..	1	..
Chile	1	3	3	7	7
China	15	6	17	12	9
Colombia	16	17	24	23	26
Costa Rica	1	..	1	2	2
Cuba	12	17	18	17	17
Cyprus	1	1	2	2	..
Czechoslovakia	..	..	..	1	..
Denmark	..	1	1	..	3
Dominican Republic	2	2	1	1	1
Ecuador	2	2	3	..	3
Egypt	3	5	7	7	12
England	21	19	6	18	24
Ethiopia	1	1	..	..	1
Finland	3	5	5	3	2
Formosa	1	2	6	14	11
France	18	19	25	26	28
Germany	6	6	7	10	9
Ghana	..	..	..	1	2
Greece	22	21	24	27	33
Guatemala	1	5	8	8	7
Haiti	1	1	1	..	..
Honduras	..	2	2	2	2
Hong Kong	1	6	4	9	15
Hungary	..	..	1	..	9
Iceland	2	..	2	..	1
India	43	44	36	35	40

Table 5 — continued

Indonesia	..	2	3	1	4
Iran	2	4	5	6	10
Iraq	2	4	2	3	7
Ireland	..	1	1	1	..
Israel	21	12	16	24	19
Italy	5	7	8	6	11
Japan	10	16	15	19	18
Jordan	..	..	..	1	1
Korea	1	6	17	27	29
Lebanon	2	..	1	1	2
Liberia	..	1	..	..	..
Luxembourg	1	2	2	1	..
Malaya	1	2	2	2	2
Mauritius	1	1	1	2	2
Mexico	21	26	29	32	26
Morocco	..	1	1	1	1
Mozambique	1	1	1	1	..
Netherlands	1	4	4	4	7
Netherlands West Indies	1	1	1	2	2
New Zealand	2	..	3	2	3
Nicaragua	1	1	2	1	1
Nigeria	3	2	2	1	1
Northern Ireland	..	..	..	..	2
Norway	16	16	16	14	12
Pakistan	4	2	2	1	3
Panama	2	2	2	2	2
Peru	8	4	4	6	10
Philippines	13	16	15	14	14
Salvador	3	3	2	3	1
Saudi Arabia	..	1	2	4	2
Scotland	2	2	3	2	7
Singapore	1	..	..	2	1
Spain	3	2	4	4	3
Sweden	5	9	6	4	3
Switzerland	3	5	6	8	7
Syria	2	4	4	2	2
Tanganyika	..	..	1	..	..
Thailand	5	5	10	11	10
Timor	..	1	..	..	..
Transjordan	..	2	2	1	..
Turkey	4	4	6	8	7
Union of South Africa	5	7	11	9	8
U.S.S.R.	..	..	..	1	1
Uruguay	4	4	6	6	6
Venezuela	35	35	36	22	16
Vietnam	1	1	2	3	2
Wales	..	4	1	1	..
Yugoslavia	..	..	..	2	1
Total, foreign	**499**	**551**	**645**	**705**	**733**
Grand total, U.S. and foreign	**5,183**	**5,348**	**5,648**	**6,000**	**6,179**

Table 6. New Students Entering from Other Colleges as Candidates for Degrees, 1957–58

Class joined at the Institute	*Years spent at college*				*Total*
	One	*Two*	*Three*	*Four or more*	
First year	13	6	..	2	21
Second year	19	27	9	14	69
Third year	..	18	23	20	61
Fourth year	..	..	3	8	11
Graduate year	..	..	33	555	588
Total	**32**	**51**	**68**	**599**	**750**

Table 7. Women Students Classified by Courses and Years, 1957–58

Course	*Year*					*Total*
	1	*2*	*3*	*4*	*G*	
Aeronautical Engineering (XVI)	..	1	..	1	..	2
Architecture (IV-A)	..	4	..	1	..	5
Fifth year	..	..	..	2	..	2
Biology (VII)	1	..	..	..	12	13
Business and Engineering Administration (XV)	..	3	..	..	2	5
Chemical Engineering (X)	1	1	..	2	..	4
Chemistry (V)	..	1	1	2	10	14
City and Regional Planning (IV-B)	..	..	..	..	3	3
Economics, Politics, and Engineering or Science (XIV-A, XIV-B)	..	..	..	..	7	7
Electrical Engineering (VI)	1	2	..	..	3	6
Food Technology (XX, XX-A, XX-B)	..	..	..	1	2	3
General Engineering (IX-B)	..	..	..	2	..	2
General Science (IX-A)	..	..	..	1	..	1
Geology and Geophysics (XII, XII-A)	..	1	..	..	..	1
Humanities and Science (XXI-B)	1	1	1	2	..	5
Mathematics (XVIII)	3	3	3	2	10	21
Mechanical Engineering (II)	..	..	1	1	1	3
Textile Technology	..	..	..	..	1	1
Metallurgy (III)	1	2	..	..	3	6
Meteorology (XIX)	..	..	..	..	2	2
Naval Architecture and Marine Engineering (XIII)	..	..	..	..	1	1
Physics (VIII)	8	1	2	2	2	15
Total	**16**	**20**	**8**	**19**	**59**	**122**

Table 8. Continued, Former, and New Students

	1952–53	*1953–54*	*1954–55*	*1955–56*	*1956–57*	*1957–58*
Students registered at the end of the last academic year (including specials)	3,130	3,361	3,395	3,621	3,870	3,996
Students who have previously attended the Institute but were not registered at the end of the last academic year (including specials)	214	212	218	244	255	302
New students who entered by examination	605	803	955	913	906	883
New students who entered without examination	304	..	..	..	..	..
New students who entered from other colleges as candidates for degrees	631	677	639	724	753	750
New students who entered as specials, not candidates for degrees	190	130	141	146	216	248
Total	**5,074**	**5,183**	**5,348**	**5,648**	**6,000**	**6,179**

Table 9. List of American Colleges and Universities with Number of Graduates Attending the Institute, 1957–58

Adelphi College	1	Carnegie Institute of Tech.	7	Drew University	2
Alabama Polytechnic Inst.	2	Case Institute of Tech.	6	Drexel Institute of Tech.	3
Alabama, University of	3	Catholic Univ. of America	3	Duke University	8
Alfred University	5	Chicago, University of	16	Duquesne University	1
Allegheny College	6	Cincinnati, University of	12		
Amherst College	25	Citadel, The	3	Earlham College	1
Antioch College	6	City College, The (N.Y.)	49	Eastern Nazarene College	2
Arizona, University of	2	Claremont Men's College	1	Eastern Washington Coll. of Education	1
Arkansas, University of	2	Clarkson College of Tech.	6	Evansville College	1
		Clark University	3		
Barnard College	1	Clemson Agricultural Coll.	4	Fenn College	1
Baylor University	2	Coe College	1	Florida State University	1
Bethany College	1	Colby College	2	Florida, University of	1
Boston College	21	Colgate University	2	Fordham University	3
Boston University	23	College of the Pacific	1	Fort Hays Kansas State College	1
Bowdoin College	8	College of Puget Sound	1	Franklin and Marshall Coll.	2
Bradford Durfee Tech. Inst.	1	College of Wooster	3		
Brandeis University	4	Colorado College	1	General Motors Institute	5
Brevard College	1	Colorado School of Mines	4	George Peabody College for Teachers	1
Bridgeport University	1	Colorado, University of	3	George Pepperdine Coll.	1
Brigham Young University	2	Columbia College	4	Georgetown University	3
Brooklyn College	9	Columbia University	17	George Washington Univ.	5
Brown University	13	Connecticut, University of	8	Georgia Institute of Tech.	16
Bucknell University	3	Cooper Union, The	18	Georgia, University of	2
Buffalo, University of	3	Cornell University	29	Gettysburg College	2
		Creighton University	1	Grinnell College	3
California Institute of Tech.	15	Dartmouth College	11		
California State Poly. Coll.	1	Dayton, University of	2	Hamilton College	2
California, University of (Berkeley)	31	Delaware, University of	5	Hartford, University of	1
California, University of (Los Angeles)	8	Denver, University of	2		
Carleton College	4	DePauw University	1		
		Detroit, University of	2		
		Doane College	1		

continued

Table 9 — continued

Harvard University	69
Haverford College	4
Hawaii, University of	2
Heidelberg College (Ohio)	1
Hiram College	1
Hobart College	2
Hofstra College	4
Holy Cross, College of	3
Houston, University of	1
Howard University	1
Hunter College of the City of New York	1
Idaho, University of	1
Illinois Institute of Tech.	10
Illinois, University of	36
Indiana Technical College	1
Indiana University	1
Iowa State College	15
Iowa, State University of	1
Ithaca College	1
Johns Hopkins University	5
Juniata College	1
Kansas State Coll. of Agric. and Applied Science	4
Kansas State Teachers College	1
Kansas, University of	5
Kent State University	1
Kentucky, University of	5
Kenyon College	2
King's College	1
Lafayette College	2
LaSalle College	1
Lebanon Valley College	1
Lehigh University	12
Long Island University	1
Louisiana State Univ. and Agr. and Mech. Coll.	2
Louisville, University of	2
Lowell Technological Inst.	4
Loyola University (Ill.)	2
Loyola University (La.)	1
Luther College	1
Lycee Francais de New York	1
Macalester College	1
Maine Maritime Academy	1
Maine, University of	6
Manhattan College	11
Marietta College	1
Marquette University	2
Marshall College	1
Maryland, University of	5
Mass. Institute of Tech.	781
Mass. Maritime Academy	3
Massachusetts, Univ. of	13
Memphis State College	1
Merrimack College	1
Miami University (Ohio)	6
Miami, University of	2
Michigan College of Mining and Technology	7
Michigan State University	5
Michigan, University of	25
Middlebury College	15
Midwestern University	1
Milwaukee School of Engr.	1
Minnesota, University of	15
Mississippi Southern Coll.	1
Mississippi State College	3
Mississippi, University of	5
Missouri School of Mines and Metallurgy	3
Monmouth College	1
Montana School of Mines	1
Montana State College	1
Morehouse College	1
Mount Holyoke College	3
Newark College of Engr.	2
New Bedford Institute of Textiles and Technology	1
New England College of Pharmacy	1
New Hampshire, Univ. of	8
New Mexico Coll. of Agric. and Mechanical Arts	2
New Mexico Institute of Mining and Tech.	1
New Mexico Military Inst.	1
New Mexico, University of	2
New York University	21
North Carolina College of Agric. and Technology	1
North Carolina State Coll.	3
North Carolina, Univ. of	3
North Central College	1
North Dakota Agric. Coll.	4
North Dakota, Univ. of	1
North East Missouri State Teachers College	1
North Texas State College	1
Northeastern University	39
Northwestern University	17
Norwich University	1
Notre Dame, Univ. of	10
Oberlin College	6
Occidental College	2
Ohio State University	11
Ohio University	4
Ohio Wesleyan University	3
Oklahoma Agric. and Mechancial College	5
Oklahoma State Univ.	1
Oklahoma, University of	6
Oregon State College	5
Oregon, University of	1
Parks College	2
Pembroke College	1
Pennsylvania State Coll.	1
Pennsylvania State Univ.	17
Pennsylvania, Univ. of	13
Philadelphia Textile Inst.	3
Pittsburgh, University of	11
Poly. Institute of Brooklyn	26
Pomona College	5
Pratt Institute	4
Princeton University	28
Principia College, The	5
Providence College	1
Purdue University	28
Puerto Rico, Univ. of	1
Queen's College (N.Y.)	4
Radcliffe College	4
Reed College	3
Rensselaer Poly. Inst.	46
Rhode Island School of Design	3
Rhode Island, Univ. of	7
Rice Institute	2
Ripon College	4
Rochester, University of	13
Russell Sage College	1
Rutgers University	9
St. Anselm's College	1
St. Augustine's College	1
St. Elizabeth College	1
St. Francis Xavier Univ.	1
St. John's University (N.Y.)	3
St. Joseph's College	2
St. Lawrence University	5
St. Louis University	6
St. Mary's University	1
St. Michaels College	1
St. Olaf College	1
San Diego State College	2
San Francisco, Univ. of	1
Sarah Lawrence College	1
Seattle University	1
Simmons College	5
South, University of the	1
South Carolina, Univ. of	2
South Dakota School of Mines and Technology	3
Southern California, University of	5
Southern Illinois Univ.	1
Southern Methodist Univ.	1
Southwestern at Memphis	2
Southwestern Louisiana Institute	1
Stanford University	17
State Teachers Coll. (Ky.)	1
Stetson University	1
Stevens Institute of Tech.	14
Swarthmore College	9
Syracuse University	13
Temple University	1
Tennessee, University of	4
Texas Agric. & Mech. Coll.	7
Texas Christian Univ.	2
Texas Technological Coll.	8
Texas Western College of the Univ. of Texas	1
Texas, University of	16
Trinity College	4
Trinity University	2
Tri-State College	2
Tufts University	31
Tulane Univ. of Louisiana	4
Union College (N.Y.)	7
U.S.A.F. Inst. of Tech.	1
U.S.C.G. Academy	19
U.S.M.M. Academy	4
U.S. Military Academy	19
U.S. Naval Academy	66
U.S.N. Postgrad. School	11
Utah, University of	7
Valparaiso University	1
Vanderbilt University	3
Vassar College	1
Vermont, University of	7
Villanova College	6
Virginia Military Inst.	9
Virginia Polytechnic Inst.	10
Virginia, University of	8
Washington & Jefferson College	4
Washington & Lee Univ.	2
Washington State Univ.	3
Washington, University of	17
Washington University	3
Wayne University	6
Webb Inst. of Naval Arch.	4
Wellesley College	1
Wesleyan University	13
West Texas State College	1
Western Reserve University	2

Table 9 — continued

Weston College	1	William & Mary, College of	3	Yale University	31
West Virginia, Univ. of	5	Williams College	19	Yeshiva College	7
Wharton School of Finance and Commerce	1	Wilson College	1	Total	2,566
Wilkes College	1	Wisconsin, University of	18		
William Jewell College	1	Worcester Poly. Institute	14		
		Wyoming, University of	1		

In all, 297 American colleges and universities were represented. In addition, graduates of 187 foreign colleges (not listed above) were attending the Institute.

Table 10. Regular Students from Other Colleges and Graduates of M.I.T. Classified by Courses, 1957–58

	No previous degree			*Graduates of other colleges*					*Graduates of M.I.T. taking graduate work*		
	Entered:			*Entered in Sept., 1957*		*Entered in previous years*					
Course	*Sept., 1957*	*Previous years*	*Total*	*Under-grad.*	*Grad.*	*Under-grad.*	*Grad.*	*Total*	*S.B. degree, 1957*	*Other grad-uates*	*Total*
Aero. Eng. (XVI)	10	8	18	2	30	2	35	69	11	10	21
Architecture (IV-A)	10	12	22	13	21	12	6	52	..	1	1
Biology (VII)	1	..	1	..	8	..	18	26	4	3	7
Bldg. Eng. & Con. (XVII)	..	..	..	..	4	..	8	12	..	2	2
Bus. & Eng. Adm. (XV)	5	18	23	3	79	2	57	141	7	12	19
Chem. Eng. (X, X-A, X-B)	8	10	18	1	84	1	93	179	20	40	60
Chemistry (V)	4	..	4	1	30	1	146	178	1	5	6
City & Reg. Plan. (IV-B)	..	..	..	..	9	..	23	32	..	2	2
Civil Engineering (I)	7	13	20	2	47	..	26	75	12	25	37
Economics (XIV-A, XIV-B)	1	1	2	..	19	..	38	57	3	4	7
Elec. Eng. (VI, VI-A, VI-B)	31	57	88	6	67	17	128	218	80	44	124
Food Tech. (XX, XX-A, XX-B)	..	..	..	..	11	..	11	22	2	8	10
Gen. Eng. (IX-B)	..	..	..	..	..	1	..	1	..	..	..
Geol. & Geophys. (XII, XII-A)	1	..	1	..	12	..	22	34	10	17	27
Humanities (XXI-A, XXI-B)	1	1	2	..	..	1	..	1	..	..	..
Mathematics (XVIII)	3	5	8	1	23	..	41	65	3	7	10
Mechanical Engineering (II)	19	28	47	4	55	10	55	124	24	38	62
Metallurgy (III)	1	3	4	..	16	..	70	86	8	33	41
Meteorology (XIX)	1	1	2	..	5	..	9	14	2	7	9
Nav. Arch. & Mar. Eng. (XIII)	4	7	11	1	3	3	7	14	..	4	4
Nav. Con. & Eng. (XIII-A)	..	..	..	..	25	..	45	70	..	..	..
Physics (VIII)	19	16	35	2	28	1	93	124	16	42	58
Sanitary Engineering (XI)	..	..	..	..	12	..	10	22	..	..	..
Science Teaching (IX-C)	..	..	..	..	..	..	..	..	1	..	1
Ship. & Spbldg. Man. (XIII-B)	..	..	..	..	..	..	..	..	1	..	1
Total	126	180	306	36	588	51	941	1,616	205	304	509

Table 11. Number of Degrees Awarded in September, 1957, February, 1958,

Field of Degree	*S.B.*			*B.Arch. and B.C.P.*			*S.M.*			*M. Arch. and M.C.P.*		
	Sept.	*Feb.*	*June*	*Sept.*	*Feb.*	*June*	*Sept.*	*Feb.*	*June*	*Sept.*	*Feb.*	*June*
Aeronautical Engineering	3	3	34	..	..	..	5	4	18	..	..	..
Architecture	..	..	..	8	2	13	..	..	..	13	3	3
Biochemical Engineering	..	..	2	..	..	..	..	..	..	..	..	..
Biochemistry	..	..	..	..	..	..	..	..	1	..	..	..
Biology	..	..	..	..	..	..	..	..	..	..	..	..
Biophysics	..	..	..	..	..	..	..	..	..	..	..	..
Building Eng. and Con.	..	1	..	..	..	..	2	..	5	..	..	..
Business and Eng. Admin.	6	5	72	..	..	..	..	..	..	..	..	..
Ceramics	..	..	..	..	..	..	1	..	..	..	..	..
Chemical Engineering	3	3	77	..	..	..	8	7	21	..	..	..
Chemical Engineering Prac.	..	..	8	..	..	..	5	5	13	..	..	..
Chemistry	5	..	25	..	..	..	..	1	1	..	..	..
City Planning	..	..	..	..	..	..	..	..	..	3	4	7
Civil Engineering	2	3	42	..	..	..	6	10	23	..	..	..
Economics and Eng.	..	..	..	..	..	..	1	..	3	..	..	..
Economics, Pol., and Eng.	2	3	7	..	..	..	..	..	..	..	..	..
Economics, Pol., and Science	1	2	2	..	..	..	..	..	..	..	..	..
Electrical Engineering	23	14	149	..	..	..	37	29	66	..	..	..
Food Technology	1	..	3	..	..	..	..	1	2	..	..	..
General Engineering	1	2	2	..	..	..	..	..	..	..	..	..
General Science	1	1	4	..	..	..	..	..	..	..	..	..
Geology and Geophysics	1	..	13	..	..	..	1	..	3	..	..	..
Humanities and Engineering	..	..	2	..	..	..	..	..	..	..	..	..
Humanities and Science	..	..	8	..	..	..	..	..	..	..	..	..
Industrial Economics	..	..	..	..	..	..	..	..	..	..	..	..
Industrial Management	..	..	..	..	..	..	9	5	75	..	..	..
Mathematics	4	1	15	..	..	..	..	3	6	..	..	..
Mechanical Engineering	7	8	95	..	..	..	20	13	34	..	..	..
Metallurgy	..	..	30	..	..	..	6	5	7	..	..	..
Meteorology	2	..	2	..	..	..	8	4	2	..	..	..
Naval Arch. & Marine Eng.	..	1	12	..	..	..	1	..	25	..	..	..
Nuclear Engineering	..	..	..	..	..	..	10	10	11	..	..	..
Physics	1	1	69	..	..	..	1	4	4	..	..	..
Quantitative Biology	..	1	7	..	..	..	..	..	..	..	..	..
Sanitary Engineering	..	..	..	..	..	..	2	1	9	..	..	..
Shipping and Shipbldg. Man.	..	..	..	..	..	..	..	..	1	..	..	..
Textile Technology	..	..	..	..	..	..	1	..	2	..	..	..
Without course classification	..	..	..	..	..	..	11	6	28	..	..	..
Total	63	49	680	8	2	13	135	108	360	16	7	10

and June, 1958

Engineer			*Ph.D.*			*Sc.D.*			*Total*			
Sept.	*Feb.*	*June*	*Sept.*	*Feb.*	*June*	*Sept.*	*Feb.*	*June*	*Sept.*	*Feb.*	*June*	
..	..	2	..	..	..	..	1	..	8	8	54	Aeronautical Engineering
..	..	..	..	..	..	..	..	..	21	5	16	Architecture
..	..	..	..	..	..	..	..	..	..	..	2	Biochemical Engineering
..	..	..	..	..	..	..	..	..	..	..	1	Biochemistry
..	..	..	..	..	1	..	..	..	..	..	1	Biology
..	..	..	..	..	..	..	..	..	..	..	..	Biophysics
..	..	..	..	..	..	..	..	..	2	1	5	Building Eng. and Con.
..	..	..	..	..	..	..	..	..	6	5	72	Business and Eng. Admin.
..	..	..	..	..	..	..	..	2	1	..	2	Ceramics
..	1	2	..	..	..	3	2	4	14	13	104	Chemical Engineering
..	..	..	..	..	..	..	..	..	5	5	21	Chemical Engineering Prac.
..	..	..	11	14	8	..	..	..	16	15	34	Chemistry
..	..	..	..	..	..	..	..	..	3	4	7	City Planning
..	..	2	..	..	..	1	1	3	9	14	70	Civil Engineering
..	..	..	..	..	..	..	..	..	1	..	3	Economics and Eng.
..	..	..	..	..	..	..	..	..	2	3	7	Economics, Pol., and Eng.
..	..	..	..	..	..	..	..	..	1	2	2	Economics, Pol., and Science
3	4	12	..	..	..	2	4	10	65	51	237	Electrical Engineering
..	..	..	..	1	..	..	..	..	1	2	5	Food Technology
..	..	..	..	..	..	..	..	..	1	2	2	General Engineering
..	..	..	..	..	..	..	..	..	1	1	4	General Science
..	..	..	1	1	3	..	..	..	3	1	19	Geology and Geophysics
..	..	..	..	..	..	..	..	..	..	..	2	Humanities and Engineering
..	..	..	..	..	..	..	..	..	..	..	8	Humanities and Science
..	..	..	2	2	7	..	..	..	2	2	7	Industrial Economics
..	..	..	..	..	..	..	..	..	9	5	75	Industrial Management
..	..	..	3	..	3	..	..	..	7	4	24	Mathematics
..	..	7	..	..	..	3	2	7	30	23	143	Mechanical Engineering
1	1	2	..	..	..	5	4	11	12	10	50	Metallurgy
..	..	..	2	1	1	1	..	..	13	5	5	Meteorology
..	..	24	..	..	..	..	..	..	1	1	62	Naval Arch. & Marine Eng.
..	..	..	..	..	..	..	1	1	10	11	12	Nuclear Engineering
..	..	..	3	5	15	..	..	..	5	10	88	Physics
..	..	..	..	..	..	..	..	..	..	1	7	Quantitative Biology
..	1	..	..	..	1	..	..	..	2	2	10	Sanitary Engineering
..	..	..	..	..	..	..	..	..	..	..	1	Shipping and Shipbldg. Man.
..	..	..	..	..	..	..	..	..	1	..	2	Textile Technology
..	..	..	..	..	..	..	..	..	11	6	28	Without course classification
4	**7**	**51**	**22**	**24**	**39**	**15**	**15**	**38**	**263**	**212**	**1,191**	Total

Table 12. Degrees of Bachelor of Science According to the Class in Which They Were Awarded

Class (calendar year)	Aeronautical Engineering	Architectural Engineering†	Architecture	Biology or Natural Hist. (incl. VII-A)	Building Eng. & Construction	Business & Eng. Administration	Chemical Engineering	Chemical Eng. Practice	Chemistry	Civil Engineering	Economics, Politics, & Eng. or Science	Electrical Eng. (including VI-A)	Electrochemical Engineering*	Food Technology & Biochemical Eng.	General Engineering	General Science or General Course	Geology and Geophysics	Humanities and Eng. or Science	Mathematics	Mechanical Eng. (including II-A)	Meteorology	Military Engineering	Mining Eng. & Metallurgy	Naval Arch. & Marine Eng.	Physics	Sanitary Engineering	Total	Total by decades
1868										6						1				1			6				14	29
1869									1	2										2				2			5	
1870									1	4										2							10	
1871				6			7		11	18		23	1	1		1				26		4	4		3		103	226
1872				2			4		7	22		36				7	1			26			4		1	6	133	
1873			1	2			8		8	25		41				6	2			30			5				129	
1874			1	1			12		11	21		33				5				31			4			3	138	
1875			1				11		14	25		33				4				30			3		2	4	146	
1876			2				7		17	26		48				7	3			34			10	5	3	4	191	
1877			4				12		20	25		33				7	1			40			7	9	3	4	179	
1878			3	1			9		25	32		33				7				41			7	7	4	3	199	
1879			1	1			10		22	30		32				1				37			9	8	2	1	176	
1880							11		19	32		23				5				34			21	9	3	4	185	1,579
1881			3	1					8	3						2				5			6				28	
1882			3	1					6	2						1				5			5		1		24	
1883			1						3	3										7			5				19	
1884									12	5										6			13				36	
1885			2						4	4		2				1				7			8				28	
1886			1	1					7	9		10				1				23			7				59	
1887			1	1					9	10		8				3				17			8		1		58	
1888			5	3					10	11		17				1				25			4		1		77	
1889			3	1					8	14		17				2				24			5		1		75	
1890			5	3					13	25		18				6				28			3		2		103	507
1891			6	2			7		11	18		23				1	1			26		4	4		3		103	
1892			13	6			4		7	22		36				7	1			26			4		1	6	133	
1893			2	2			8		8	25		41				6	2			30			5				129	
1894			14	1			12		11	21		33				5				31			4			3	138	
1895			15				11		14	25		33				4				30			3		2	4	146	
1896			24	3			7		17	26		48				7	3			34			10	5	3	4	191	
1897			16	2			12		20	25		33				7	1			40			7	9	3	4	179	
1898			29	3			9		25	32		33				7				41			7	7	4	3	199	
1899			22	2			10		22	30		32				1				37			9	8	2	1	176	
1900			21	3			11		19	32		23				5				34			21	9	3	4	185	1,579
1901			21	1			14		17	37		25				6	1			39			18	16	1	4	200	
1902			18	5			9		14	24		35				3				46			14	14	3	7	192	
1903			15	1			10		13	26		39	1		8	1	1			37			27	12	3	4	190	
1904			24	3			7		15	34		34				5	1			45			32	17	5	2	232	

1905	..	..	12	3	..	..	13	..	23	46	..	31	3	..	..	3	1	..	..	54	..	..	..	26	24	..	5	244			
1906	..	..	22	2	..	..	10	..	21	47	..	37	3	..	..	..	..	..	..	69	..	..	..	38	19	4	6	278			
1907	..	..	21	..	..	..	14	..	10	37	..	32	5	..	..	..	2	..	..	52	..	..	..	22	10	..	3	208			
1908	..	..	19	4	..	..	15	..	16	48	..	38	2	..	..	..	..	..	..	62	..	..	..	19	5	..	2	230			
1909	..	..	18	5	..	..	13	..	12	51	..	42	3	..	..	..	..	..	..	41	..	..	..	30	5	3	9	232			
1910	..	..	18	3	..	..	18	..	10	57	..	36	3	..	..	2	..	..	..	57	..	..	..	24	11	..	12	251	2,257		
1911	..	..	10	1	..	..	19	..	12	46	..	49	5	..	..	2	..	..	..	49	..	..	..	17	6	1	15	232			
1912	..	..	21	4	..	..	31	..	7	55	..	52	3	..	..	1	..	..	..	47	..	..	..	21	3	2	14	261			
1913	..	..	26	2	..	..	30	..	12	58	..	43	8	..	..	..	..	..	..	50	..	..	..	20	4	1	15	269			
1914	..	..	19	6	..	..	37	..	9	60	..	51	8	..	..	4	..	..	..	65	..	..	..	17	8	1	19	304			
1915	..	..	30	3	..	..	33	..	23	49	..	42	10	..	..	3	..	..	..	69	..	..	..	5	7	3	12	289			
1916	..	..	37	5	..	..	32	..	11	45	..	56	14	..	..	2	..	..	..	84	..	..	..	5	9†	3	18	321			
1917	..	..	27	10	..	37	43	..	13	49	..	45	10	..	..	5	2	..	..	63	..	..	..	14	9†	1	17	345			
1918	..	..	28	7	..	29	40	..	10	45	..	50	11	..	2	4	1	..	..	75	..	..	..	10	4	3	5	324			
1919	..	..	16	9	..	28	44	..	8	45	..	50	6	..	3	1	..	..	..	66	..	..	..	7	7	4	6	300			
1920	..	..	19	2	..	48	63	..	6	52	..	30	9	..	1	4	..	..	..	55	..	..	..	13	12	2	2	318	2,963		
1921	..	..	11	3	..	70	92	..	9	98	..	75	15	..	15	..	3	..	..	128	..	..	..	24	18	1	3	565			
1922	..	..	32	8	..	126	98	15	11	65	..	109	25	..	25	1	8	..	..	56	..	..	..	27	16	8	7	637			
1923	..	13	18	6	..	115	73	19	16	64	..	78	16	..	23	2	8	..	3	106	..	..	..	23	13	9	3	608			
1924	..	6	15	6	..	82	57	8	13	69	..	125	17	..	36	4	2	..	1	82	..	..	..	19	11	3	1	557			
1925	..	6	18	2	..	94	53	8	18	57	..	110	9	..	37	2	3	..	2	98	..	..	..	23	10	5	..	555			
1926	..	9	24	5	..	95	45	13	19	76	..	108	14	..	33	2	4	..	1	76	..	..	..	20	14	1	2	561			
1927	2	15	19	6	..	89	39	6	13	73	..	121	8	..	22	2	3	..	3	72	..	..	1	9	4	4	3	514			
1928	8	19	16	5	..	73	38	7	13	59	..	114	11	..	12	2	1	..	3	67	..	..	..	12	3	3	5	471			
1929	29	25	26	7	9	69	37	11	18	46	..	84	10	..	14	1	2	..	5	64	..	..	..	11	5	4	6	483			
1930	29	15	44	9	23	59	39	12	11	46	..	76	8	..	9	1	2	..	1	48	..	..	..	6	6	11	4	459	5,410		
1931	39	10	18	16	15	68	32	10	12	49	..	83	6	..	22	5	3	..	4	70	..	..	..	12	13	7	2	496			
1932	27	16	5	15	18	70	45	7	15	38	..	74	4	..	29	3	2	..	3	68	..	..	4	21	16	21	4	505			
1933	27	9	..	13	9	56	38	3	18	47	..	86	8	..	16	3	2	..	7	86	..	..	..	14	13	14	2	471			
1934	26	10	..	16	13	78	48	6	15	35	..	82	7	..	8	9	1	..	8	50	..	..	..	26	25	28	5	496			
1935	27	8	..	18	8	74	43	5	15	18	..	57	8	..	19	4	1	..	3	45	..	..	..	14	14	19	1	401			
1936	27	3	..	13	12	63	31	20	16	23	..	68	5	..	25	6	2	..	8	47	..	..	..	10	18	11	2	410			
1937	30	3	..	9	4	61	34	9	13	15	..	67	5	..	20	4	..	..	4	46	..	..	..	19	19	17	1	380			
1938	25	3	..	11	4	56	51	6	14	22	..	62	4	..	28	6	1	..	2	50	10	..	..	5	23	14	2	399			
1939	30	2	..	6	7	56	53	12	25	23	..	67	7	..	19	13	4	..	2	72	20	..	..	9	8	17	1	453			
1940	29	..	..	12	9	59	59	12	23	14	..	73	2	..	36	20	6	..	7	68	22	..	..	7	24	22	..	504	4,515		
1941	36	..	..	6	7	59	54	8	28	22	..	79	..	..	23	5	8	..	6	90	29	..	..	..	18	23	..	501			
1942	39	..	..	17	3	61	60	8	34	16	..	66	..	..	20	11	5	..	4	98	34	..	..	..	29	25	1	531			
1943	38	..	..	10	5	49	49	14	21	14	..	83	..	..	18	11	2	..	6	80	24	..	..	..	33	14	1	472			
1944	57	..	..	4	3	28	41	20	12	18	..	47	..	..	14	4	1	..	2	78	8	..	..	..	37	20	2	396			
1945	22	..	..	1	1	22	36	..	5	9	..	45	..	..	6	1	..	..	5	70	3	..	..	..	13	16	..	255			

* Prior to 1909 this Course was designated as Option 3 (Electrochemistry) of Course VIII.
‡ Prior to 1923 these degrees were awarded in Architecture.
** Prior to 1938 these degrees were included in Mining Engineering and Metallurgy.
† Two received the degree in Naval Architecture, Course XIII-B, in 1916 and three in 1917.

continued

Table 12 — continued

Class (calendar year)	Aeronautical Engineering	Architectural Engineering	Architecture	Biology or Natural Hist. (incl. VII-A)	Building Eng. & Construction	Business & Eng. Administration	Chemical Engineering	Chemical Eng. Practice	Chemistry	Civil Engineering	Economics, Politics, & Eng. or Science	Electrical Eng. (including VI-A)	Electrochemical Engineering	Food Technology & Biochemical Eng.	General Engineering	General Science or General Course	Geology and Geophysics	Humanities and Eng. or Science ***	Mathematics	Mechanical Eng. (including II-A)	Metallurgy	Meteorology	Military Engineering	Mining Eng. & Metallurgy	Naval Arch. & Marine Eng.	Physics	Sanitary Engineering	Total	Total by decades
1946	84	. .	. .	. .	.	33	59	. .	9	13	. .	91	. .	1	12	2	1	. .	4	93	7	24	. .	. .	. .	12	. .	479	
1947	84	. .	. .	4	9	154	114	. .	23	45	. .	189	. .	6	28	3	. .	. .	7	170	20	12	. .	. .	29	35	. .	933	
1948	64	. .	. .	13	29	225	163	. .	35	31	10	262	. .	3	37	8	1	. .	12	186	16	6	. .	. .	12	60	. .	1,173	
1949	51	. .	. .	3	23	157	72	12	28	49	16	176	. .	12	33	7	3	. .	5	114	17	5	. .	. .	16	40	. .	839	
1950	51	. .	. .	16	29	121	92	33	37	55	35	180	. .	13	39	6	11	. .	21	185	36	9	. .	. .	17	61	. .	1,047	6,626
1951	50	. .	. .	14	32	119	92	27	26	55	23	150	. .	10	26	7	18	. .	13	139	40	7	. .	. .	23	53	. .	924	
1952	34	. .	. .	9	30	98	65	11	26	52	14	130	. .	8	14	7	18	. .	21	117	38	9	. .	. .	26	67	. .	794	
1953	40	. .	. .	12	18	77	59	12	23	55	12	126	. .	5	21	10	18	. .	17	81	27	5	. .	. .	10	58	. .	686	
1954	19	. .	. .	12	12	91	58	13	18	43	12	106	. .	4	24	4	11	. .	12	93	31	7	. .	. .	15	51	. .	636	
1955	36	. .	. .	9	7	87	62	8	12	41	9	147	. .	3	21	6	13	. .	13	88	22	1	. .	. .	11	47	. .	643	
1956	45	. .	. .	15	21	77	102	6	20	55	13	133	. .	10	12	11	15	. .	23	119	26	2	. .	. .	15	39	. .	759	
1957	33	. .	. .	11	10	97	64	9	18	38	19	167	. .	8	11	9	6	. .	15	123	24	3	. .	. .	7	63	. .	735	
§1958	37	. .	. .	8	1	77	80	8	25	45	14	163	. .	5	4	5	13	10	16	103	30	2	. .	. .	13	70	. .	729	
Total	1,175	172	865	465	376	3,287	2,913	378	1,232	2,942	177	5,283	301	88	817	332	219	10	269	5,072	484	92	5	880	872	1,048	264	30,018	

§ Includes only February and June degrees.

*** Prior to 1958 these degrees were included in General Engineering and General Science or General Course.

Table 13. Degrees of Master of Science Awarded

Class (calendar year)	Aeronautical Engineering	Architecture	Biology & Public Health (incl. VII-A)	Building Eng. & Construction	Ceramics	Chemical and Nuclear Eng.	Chemical Eng. Practice	Chemistry	Civil Engineering	Economics & Eng. or Science	Electrical Eng. (including VI-A)	Food Technology & Biochemical Eng.	Geology and Geophysics	Industrial Management (XV)	Mathematics	Mechanical Eng.	Metallurgy	Meteorology	Naval Arch. & Marine Eng.	Naval Construction and Engineering	Petroleum Engineering	Physics	Sanitary Engineering	Without Course classification	Total
1886	.	1	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
1887	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
1888	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1889	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1890	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1891	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1892	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1893	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
1894	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
1895	.	1	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	3
1896	.	2	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3
1897	.	2	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	4
1898	.	1	.	.	.	2	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	1	.	.	5
1899	.	1	1	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3
1900	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1901	.	2	.	.	.	.	.	.	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	4
1902	.	3	.	.	.	.	.	3	.	.	.	.	.	.	.	2	.	.	.	.	.	.	.	.	8
1903	.	5	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	1	.	7
1904	.	4	.	.	.	.	.	1	.	.	2	.	.	.	.	1	.	.	.	3	.	1	.	.	12
1905	.	9	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	8	.	.	1	.	18
1906	.	3	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	2	3	.	.	.	.	9
1907	.	6	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.	8	.	.	.	.	15
1908	.	1	.	.	.	.	.	1	.	.	3	.	.	.	.	.	.	.	.	7	.	.	.	.	12

continued

Table 13 — continued

Class (calendar year)	Aeronautical Engineering	Architecture	Biology & Public Health (incl. VII-A)	Building Eng. & Construction	Ceramics	Chemical and Nuclear Eng.	Chemical Eng. Practice	Chemistry	Civil Engineering	Economists & Eng. or Science	Electrical Eng. (including VI-A)	Food Technology & Biochemical Eng.	Geology and Geophysics	Industrial Management (XV)	Mathematics	Mechanical Eng. (including II-A)	Metallurgy	Meteorology	Naval Arch. & Marine Eng.	†Naval Construction and Engineering	Petroleum Engineering	Physics	Sanitary Engineering	Without Course classification	Total
1909	.	6	.	.	.	.	.	1	2	.	1	.	1	.	.	1	.	.	.	3	.	1	.	.	17
1910	.	6	1	.	.	1	.	1	2	.	1	.	.	.	.	1	.	.	.	7	.	.	.	.	19
1911	.	5	2	.	.	.	.	2	2	.	4	.	.	.	.	2	.	.	.	3	.	.	.	.	20
1912	.	4	2	.	.	.	.	3	3	.	2	.	.	.	.	.	.	.	.	4	.	.	2	.	20
1913	.	4	1	.	.	7	.	.	1	.	1	.	1	.	.	2	.	.	.	2	.	.	.	.	19
1914	.	3	2	.	.	3	.	5	3	.	2	.	1	.	.	1	.	.	.	2	.	.	3	.	25
1915	1	4	.	.	.	2	.	2	1	.	10	.	.	.	.	4	.	.	1	2	.	.	.	.	27
1916	5	7	1	.	.	1	.	3	5	.	6	.	.	.	.	4	.	.	.	2	.	.	1	.	35
1917	4	3	.	.	.	1	.	1	3	.	5	.	.	.	.	1	.	.	.	9	.	1	2	.	30
1918	5	1	1	.	.	1	.	1	1	.	2	.	.	.	.	2	.	.	.	.	.	.	.	1	15
1919	2	.	.	.	.	.	.	.	4	.	4	.	.	.	1	1	.	.	.	.	.	.	.	.	15
1920	.	.	1	.	.	3	.	3	4	.	7	.	3	.	1	5	.	.	.	19	.	1	.	4	50
1921	3	.	.	.	.	29	.	2	4	.	4	.	2	.	.	10	.	.	.	20	.	.	.	17	93
1922	5	.	.	.	.	6	32	6	2	.	37	.	2	.	2	4	.	.	.	10	.	1	.	18	126
1923	10	.	.	.	.	3	34	4	5	.	45	.	2	.	.	15	1	.	4	21	.	3	.	26	170
1924	4	.	.	.	.	6	41	1	5	.	34	.	1	.	.	8	1	.	.	12	.	5	.	28	146
1925	5	.	.	.	.	3	35	3	5	.	35	.	.	1	.	10	2	.	.	.	.	2	1	21	123
1926	6	.	.	.	.	5	20	2	2	.	60	.	3	.	.	6	1	.	.	12	.	.	.	25	142
1927	9	.	1	.	.	2	26	4	6	.	54	.	6	.	1	13	.	.	.	6	.	1	.	32	161
1928	9	.	.	.	.	5	14	2	8	.	63	.	.	.	2	13	.	.	.	9	.	1	.	43	169
1929	5	.	.	.	.	3	21	4	6	.	79	.	4	2	2	16	.	.	.	6	.	2	1	45	196
1930	3	.	.	.	.	7	22	5	9	.	51	.	1	1	2	5	3	.	1	5	.	1	1	53	170
1931	4	.	2	.	.	15	34	5	12	.	57	.	2	5	5	10	4	4	.	8	.	2	.	20	189
1932	5	.	5	.	.	25	33	8	17	.	56	.	2	9	3	16	1	4	.	7	.	6	.	40	273
1933	10	.	1	.	.	14	26	7	12	.	46	.	.	5	1	18	2	.	1	13	.	4	2	20	182
1934	7	.	5	.	.	16	19	11	9	.	46	.	3	5	3	20	5	1	.	11	.	3	1	21	186

1935	3	..	1	..	..	16	14	4	13	..	55	..	..	2	3	16	6	..	..	10	..	7	2	21	173
1936	5	..	..	..	2	7	30	3	19	..	22	..	2	4	2	14	..	4	1	7	1	5	..	23	151
1937	12	..	1	..	1	12	29	8	17	7	35	..	..	5	1	15	4	4	..	8	1	2	1	23	186
1938	13	..	.	..	..	11	28	1	29	2	58	..	..	8	1	24	1	4	..	7	1	3	..	30	221
1939	8	..	3	..	..	20	34	1	31	3	45	..	2	8	1	21	6	6	..	8	..	5	2	28	232
1940	9	..	1	..	..	16	37	3	20	..	54	..	4	9	5	22	7	8	18	10	2	3	2	37	267
1941	16	..	1	..	..	15	42	3	10	3	35	..	3	12	2	25	7	18	15	22	..	4	1	25	259
1942	9	..	2	..	1	12	23	2	5	1	24	..	2	16	1	24	8	11	15	9	..	..	1	7	173
1943	21	..	1	..	..	15	36	3	9	..	30	..	2	..	..	26	5	14	7	18	..	2	1	4	194
1944	22	..	..	..	1	3	7	2	9	..	13	..	..	1	..	12	5	11	1	55	..	..	3	5	150
1945	9	..	3	..	..	12	..	3	5	..	25	..	..	1	2	11	7	6	..	23	..	2	3	9	121
1946	47	..	1	..	..	29	2	5	24	..	45	..	2	4	5	47	4	5	3	46	..	2	4	9	284
1947	67	..	5	..	..	65	32	12	47	1	63	5	5	18	9	64	13	8	7	..	..	10	13	12	456
1948	40	..	4	9	1	31	39	13	30	5	92	..	..	19	5	63	11	12	4	33	..	5	9	13	438
1949	44	..	6	5	..	36	41	7	26	3	109	5	1	29	10	58	15	8	5	..	..	11	9	19	447
1950	32	..	2	7	..	57	19	3	29	3	110	2	2	22	11	58	17	6	3	..	..	14	9	20	426
1951	40	..	4	3	1	56	30	8	20	2	106	1	5	25	14	53	20	8	8	..	..	12	10	18	444
1952	29	..	7	4	..	36	19	4	24	3	111	2	2	26	6	32	29	19	4	..	..	15	7	26	405
1953	36	..	7	12	..	34	12	11	34	..	102	3	2	26	8	49	17	22	4	..	..	16	8	36	439
1954	33	..	4	3	..	35	25	3	37	1	101	6	7	64	9	64	26	14	8	..	..	11	8	53	512
1955	31	..	1	7	1	47	17	1	33	2	106	6	2	49	3	45	25	10	8	..	..	13	13	41	461
1956	30	..	4	11	1	40	34	1	41	1	108	6	6	50	7	42	26	5	7	..	..	10	12	41	483
1957	33	..	1	6	3	62	44	3	30	2	124	2	1	67	12	75	17	13	30	..	..	9	13	52	599
*1958	22	..	1	5	..	49	18	2	33	3	95	3	3	80	9	49	12	6	26	..	..	8	10	34	468
Total	713	84	86	72	12	878	969	204	710	42	2,385	41	87	573	149	1,104	308	231	183	478	5	207	157	1,000	10,678

* Includes only February and June degrees.
† Beginning 1949, see Naval Engineer, Table 17.

See note below 126

10,804

In addition to the above, a total of 126 Master of Science degrees have been awarded in discontinued Courses, including Architectural Engineering, Electrochemical Engineering, Fuel and Gas Engineering, General Science, Mining Engineering, Naval Construction (foreign students), and Railroad Operation. (See the Report of the Registrar for 1940–41 for details.) The grand total of Master of Science degrees awarded by the Institute is therefore 10,804.

Table 14. Degrees Awarded in Architecture and City Planning

Class (calendar year)	Bachelor in Architecture	†Bachelor in City Planning	Master in Architecture	Master in City Planning
1921	..	..	3	..
1922	..	..	2	..
1923	..	..	7	..
1924	..	..	8	..
1925	..	..	5	..
1926	..	..	9	..
1927	..	..	7	..
1928	..	..	6	..
1929	..	..	9	..
1930	..	..	7	..
1931	..	..	9	..
1932	11	..	5	..
1933	24	..	7	..
1934	27	..	..	..
1935	17	4	11	..
1936	14	4	4	2
1937	9	2	11	3
1938	19	1	3	3
1939	14	1	10	3
1940	11	2	21	7
1941	17	2	6	1
1942	15	1	4	4
1943	10	..	3	6
1944	8	..	2	3
1945	5	..	..	7
1946	7	..	2	8
1947	9	1	20	15
1948	11	3	14	13
1949	24	2	10	12
1950	20	4	17	13
1951	27	2	20	12
1952	33	1	15	10
1953	31	..	19	9
1954	26	1	13	13
1955	29	..	23	7
1956	18	..	19	8
1957	26	..	18	6
*1958	15	..	6	11
Total	477	31	355	176

* Includes only February and June degrees.

† From 1935 to 1944, Bachelor of Architecture in City Planning.

Table 15. Degrees of Master in Public Health Awarded

(Discontinued after 1944)

Class (calendar year)	Prior to 1948	1948*	Total
1923	..	2	2
1926	..	1	1
1927	..	2	2
1929	..	1	1
1930	..	5	5
1931	..	4	4
1933	..	7	7
1934	..	4	4
1935	..	4	4
1937	..	6	6
1938	..	2	2
1939	..	6	6
1940	..	7†	7
1941	3	6	9
1942	11	1	12
1943	10	10	20
1944	7	5	12
Total	31	73	104

* In June, 1948, 72 former recipients of the Certificate of Public Health were awarded the degree of Master in Public Health as of the class in which they received their Certificate of Public Health.

† Includes one degree awarded in June, 1954.

Table 16. Degrees of Engineer Awarded

Class (calendar year)	*Aeronautical Engineer*	*Building Engineer*	*Chemical Engineer*	*Civil Engineer*	*Electrical Engineer*	*Marine Mech. Engineer*	*Mechanical Engineer*	*Metallurgical Engineer*	*†Meteorologist*	*Naval Architect*	*Naval Engineer*	*Sanitary Engineer*	*Total*
1949	..	..	..	..	2	..	..	..	1	..	37	..	40
1950	2	..	..	..	10	..	8	2	..	..	27	..	49
1951	3	..	1	..	9	..	10	2	..	1	33	..	59
1952	2	..	..	1	6	..	13	1	1	..	38	3	65
1953	3	..	..	3	4	..	8	1	..	..	19	..	38
1954	4	2	2	1	7	..	8	3	..	1	29	2	59
1955	3	2	..	2	8	1	5	..	..	1	25	..	47
1956	6	..	..	2	6	2	12	1	..	1	29	2	61
1957	4	..	2	..	17	..	7	4	..	2	22	..	58
*1958	2	..	3	2	16	1	7	3	..	1	22	1	58
Total	29	4	8	11	85	4	78	17	2	7	281	8	534

* Includes only February and June degrees.
† Discontinued in June, 1956.

Table 17. Degrees of Doctor of Philosophy Awarded

Class (calendar year)	Biology	Chemistry	Electrical Engineering	Food Technology	Geology	Industrial Economics	Mathematics	Meteorology	Physics	Group Psychology	Sanitary Engineering	Total
1907	..	3	..	..	..	..	..	..	..	..	..	3
1908	..	3	..	..	..	..	..	..	..	..	..	3
1909	..	..	..	..	..	..	..	..	..	..	..	..
1910	..	1	..	..	1	..	..	..	..	..	..	2
1911	1	..	..	..	..	..	..	..	..	..	..	1
1912	..	3	..	..	3	..	..	..	..	..	..	6
1913	..	1	..	..	..	..	..	..	..	..	..	1
1914	..	2	..	..	..	..	..	..	..	..	..	2
1915	..	2	..	..	..	..	..	..	..	..	..	2
1916	..	1	..	..	1	..	..	..	1	..	..	3
1917	..	3	..	..	1	..	..	..	..	..	..	4
1918	..	3	..	..	1	..	..	..	..	..	..	4
1919	..	..	..	..	..	..	..	..	1	..	..	1
1920	..	4	..	..	1	..	..	..	..	..	..	5
1921	1	3	..	..	..	..	..	..	3	..	..	7
1922	..	4	..	..	1	..	..	..	..	..	..	5
1923	..	5	..	..	1	..	..	..	..	..	..	6
1924	2	10	..	..	..	..	..	..	2	..	..	14
1925	..	11	..	..	..	..	..	..	..	..	..	11
1926	..	2	..	..	2	..	..	..	..	..	..	4
1927	2	6	..	..	1	..	1	..	1	..	..	11
1928	1	5	..	..	1	..	1	..	..	..	..	8
1929	4	8	..	..	2	..	1	..	..	..	..	15
1930	..	5	..	..	2	..	3	..	..	..	..	10
1931	..	9	..	..	..	..	1	..	..	..	..	10
1932	1	12	..	..	..	..	1	..	2	..	..	16
1933	2	10	..	..	3	..	3	..	..	..	..	18
1934	2	10	..	..	2	..	2	..	1	..	..	17
1935	4	15	..	..	2	..	3	..	7	..	..	31
1936	..	15	..	..	..	..	3	..	12	..	..	30
1937	2	11	..	..	4	..	1	..	10	..	..	28
1938	2	12	..	..	2	..	4	..	7	..	..	27
1939	1	33	..	..	4	..	3	..	4	..	..	45
1940	3	19	..	..	5	..	4	..	5	..	..	36
1941	1	18	..	..	1	..	3	..	5	..	..	28
1942	1	19	..	..	5	..	1	..	8	..	..	34
1943	2	8	..	..	2	..	3	..	8	..	..	23
1944	2	12	..	..	..	1	..	..	9	..	..	24
1945	1	6	..	..	..	..	1	..	1	..	..	9
1946	2	5	..	1	..	4	4	..	1	..	..	17
1947	3	14	1	1	..	3	4	..	17	..	..	43
1948	3	27	..	..	5	1	8	..	34	5	..	83
1949	2	40	..	2	4	3	5	..	36	3	..	95
1950	4	31	..	..	3	7	6	..	40	..	..	91
1951	2	30	..	..	8	7	7	..	30	..	..	84

Table 17 — continued

Class (calendar year)	*Biology*	*Chemistry*	*Electrical Engineering*	*Food Technology*	*Geology*	*Industrial Economics*	*Mathematics*	*Meteorology*	*Physics*	*Group Psychology*	*Sanitary Engineering*	*Total*
1952	4	30	1	1	9	7	7	..	27	..	..	86
1953	1	37	..	5	7	8	7	..	31	1	..	97
1954	5	26	..	1	8	10†	9	..	37	..	..	96
1955	7	26	..	1	5	4	6	..	31	..	..	80
1956	4	32	..	2	5	13†	7	1	29	..	..	93
1957	6	40	..	7	4	7	7	7	22	..	..	100
1958*	1	22	..	1	4	9	3	2	20	..	1	63
Total	**79**	**654**	**2**	**22**	**110**	**84**	**119**	**10**	**442**	**9**	**1**	**1,532**

† Includes one in 1954 and two in 1956 in psychology.
* Includes only February and June degrees.

Table 18. Degrees of Doctor of Science Awarded

Class (calendar year)	Aeronautical Engineering	Ceramics	Chemical Engineering	Chemistry	Civil Engineering	Electrical Engineering	Electrochem. Engineering	Food Technology & Biochemical Engr.	Geology	Mathematics	Mechanical Engineering	Metallurgy	Meteorology	Mineral Engineering	Naval Architecture	Petroleum Engineering	Physics	Sanitary Engineering	Total
1911	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	1
1912	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1913	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1914	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	1
1915	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	1
1916	1	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	1
1917	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1918	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.
1919	.	.	.	.	.	.	.	.	.	.	.	.	.	1	.	.	.	.	3
1920	1	.	.	.	.	.	.	.	1	.	.	.	.	.	.	.	.	.	.
1921	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	.	3
1922	1	.	.	1	.	1	.	.	1	.	.	1	.	.	.	.	2	.	5
1923	1	.	.	.	.	1	.	.	1	.	.	1	.	.	.	.	1	.	6
1924	.	.	2	.	.	.	.	.	.	.	.	3	.	.	.	.	.	.	5
1925	1	.	3	1	.	1	.	.	.	.	.	4	.	.	.	.	.	.	9
1926	.	.	1	1	1	1	1	.	.	.	1	2	.	.	.	.	1	.	6
1927	.	.	.	.	.	1	.	.	.	1	.	1	.	.	.	.	.	.	10
1928	1	.	5	.	1	2	.	.	.	.	.	1	.	.	1	.	1	.	6
1929	.	.	3	.	.	.	.	.	.	.	.	1	.	.	.	.	.	.	20
1930	.	.	9	.	.	6	.	.	.	1	3	1	.	.	.	.	.	.	9
1931	.	.	3	2	.	3	.	.	1	.	2	1	.	1	.	.	2	.	14
1932	.	.	5	.	1	2	.	.	.	1	.	6	.	.	.	.	.	.	24
1933	.	.	10	1	2	3	1	.	1	.	3	2	1	.	.	.	.	1	13
1934	.	.	3	.	.	2	.	.	.	2	.	1	1	.	.	.	1	1	14
1935	.	1	2	1	.	4	.	.	.	.	2	3	.	1	.	.	2	.	24
1936	2	1	12	.	.	1	.	.	.	.	.	.	.	.	.	.	.	.	.

1937	1	1	9	1	1	6	..	..	..	..	2	..	..	..	..	1	1	..	23
1938	..	1	12	..	2	7	..	..	1	..	2	5	3	..	..	..	5	..	38
1939	2	1	10	..	3	1	..	..	..	..	..	4	1	1	..	..	3	..	26
1940	..	2	12	..	3	1	..	..	1	..	2	2	..	1	..	..	4	1	29
1941	1	1	15	3	..	3	..	..	..	..	3	8	3	..	..	..	3	1	41
1942	1	2	14	..	2	..	..	..	..	..	1	3	1	..	..	..	2	..	26
1943	..	2	10	..	..	1	..	..	..	..	..	5	..	..	..	..	2	..	20
1944	2	..	4	..	..	1	..	..	2	..	1	4	..	..	..	..	1	..	15
1945	..	1	7	..	2	..	..	..	..	..	1	3	1	..	..	..	..	..	15
1946	1	..	11	..	3	1	..	..	1	..	2	1	2	..	..	..	1	..	23
1947	2	1	10	..	2	4	..	2	1	..	2	11	1	..	..	..	1	..	37
1948	3	1	10	..	3	3	..	..	1	..	4	9	9	..	..	..	3	..	46
1949	2	5	21	..	6	8	..	..	..	..	7	15	4	..	..	..	1	2	71
1950	6	3	12	1	5	13	..	1	..	..	14	11	4	..	..	..	..	..	70
1951	5	2	10	..	7	11	..	..	..	..	10	19	2	..	1	..	3	4	74
1952	3	2	13	1	5	16	..	2	..	..	9	14	3	..	..	..	1	3	72
1953	4	3	12	..	2	14	..	1	..	..	16	16	3	..	..	..	..	2	73
1954	4	6	10	..	2	10	..	..	2	1	13	18	3	..	..	..	..	2	71
1955	3	4	12	..	4	16	..	2	..	..	11	20	3	..	..	..	..	1	76
1956	5	1	11	1	3	17	..	1	..	..	12	16	..	..	..	..	..	2	69
1957	1	..	8	..	7	9	..	2	..	..	13	22	2	..	..	..	2	2	68
*1958	1	2	8	..	4	14	..	..	..	..	9	15	..	..	..	..	..	..	53
Total	55	43	299	13	71	186	2	11	14	6	145	249	47	5	2	1	43	21	1,213

* Includes only February and June degrees.

Table 19. Degrees of Doctor of Public Health Awarded

(Discontinued after 1944)

Class (calendar year)	*Number*
1924	1
1927	1
1928	1
1930	1
1939	1
1942	1
1944	3
Total	9

Table 20. Degrees of Doctor of Engineering Awarded

(Discontinued after 1918)

Class (calendar year)	*Electrical Engineering*	*Electrochemical Engineering*	*Total*
1910	1	..	1
1914	1	..	1
1916	1	..	1
1917	..	1	1
Total	3	1	4

Table 21. Summary of Degrees Awarded (1868–1958)

Bachelor of Science	30,018
Bachelor in Architecture	477
Bachelor in City Planning	31
Master of Science	10,804
Master in Architecture	355
Master in City Planning	176
Master in Public Health (discontinued after 1944)	104
Advanced Engineering	534
Doctor of Philosophy	1,532
Doctor of Science	1,213
Doctor of Public Health (discontinued after 1944)	9
Doctor of Engineering (discontinued after 1918)	4
Grand total	45,257

ROBERT E. HEWES

Principal Honors and Awards to the Staff

Administration

PIETRO BELLUSCHI
Chairman of the Advisory Committee, Franklin Delano Roosevelt Memorial Commission.

VANNEVAR BUSH
New England Award, Engineering Societies of New England.
Chairman of the Board of Directors, Merck and Company.
Trustee of the Carnegie Institution of Washington.

EDWARD A. CROCKER
President of the New England Intercollegiate Tennis Association.

MARK J. DONDERO
Secretary of the Campus Safety Association.

HARRIET L. HARDY
Honorary Member of Phi Beta Kappa, Wellesley College.
Honorary Member of Alpha Omega Alpha, Cornell University.

HAROLD L. HAZEN
Chairman of the Committee on Development of Engineering Faculties, American Society for Engineering Education.

JAMES R. KILLIAN, JR.
Appointed Special Assistant to President Eisenhower for Science and Technology.
Honorary Degree of Doctor of Applied Science, University of Montreal.
Honorary Degree of Doctor of Science, Columbia University.
Honorary Degree of Doctor of Science, College of Wooster.
Honorary Degree of Doctor of Laws, Brandeis University.

JOHN I. MATTILL
Chairman of the Public Relations Committee, American Society for Engineering Education.
Director of the New England District, American College Public Relations Association.

HERMAN POLLACK
Honorary Degree of Doctor of Divinity, Hebrew Union College, Jewish Institute of Religion.

H. GUYFORD STEVER
Honorary Degree of Doctor of Science, Colgate University.
Chairman of the Special Committee on Space Technology, National Advisory Committee on Aeronautics.
Vice President of the Institute of the Aeronautical Sciences.

JULIUS A. STRATTON
Honorary Degree of Doctor of Laws, Union College.

ROBERT F. TILLEY
Secretary-Treasurer of the Boston Dermatology Club.

Department of Aeronautical Engineering

RAYMOND L. BISPLINGHOFF
Senior Postdoctoral Fellowship, National Science Foundation.
Sylvanus Albert Reed Award, Institute of the Aeronautical Sciences.

CHARLES S. DRAPER
Airpower Trophy, Air Force Association.
Holley Medal, American Society of Mechanical Engineers.

JEROME C. HUNSAKER
Gold Medal, Royal Aeronautical Society.
Water-Based Aviation Award, Institute of the Aeronautical Sciences.
Distinguished Service Medal, National Advisory Committee for Aeronautics.

JAMES W. MAR
Postdoctoral Fellowship, National Science Foundation.

RENE H. MILLER
Honorary Fellow and Technical Director of the American Helicopter Society.
Editor of the *Journal of the American Helicopter Society.*

Department of Architecture

HERBERT L. BECKWITH
Fellowship, American Institute of Architects.

ALBERT BUSH-BROWN
Editor for Architecture, *Encyclopaedia Britannica.*
Editor of the *Journal of Architectural Education.*
Second place, Essay Award, American Institute of Architects (in collaboration with Dean John E. Burchard).

RICHARD F. FILIPOWSKI
First prize in sculpture, 1958 Boston Arts Festival.

MARVIN E. GOODY
Award of merit in the Architectural Division, 1958 Boston Arts Festival (for Hillside School for Boys, Marlboro, Massachusetts, Hamilton and Goody, Architects).
Membership, Boston Society of Architects.

RICHARD W. HAMILTON
Award of merit in the Architectural Division, 1958 Boston Arts Festival (for Hillside School for Boys, Marlboro, Massachusetts, Hamilton and Goody, Architects).

Department of Biology

ETHEL H. BAILEY
Secretary of the Boston Section, Society for the Advancement of Management.

J. MORTON GILLESPIE
Fulbright travel grant.

JAMES F. KOERNER
Postdoctoral Research Fellowship, U. S. Public Health Service.

CYRUS LEVINTHAL
Fellow of the American Academy of Arts and Sciences.

FRANK G. ROTHMAN
Research Fellowship, American Cancer Society.

Department of Chemical Engineering

EDWIN R. GILLILAND
Director of the American Institute of Chemical Engineers.

WARREN K. LEWIS
Award in Industrial and Engineering Chemistry, American Chemical Society.
Gold Medal for Distinguished Achievement, American Petroleum Institute.
Founders' Award, American Institute of Chemical Engineers.

LOWELL M. SCHWARTZ
Predoctoral Fellowship, National Science Foundation.

THOMAS K. SHERWOOD
Member, National Academy of Sciences.

HAROLD C. WEBER
Certificate of Achievement, Chemical Corps (U. S. Army).

Department of Chemistry

MARIO E. BAUR
Postdoctoral Fellowship, National Science Foundation.

GEORGE H. BÜCHI
Ruzicka Prize, Swiss Chemical Society.
Fritzsche Award, American Chemical Society.

CHARLES D. CORYELL
Scientific Adviser to the UNESCO Conference on Use of Radioisotopes in Scientific Research.

JAMES E. DAVIS
Predoctoral Fellowship, National Science Foundation.

SAMUEL O. GRIM
Predoctoral Fellowship, National Science Foundation.

RICHARD C. LORD
Member of the Commission on Molecular Spectroscopy, International Union of Pure and Applied Chemistry.
Member of the Board of Directors, Optical Society of America.

LOCKHART B. ROGERS
Chairman of the Northeastern Section, American Chemical Society.
Chairman of the Boston Section, The Electrochemical Society.
Chairman of the 1958 Massachusetts Science Talent Search.

CHARLES H. SEDERHOLM
Predoctoral Fellowship, National Science Foundation.

WALTER H. STOCKMAYER
Bourke Overseas Lecturer, The Faraday Society.

WILLIAM E. THIESSEN
Predoctoral Fellowship, National Science Foundation (second year).

EDWARD R. THORNTON
Predoctoral Fellowship, National Institutes of Health.

JOHN T. WASSON
Postdoctoral Fellowship, National Science Foundation.

STEPHEN J. WEININGER
Predoctoral Fellowship, National Science Foundation.

Department of City and Regional Planning

FREDERICK J. ADAMS
Chairman of the Committee on Functional Divisions, American Institute of Planners.

ROLAND B. GREELEY
Vice Chairman of the Research Division, United Community Services of Metropolitan Boston.

BURNHAM KELLY
Vice Chairman of the Housing Association of Metropolitan Boston.

Department of Civil and Sanitary Engineering

ALEXANDER J. BONE
Vice President — Educational Division, American Road Builders Association.

JAMES W. DAILY
Chairman of the Cavitation Committee, American Society of Mechanical Engineers.
Chairman of the Hydraulics Section, Boston Society of Civil Engineers.
Chairman of the Committee on Hydraulic Machinery and Cavitation, International Association for Hydraulic Research.

ALBERT G. H. DIETZ
Fellow of the American Academy of Arts and Sciences.

ROLF ELIASSEN
Chairman of the Committee on Water Conditioning and Corrosion Prevention, American Water Works Association.

ROBERT J. HANSEN
Chairman of the Committee on Structural Dynamics, Engineering Mechanics Division, American Society of Civil Engineers.
Chairman of the Committee on Structural Dynamics, Column Research Council.

DONALD R. F. HARLEMAN
Chairman of the Committee on Hydromechanics, Hydraulics Division, American Society of Civil Engineers.

ROSS E. MCKINNEY
Chairman of the Publications Committee, Sanitary Engineering Division, American Society of Civil Engineers.

CHARLES L. MILLER
Vice President of the North Atlantic Region, American Society of Photogrammetry.
National Director of the American Road Builders Association.
Trustee of the Highway Engineering Education Foundation.

VINCENT J. ROGGEVEEN
Doctoral Research Fellowship, Ford Foundation.

HOWARD SIMPSON
Desmond Fitzgerald Medal, Boston Society of Civil Engineers.

JOHN B. WILBUR
Chairman of the Nominating Committee, Boston Society of Civil Engineers.

GORDON R. WILLIAMS
Vice Chairman of the Committee on Floods, Boston Society of Civil Engineers.

MARTIN WOHL
Honorable Mention, 1958 Massachusetts Highway Association Contest.

Department of Economics and Social Science

ROBERT L. BISHOP
Fellow of the American Academy of Arts and Sciences.

ROGER W. BROWN
Research Award, Ford Foundation.

DANIEL LERNER
Chairman of the Committee on International Polling and Member of the Executive Council, World Association for Public Opinion Research.

LAURENCE W. MARTIN
Research Fellowship, Rockefeller Foundation.

NORMAN J. PADELFORD
Member of the National Defense Executive Reserve, Department of State.
Honorary Fellow, American-Scandinavian Foundation.
Honorary Member of Phi Beta Kappa, Carleton College.

ROBERT C. WOOD
Visiting Professor of Public Administration, Syracuse University.

Department of Electrical Engineering

RICHARD B. ADLER
Chairman of the Committee on Transistor Circuit Representation, Institute of Radio Engineers.

LEO L. BERANEK
Chairman of the Working Group on Instrumentation for Measurement and Generation of High Intensity Noise, Committee on Hearing and Bioacoustics (Armed Forces — N.R.C.).
Chairman of the Awards Committee, Boston Section, Institute of Radio Engineers.

MELVIN M. BRADY
Fulbright Award for study in Norway.

GORDON S. BROWN
Honorary Degree of Doctor of Engineering, Purdue University.
Director of the Institute of Radio Engineers.
J. I. Carroll Memorial Fellow, University of Sydney, New South Wales, Australia.

DUDLEY A. BUCK
Chairman of the School Committee, Wilmington, Massachusetts.

LAN J. CHU
Fellow of the American Academy of Arts and Sciences.
Member of Academia Sinica, China.
Chairman, Section on Mode and Large Signal Theories, International Symposium on Electronic Waveguides, Brooklyn Polytechnic Institute.

ROBERT M. FANO
Fellow of the American Academy of Arts and Sciences.

THOMAS J. GOBLICK, JR.
Fulbright Award for study in England.

PAUL E. GRAY
Television Shares Award.

ERNST A. GUILLEMIN
Walker Ames Visiting Professor of Electrical Engineering, University of Washington.

HERMANN A. HAUS
Chairman of the Section on Electronic Beam Dynamics, National Academy of Sciences Conference on Plasma Dynamics.
Chairman of the Subcommittee on Noise, Institute of Radio Engineers.

FREDERICK C. HENNIE, III
Television Shares Award.

LEO JEDYNAK
Television Shares Award.

ROBERT L. KYHL
W. R. G. Baker Award, Institute of Radio Engineers (joint recipient).

ARTHUR L. LOEB
Member of the Executive Committee, Society for Industrial and Applied Mathematics.
Arrangements Chairman for the Cambridge Section, Society for Industrial and Applied Mathematics.
President of the Boston Chapter, American Recorder Society.

CHARLES W. MERRIAM, III
Television Shares Award.

ROBERT P. RAFUSE
Sprague Electric Company Award.

WALTER A. ROSENBLITH
Chairman of the Committee on Publications and Editorial Policy, Biophysical Society.
Member of the New York Academy of Science.
Member of the Council and of the Executive Board, Biophysical Society.

WILLIAM M. SIEBERT
Member of the Security Resources Panel (Gaither Committee).

ALEXANDER SMAKULA
Member of the New York Academy of Sciences.

KENNETH N. STEVENS
Associate Editor for Speech Communication, *Journal of the Acoustical Society of America.*

JEROME B. WIESNER
Member of the President's Science Advisory Committee.

KARL L. WILDES
Certificate, People to People Foundation.

JOHN M. WOZENCRAFT
Chairman of the *Ad Hoc* Committee on Technology Monographs, Communications Series.

Department of Food Technology

SAMUEL A. GOLDBLITH
National Councilor of the Institute of Food Technologists.

JOHN T. R. NICKERSON
Treasurer of the Northeast Section, Institute of Food Technologists.

Department of Geology and Geophysics

MARTIN J. BUERGER
Honorary Member of the German Mineralogical Society.
Visiting Professor, Institute of Geophysics, University of California.

WILLIAM H. DENNEN
President of the Boston Geological Society.

HAROLD W. FAIRBAIRN
Fellow of the American Academy of Arts and Sciences.

PATRICK M. HURLEY
"Professeur Associe" to the University of Nancy (by the Minister of Education, France).

GORDON J. F. MACDONALD
Visiting Investigator, Department of Astrophysics, California Institute of Technology.

ROBERT R. SHROCK
Vice President and Chairman of the Section on Geology and Geography, American Association for the Advancement of Science.

WALTER L. WHITEHEAD
Honorary Degree of Doctor of Science, St. Francis Xavier University, Antigonish, Nova Scotia.

Department of Humanities

HOWARD R. BARTLETT
United States Specialist on General Education in India (U. S. International Educational Exchange Grant).

ALFRED D. CHANDLER, JR.
Fellowship, John Simon Guggenheim Memorial Foundation.

GIORGIO D. DE SANTILLANA
Sidney Hillman Foundation Prize Award.

THEODORE D. LOCKWOOD
Guest Lecturer, Juniata Christian Association, Juniata College.

JOHN B. RAE
Member of the Executive Committee, Society for the History of Technology.

WILLIAM D. STAHLMAN
Treasurer of the History of Science Society.

School of Industrial Management

ROBERT B. FETTER
Chairman of the Ford Foundation Conference on Research Needs in Production Management.

INGO INGENOHL
Chairman of the Fellowship Committee, Cambridge Rotary Club.

BILLY E. GOETZ
President of the Academy of Management.

ROBERT H. GREGORY
Chairman of the Committee on Accounting Instruction in Electronic Data Processing, American Accounting Association.

RICHARD B. MAFFEI
Vice President of the Wharton School Alumni Society, Boston.

LEO B. MOORE
Award of the Standards Engineers Society — American Society of Testing Materials.
Chairman of the Awards Committee, Standards Engineers Society.

ELI SHAPIRO
Faculty Research Fellowship, Ford Foundation.

Department of Mathematics

ALBERTO P. CALDERON
Fellow of the American Academy of Arts and Sciences.

KENKICHI IWASAWA
Fellowship, John Simon Guggenheim Memorial Foundation.

HENRY P. McKEAN, JR.
Fulbright Award and National Science Foundation Postdoctoral Fellowship for study in Japan.

DIRK J. STRUIK
Profesor Extraordinario, Universidao Nacional de Mexico.
Honorary member of the Sociedad Matematica Mexicana.

GEORGE B. THOMAS, JR.
Vice President of the Mathematical Association of America.

NORBERT WIENER
Honorary Degree of Doctor of Science, Grinnell College.

Department of Mechanical Engineering

DOUGLAS P. ADAMS
Visiting Lecturer in Engineering Sciences, Harvard University.

JEROME CATZ
Secretary-Treasurer of the New England Local Section, Society for Experimental Stress Analysis.

SAMUEL C. COLLINS
Kamerlingh Onnes Gold Medal, University of Leiden.

THOMAS P. GOODMAN
Melville Medal, American Society of Mechanical Engineers.

CHARLES H. KRUGER
Fellowship, National Science Foundation.

WILLEM LANSEN
Fellowship, Sir Walter Teagle Foundation.

FRANK A. MCCLINTOCK
James Clayton Fund Prize, International Conference on Fatigue of Metals, Institution of Mechanical Engineers.

WILLIAM M. MURRAY
Secretary-Treasurer of the Society for Experimental Stress Analysis.

MILTON C. SHAW
Gold Medal, American Society of Tool Engineers.

TAU-YI TOONG
Fellowship, John Simon Guggenheim Memorial Foundation.

ARTHUR L. TOWNSEND
James H. McGraw Award, American Society for Engineering Education.

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Secretary of the New England Regional Conference Committee, American Institute of Mining, Metallurgical, and Petroleum Engineers.

BENJAMIN L. AVERBACH
Expert to the American delegation, International Institute of Welding.

JAMES H. BROWN
Secretary-Treasurer of the Boston Section, American Institute of Mining, Metallurgical, and Petroleum Engineers.

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Chairman of the Education Committee, Mineral Beneficiation Division, American Institute of Mining, Metallurgical, and Petroleum Engineers.

JOHN CHIPMAN
Gold Medal, American Society for Metals.

MORRIS COHEN
Burgess Memorial Lecture, Washington Chapter, American Society for Metals.
American Society for Metals Visiting Lectureship, University of Pennsylvania.

GEORGE ECONOMOS
Chairman of the Committee on Non-Metallic Magnetic Materials, American Society for Testing Materials.

ANTOINE GAUDIN
Chemical Engineering Achievement Award, *Chemical Engineering* magazine.
Member of the Board, Engineering Foundation.
Chairman of the Basic Science Committee, Minerals Beneficiation Division, American Institute of Mining, Metallurgical, and Petroleum Engineers.

THOMAS B. KING
Chairman of the Publications Committee, Extractive Metallurgy Division, American Institute of Mining, Metallurgical, and Petroleum Engineers.
Vice Chairman of the Boston Section, American Institute of Mining, Metallurgical, and Petroleum Engineers.
Chairman of the Semi-Conductors Conference, American Institute of Mining, Metallurgical, and Petroleum Engineers.

W. DAVID KINGERY
John Jeppson Gold Medal, American Ceramic Society.
Outstanding Service Award, New England Section, American Ceramic Society.

FREDERICK H. NORTON
Honorary Member, British Ceramic Society.

ERNST B. WEGLEIN
Alumni Award, School of Engineering, Columbia University.

Department of Meteorology

JULE G. CHARNEY
Robert M. Losey Award, Institute of the Aeronautical Sciences.

HENRY G. HOUGHTON
Award for Outstanding Services, American Meteorological Society.
Chairman of the University Committee on Atmospheric Research.
Councilor of the American Meteorological Society.

Department of Modern Languages

A. NOAM CHOMSKY
Postdoctoral Fellowship, National Science Foundation.

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Department of Naval Architecture and Marine Engineering

S. CURTIS POWELL
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Chairman of the Resistance and Propulsion Panel, Society of Naval Architects and Marine Engineers.

Department of Physics

SANBORN C. BROWN
Chairman of the Rumford Committee and of the School Science Committee, American Academy of Arts and Sciences.
Chairman of the Apparatus Committee and Treasurer, American Association of Physics Teachers.

WILLIAM W. BUECHNER
Visiting Professor in India (University Grants Commission, Government of India, and U. S. Department of State).

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Assistant Director of the Reactor Division, Atomic Energy Commission.

ALBERT G. HILL
Director of Research, Institute for Defense Analyses.

FRANCIS E. LOW
Associate Editor of *Physical Review.*
Fellow of the American Physical Society.

JOHN C. SLATER
Chairman of the Division of Solid State Physics, American Physical Society.
Chairman of the Commission on Solid State Physics, International Union of Pure and Applied Physics.

MALCOM W. P. STRANDBERG
Fellow of the American Academy of Arts and Sciences.
Member of the New York Academy of Arts and Sciences

GEORGE E. VALLEY
Chief Scientist, United States Air Force.

VICTOR WEISSKOPF
Vice President of the American Physical Society.
Fellowship, John Simon Guggenheim Memorial Foundation.

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Fellow of the American Academy of Arts and Sciences.

School for Advanced Study

ROMAN JAKOBSON
President of the Permanent International Council for Phonetic Sciences.

Libraries

MARGUERITE CHAMBERLAIN
Chairman of the Engineering School Libraries Committee, New England Section, American Society for Engineering Education.

IRMA Y. JOHNSON
Secretary of the Science-Technology Group, Boston Chapter, Special Libraries Association.

NATALIE N. NICHOLSON
Fellowship, Carnegie Corporation.

CAROLINE SHILLABER
Chairman of the National Committee of Planning Librarians.

Center for International Studies

LINCOLN P. BLOOMFIELD
Member of the Board of Editors, *International Organization.*
Member of the Board of Directors, American Unitarian Association.

LEON V. HIRSCH
Doctoral Dissertation Fellowship, Ford Foundation Program in Economic Development and Administration.

WASHINGTON PLATT
Fellowship, John Simon Guggenheim Memorial Foundation.

Division of Sponsored Research

MARTIN L. ERNST
Secretary of the Operations Research Society of America.

HERBERT P. GALLIHER, JR.
Associate Editor of *Operations Research.*
Chairman of the Education Committee and of the Thirteenth National Meeting, Operations Research Society of America.

HAIG G. GECHIJIAN
Chairman of the Boston Section, American Society of Refrigerating Engineers.

FERENC A. G. DE KAZINCZY
Honorary Fellow of the Sweden-America Foundation.

HSIAO L. KUO
Visiting Associate Professor, University of Chicago.

JOHN E. WARD
National Chairman of the Professional Group on Automatic Control, Institute of Radio Engineers.

Lincoln Laboratory

ARNOLD B. BAILEY
Chairman of the Professional Group on Aeronautical and Navigational Electronics, Boston Chapter, Institute of Radio Engineers.

RICHARD H. BAKER
Chairman of the Program Committee, 1958 Transistor and Solid State Circuits Conference.

DAVID R. BROWN
Chairman of the Electronic Computers Committee, Institute of Radio Engineers.

WARNER C. DANFORTH, JR.
President of the Boston Alumni Chapter, Eta Kappa Nu.

WILBUR B. DAVENPORT, JR.
Chairman of the Professional Group on Information Theory, Institute of Radio Engineers.
Fellow of the Institute of Radio Engineers.

RONALD G. ENTICKNAP
Chairman of the Professional Group on Airborne and Navigational Electronics, Boston Chapter, Institute of Radio Engineers.

CLARENCE W. FARR
Chairman of the Science Education Subcommittee, National Joint Computer Committee.

HARRY C. GATOS
Vice Chairman of the Boston Section, The Electrochemical Society.

IRVING GOLDBERG
Clarkson Alumni Award of Northeastern University.

BENJAMIN J. LEON
Treasurer of the Boston Alumni Chapter, Eta Kappa Nu.

EUGENE W. PIKE
Fellow of the American Physical Society.
Chairman of the Operating Committee, Statistical Summer Seminar, American Statistical Association.

WILLIAM H. RADFORD
Honorary Degree of Doctor of Engineering, Drexel Institute of Technology.

J. E. KEITH SMITH
Program Chairman for the 1958 Convention, Psychometric Society.

Arts and the Faculty

Administration

PIETRO BELLUSCHI
Design (with others) of the First Unitarian Church of Montgomery County, Bethesda, Maryland.
Designer of three churches chosen for exhibition at the Brussels International Exposition.
Designer of church chosen for the International Architectural Exhibit in Moscow, U.S.S.R.

Department of Electrical Engineering

ARTHUR L. LOEB
Director of the annual spring concert of the American Recorder Society.

Department of Humanities

KLAUS LIEPMANN
Conductor of the M.I.T. Choral Society in volume 1 of "The Art of André Marchal," Unicorn Records release.

ERNST LEVY
Premiere performance of Thirteenth Symphony on the Swiss National Radio, November, 1957, from tapes recorded by the Basle Symphony Orchestra, the composer conducting, in June, 1957.
Premiere performance of Suite Number 3 for Orchestra, Brooklyn College, 1957.

Department of Mechanical Engineering

C. FAYETTE TAYLOR
Painting ("Retrospect") chosen for exhibit at the 1958 Boston Arts Festival.
Painting ("Design in Plywood") chosen for exhibit at the University of Massachusetts, Amherst, May, 1958.

Lincoln Laboratory

WILLIAM F. HOLST
Premiere performance of A Woodwind Quintet in G Minor by the Cambridge Wind Ensemble at Greene, Maine, July, 1957.

Publications from the Institute

PERIODICAL PUBLICATIONS, BOOKS, AND REVIEWS BY THE STAFF, JULY 1, 1957–JUNE 30, 1958[1]

Department of Aeronautical Engineering

BICKNELL, JOSEPH, E. E. LARRABEE, R. C. SEAMANS, JR. and H. P. WHITAKER. Automatic Control of Aircraft. *Journées Internationales de Sciences Aeronautiques, Paris. Compte Rendus*, Pt. 1, pp. 95–117, 1957.

BISPLINGHOFF, RAYMOND L. The Finite Twisting and Bending of Heated Elastic Lifting Surfaces. *Institut für Flugzeugstatik und Leichtbau an der E.T.H., Zürich.* Mitteilung Nr. 4, 1957.

BISPLINGHOFF, RAYMOND L., T. H. H. PIAN and K. A. FOSS. Response of Elastic Aircraft to Continuous Turbulence. *North Atlantic Treaty Organization. Aeronautical Research and Development, Advisory Group for. Report* no. 117, 1957.

BISPLINGHOFF, RAYMOND L. Aeroelasticity. *Appl. Mech. Rev.* 11, pp. 99–103, March, 1958.

DRAPER, CHARLES S. High-precision Ball Bearings Move Into Space. (In *Instrument Ball Bearing Conference, Proc. General Motors Corp. New Departure Div.*, 1957.)

DUGUNDJI, JOHN. Effect of Quasi-steady Air Forces on Incompressible Bending-torsion Flutter. *J. Aero Sci.* 25, pp. 119–121, February, 1958.

EMMONS, HOWARD W., editor. *Fundamentals of Gas Dynamics.* Princeton, N. J., Princeton Univ. Press, 1958.

EMMONS, HOWARD W. Flow Discontinuities Associated with Combustion. (A Chapter in *Fundamentals of Gas Dynamics*, edited by H. W. Emmons. Princeton, N. J., Princeton Univ. Press, 1957.)

HUNSAKER, JEROME C. Henry Smith Pritchett. (A Chapter in *The Saturday Club, 1920–1956*, edited by E. W. Forbes and J. H. Finley, Jr., Boston, Houghton Mifflin, 1958.)

[1]For reprints of periodical publications and reviews, consult the author; for copies of books, consult the publishers or a retail bookseller. This compilation has been prepared under the direction of Miss Eleanor Bartlett, Special Collections and Gifts Librarian.

HUNSAKER, JEROME C. Edward Leyburn Moreland. (A Chapter in *The Saturday Club, 1920–1956*, edited by E. W. Forbes and J. H. Finley, Jr., Boston, Houghton Mifflin, 1958.)

MAR, JAMES W. and L. A. SCHMIT. Some Structural Penalties Associated with Thermal Flight. *A.S.M.E. Trans.* 79, pp. 990–1004, July, 1957.

MOLLØ-CHRISTENSEN, ERIK L., M. T. LANDAHL and J. R. MARTUCCELLI. A Short Static-Pressure Probe Independent of Mach Number. *J. Aero. Sci.* pp. 625–626, August, 1957.

PIAN, THEODORE H. H. Structural Damping. (A Chapter in *Random Vibration*, edited by S. H. Crandall. Cambridge, Mass., Technology Press, 1958.)

PIAN, THEODORE H. H. On the Variational Theorem for Creep. *J. Aero. Sci.*, pp. 846–847, November, 1957.

SANDORFF, PAUL E. Space Flight — Structures and Materials. *Aviation Age* 28, pp. 50–63, March, 1958.

STEVER, H. GUYFORD. Condensation Phenomena in High Speed Flows. (A Chapter in *Fundamentals of Gas Dynamics*, edited by H. W. Emmons. Princeton, N. J., Princeton Univ. Press, 1958.)

TRILLING, LEON and J. W. CLARK. Aerodynamic Force Coefficients on Yawed Slender Configurations at High Mach Numbers. *J. Aero. Sci.* 24, pp. 913–915, December, 1957.

TRILLING, LEON. Oscillating Shock Boundary Layer Interaction. *J. Aero. Sci.* 25, pp. 301–306, May, 1958.

Department of Architecture

BELLUSCHI, PIETRO. Why Hire an Architect. *House & Garden* 113, pp. 66–67, 104, June, 1958.

BUSH-BROWN, ALBERT. History and Criticism as Creative. *J. Arch. Educ.* 12, p. 5, Summer, 1957.

BUSH-BROWN, ALBERT. College Architecture: An Expression of Educational Philosophy. *Arch. Record* 122, pp. 154–158, August, 1957.

BUSH-BROWN, ALBERT. Dormitory Design: Economical Housing Isn't Enough. *Arch. Record* 122, pp. 196–200, August, 1957.

BUSH-BROWN, ALBERT. Educational Architecture. (In *Encyclopaedia Britannica*. Chicago, Encyclopaedia Britannica, 1958.)

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GOODY, MARVIN E. Building Materials and Methods. *Institutions Mag.*, pp. 134–135, January, 1958.

KELLY, BURNHAM. Anachronistic Building Codes Block Advances; New Approach Called For. *Harvard Law Record* 26, pp. 1, 4, April 10, 1958.

SPRING, BERNARD P. *Building with Plastic Structural Sandwich Panels.* Cambridge, Mass., M.I.T. Dept. of Arch., 1958.

Department of Biology

BELL, EUGENE. Some Changes in Liver Tissue Which Survives Irradiation with Ultrasound. (In *Ultrasound in Biology and Medicine*, edited by E. Kelly. Washington, D.C., Am. Inst. Biol. Sci., 1957.)

BELL, EUGENE. The Action of Ultrasound on the Mouse Liver. *J. Cellular & Comp. Physiol.* 50, pp. 83–104, August, 1957.

BROWN, GENE M. Phosphopantothenic Acid, an Intermediate in Coenzyme A Synthesis in *Proteus Morganii*. *Federation Proc.* 17, p. 197, March, 1958.

BROWN, GENE M. Requirement of Cytidine Triphosphate for the Biosynthesis of Phosphopantetheine. *Am. Chem. Soc. J.* 80, p. 3161, June 20, 1958.

BUCHANAN, JOHN M., B. LEVENBERG, I. MELNICK and S. C. HARTMAN. The Specific Action of Azaserine on Enzymes Concerned with Purine Biosynthesis. (A Chapter in *The Leukemias: Etiology, Pathophysiology, and Treatment*, edited by J. W. Rebuck, F. H. Bethel and R. Monto. N. Y., Academic Press, 1957.)

BUCHANAN, JOHN M., J. G. FLAKS and M. J. ERWIN. Biosynthesis of the Purines. XVI. The Synthesis of Adenosine 5′-Phosphate and 5-Amino-4-Imidazolecarboxamide Ribotide by a Nucleotide Pyrophosphorylase. *J. Biol. Chem.* 228, pp. 201–213, September, 1957.

BUCHANAN, JOHN M., J. G. FLAKS and L. WARREN. Biosynthesis of the System. *J. Biol. Chem.* 228, pp. 215–229, September, 1957.

BUCHANAN, JOHN M., J. G. FLAKS and M. J. ERWIN. Biosynthesis of the Purines. XVIII. 5-Amino-1-Ribosyl-4-Imidazolecarboxamide 5′-Phosphate Transformylase and Inosinicase. *J. Biol. Chem.* 229, pp. 603–612, December, 1957.

BUCHANAN, JOHN M. and L. WARREN, Biosynthesis of the Purines. XIX. 2-Amino-N-Ribosylacetamide 5′-Phosphate (Glycinamide Ribotide) Transformylase. *J. Biol. Chem.* 229, pp. 613–626, December, 1957.

BUCHANAN, JOHN M., L. WARREN and J. G. FLAKS. Biosynthesis of the Purines. XX. Integration of Enzymatic Transformylation Reactions. *J. Biol. Chem.* 229, pp. 627–640, December, 1957.

COELHO, ROSE R. The Exchange of Potassium in Frog Nerve: Role of Aerobic Metabolism and Glycolysis. *J. Cellular & Comp. Physiol.* 49, pp. 261–280, April, 1957.

COELHO, ROSE R., O. D. CHRISMAN, C. O. BECHTOL and R. BRENNAN. Sulphur Metabolism in Cartilage. I. Joint-fluid Sulphate. *J. Bone & Joint Surgery* 40-A, pp. 457–461, April, 1958.

COHEN, CAROLYN and A. G. SZENT-GYORGIO. Role of Proline in Polypeptide Chain Configuration of Proteins. *Science* 126, pp. 697–698, October 11, 1957.

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GILLESPIE, J. MORTON. The Isolation from Wool of a Readily Extractable Protein of Low Sulphur Content. *Biochimica & Biophysica Acta* 27, pp. 225–226, January, 1958.

GLIMCHER, MELVIN J., A. J. HODGE and F. O. SCHMITT. Macromolecular Aggregation States in Relation to Mineralization: The Collagen-Hydroxapatite System as Studied in Vitro. *Nat. Acad. Sci. Proc.* 43, pp. 860–867, October, 1957.

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GOULD, BERNARD S. and J. F. WOESSNER. Collagen Biosynthesis. Tissue Culture Experiments to Ascertain the Role of Ascorbic Acid in Collagen Formation. *J. Biophys. & Biochem. Cytology* 3, pp. 685–695, September, 1957.

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HALL, CECIL E. and T. INOUE. Experimental Study of Electron Scattering in Electron Microscope Specimens. *J. Appl. Phys.* 28, pp. 1346–1348, November, 1957.

HALL, CECIL E. and M. LITT. Morphological Features of DNA Macromolecules as Seen with the Electron Microscope. *J. Biophys. & Biochem. Cytology* 4, pp. 1–4, January, 1958.

HALL, CECIL E. and P. DOTY. A Comparison Between the Dimensions of Some Macromolecules Determined by Electron Microscopy and by Physical Chemical Methods. *Am. Chem. Soc. J.* 80, pp. 1269–1274, March 20, 1958.

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[1]Copies of all the reports listed here have been deposited in the M.I.T. Library (Special Collections), where they may be consulted. Microfilm or photoprint copies may be obtained through the Microreproduction Service, Charles Hayden Memorial Library. Inquiries or orders should include all the information printed for each title and should specifically name the sponsoring laboratory. This compilation has been prepared under the direction of Miss Eleanor Bartlett, Special Collections and Gifts Librarian.

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JOHN FLOYD WHITE, JR., *Errors of Idealized Pendulous Integrating Gyro Accelerometers* (June, 1958).

Department of Architecture

MASTER IN ARCHITECTURE

NAIBU AKASHI, *Community Center for Ichikawa* (September, 1957).

ARTHUR GROSVENOR ALDERSEY-WILLIAMS, *Design Requirements of Multi-Purpose Factory Buildings* (September, 1957).

ROBERT PICKETT BREADING, *College of the Arts for the Pennsylvania State University* (September, 1957).

SIGMUND ASBJORN BRUDEVOLD, *Bus Terminal Study for Tacoma, Washington* (February, 1958).

EARL ROBERT FLANSBURGH, *New Quadrangle for Cornell University* (September, 1957).

WILLIAM LAWRENCE GARVIN, *Shire for Middlesex County, Massachusetts* (June, 1958).

DONALD DOUGLAS HANSON, *Cultural Center for the City of St. Paul* (September, 1957).

BERNARD JENSEN, *Housing Study for San Francisco* (February, 1958).

MICHAEL KESELICA, JR., *New Concert Hall — Lincoln Square, New York City* (September, 1957).

HAJIME KINOSHITA, *Minette Bay Development* (September, 1957).

FRANK RICHARD KRUEGER, *Summer Theatre and Arts Colony* (September, 1957).

CHONG-KEAT LIM, *Free Form in Contemporary Architecture* (September, 1957).

JOHN ARTHUR MILLER, *Design for the Raritan Yacht Club* (February, 1958).

JOHN NEVILLE MORPHETT, *Industrial Plant for the Polaroid Corporation* (September, 1957).

RICHARD PROCTOR SWALLOW, *Housing a Learned Honorary Society* (September, 1957).

ALBERT ANTHONY TAPPÉ, *Garment Center for Boston, Massachusetts* (June, 1958).

KENNETH GORDON TERRISS, *Arctic Habitat* (June, 1958).

LLOYD JOHN WILLIAMS, *Lincoln Center for the Performing Arts* (September, 1957).

HANFORD YANG, *Art Museum for New York City* (September, 1957).

Department of Biology

DOCTOR OF PHILOSOPHY

JACOB STRUCK, JR., *Oxidation of L-α-Amino Acids by Liver Enzymes* (June, 1958).

MASTER OF SCIENCE

SONIA BETTY ORLOWSKI, *Interaction of Isoniazid with Enzyme-Bound Pyridoxal Phosphate* (June, 1958).

Department of Chemical Engineering

DOCTOR OF SCIENCE — CHEMICAL ENGINEERING

ALLAN HARDY BONNELL, *Application of Well-Stirred Reactors to Combustion Chamber Models* (June, 1958).

SAM H. DAVIS, JR., *Transients in Continuous Distillation Columns* (September, 1957).

ALLAN SACHS HOFFMAN, *Mechanism of Graft Polymerization by High-Energy Irradiation* (September, 1957).

RICHARD GILPIN MC KEE, *Sorption by Structurally Modified Polymers* (September, 1957).

JAMES RUSSELL POWELL, JR., *Nuclear Characteristics of Heavy-Water Moderated, Enriched Homogeneous Reactors* (February, 1958).

JAMES MC KEE RYAN, *Mass Transfer with Chemical Reaction at a Rotating Cylinder* (June, 1958).

ROBERT GALE SHAVER, *Turbulent Flow of Pseudoplastic Fluids in Straight, Cylindrical Tubes* (February, 1958).

MARIUS TROOST, *Study of Neutron Transport by Monte Carlo Methods* (June, 1958).

THOMAS ALFRED UNGER, *Preparation of a Selectively Black Surface for Use in the Collection of Solar Energy* (June, 1958).

DOCTOR OF SCIENCE — NUCLEAR ENGINEERING

ROY ARTHUR AXFORD, *Multiple Scattering Theory of Particle Penetration Through and Reflection from Finite Slabs* (February, 1958).

HENRI BERNARD SMETS, *Low and High Power Nuclear Reactor Kinetics* (June, 1958).

CHEMICAL ENGINEER

REYNALDO GOMIDE, *Residence-Time of Liquids in Extraction Packed Towers* (February, 1958).

WILLIAM CHI-LIANG WU, *Urea-formaldehyde Silicone Copolymers* (June, 1958).

MASTER OF SCIENCE — CHEMICAL ENGINEERING

NAVINCHANDRA GOVINDJI ASHAR, *Fluidization Characteristics of Iron Ore* (June, 1958).

EARL THOMAS BOONE, *Filtration with High Slurry Velocities* (February, 1958).

JOSEPH ALLEN CLUMPNER, *Comparison of Water and Air Systems for Space Heating with Solar Energy* (June, 1958).

AUSTIN GEORGE HABIB, *Absorption of Chlorine in Water* (September, 1957).

BOYD ELBERT HARPER, JR., *Study of Dynamic Behavior of Fast Nuclear Reactor Power System* (February, 1958).

CHING-RONG HUANG, *Mechanism of Adhesion* (June, 1958).

JOSEPH EDWARD LEITGEB, *Application of the Ripple Tray to Solid-Gas System* (February, 1958).

ROBERT CARL LUMMIS, *Contact Angle Hysteresis on Gel Surfaces* (June, 1958).

ALBERT JEAN DANIEL MATTER, *Rate of Reaction of Chlorine over Silicon* (with Patrick Georges Nollet, June, 1958).

JAMES BRADEN MC NEELY, *Nitrogen Dioxide Absorption in Water* (September, 1957).

MARIA ALICE TEIXEIRA MENDES, *Decomposition Flame Above Liquid Hydrogen Peroxide* (September, 1957).

ALBERT LLOYD MOORE, *Absorption from Gas Bubbles with Simultaneous Chemical Reaction* (June, 1958).

DEPARTMENT OF CHEMICAL ENGINEERING

NOEL EDWARD MOORE, *Production of Sound by Flowing Fluids* (February, 1958).

THOMAS RICHARD NEVILLE, JR., *Kinetics of Reaction: Silica + Chlorine in Presence of Carbon* (June, 1958).

PATRICK MARIE NIVELLEAU DE LA BRUNIÉRE, *Analysis of Cross-Flow Cooling Tower Operation* (September, 1957).

KENDALL BROOKS RANDOLPH, *Redox Reactions in Systems of Coal and Certain Aqueous Ions* (September, 1957).

JOHN HELMUTH ROBERTS, *Supercooling of Hydrogen Peroxide* (June, 1958).

JOHN ASHLEY SIMMONS, *Some Thermodynamic Properties of Sulphur* (June, 1958).

BARRY ALAN STEIN, *Continuous Counter Current Ion Exchange Device* (September, 1957).

MICHAEL LOUIS TROMBETTA, *Co-Current Gas-Liquid Flow* (June, 1958).

ALEXANDER VRANOS, *Reaction of Methane and Steam in Fluidized Bed* (June, 1958).

ZWI HERMAN WALDMAN, *Some Experiments on the Wear of Cast Iron* (September, 1957).

MASTER OF SCIENCE — CHEMICAL ENGINEERING PRACTICE

ARNULFO MONTES NADELA, *Scaling of Turbulent Hot Air Jets* (September, 1957).

RENÉ EMILIO UNSON, *Scaling of Heated Air Jets* (September, 1957).

MASTER OF SCIENCE — NUCLEAR ENGINEERING

LEONEL EDUARDO DE MONTANDON BRAGA, *Heat Transfer from a Flat Plate with Arbitrary Surface Temperature to a Turbulent Boundary Layer* (September, 1957).

JAMES PATTON CUNNINGHAM, *Fuel Burnup Studies for a Pressurized Water Reactor* (June, 1958).

RAFFAELE GIUSEPPE DI MENZA, *Flow Regimes in a Two-Phase Boiling Analogy System* (February, 1958).

THEODORE ROBERT FICK, *Vacuum-Induction Melting Techniques to Improve Corrosion Resistance and Homogeneity in a Uranium-Niobium Alloy* (with James Vernon Haley, September, 1957).

ROBERT BERNARD FLANDERS, *Evaluation of Fluid Gamma Emitting Media for a Food Irradiation Reactor* (February, 1958).

FRANK GILLILAND, *Use of a Chip Method to Produce Homogeneous Uranium-Niobium Rods* (September, 1957).

MORTON IRWIN GOLDMAN, *Fixation of Aluminum-Bearing Fission Product Wastes in Vitreous Ceramics* (June, 1958).

ROBERT WILLIAM GREEN, *Design of a Wire Scintillation Counter* (June, 1958).

JAÇEK JEDRUCH, *Economics of Using Zircaloy-2 for Slightly Enriched Reactor Fuel* (February, 1958).

KEITH GILBERT LAKEY, *End Seal Defects in Coextruded Reactor Fuel Elements* (with James Bruce Risser, September, 1957).

JEFFERY LEWINS, *Comparison of End and Centre Fed Coolant in Nuclear Reactors* (September, 1957).

GEORGE CONRAD LINDAUER, *Dose Rate Calculations from Stack Effluent of the M.I.T. Reactor* (September, 1957).

ARTEMIO REYES MAGTOTO, *Gamma-Ray Collinators for Radioisotope Scanning* (June, 1958).

JEAN MARIE FRANÇOIS JOSEPH MORELLE, *Preferred Orientation and Anisotropy of Rolled Niobium* (September, 1957).

RICHARD THOMAS NOWAK, *Determination of Reactor Flux Distributions Using Analog Computer Techniques* (February, 1958).

JULES HERMAN QUEQUIN, *Transfer Functions of the M.I.T. Reactor* (February, 1958).

WILLIAM FRANCIS REILLY, *Construction and Calibration of a Standard Pile* (June, 1958).

FRANK SALZ, *Heat Transfer from Heterogeneous Reactor Fuel Elements* (June, 1958).

DANIEL SCHWARTZ, *Pile Oscillator for the M.I.T. Reactor* (June, 1958).

HENRI BERNARD SMETS, *Nuclear Power Plant Transfer Functions* (September, 1957).

FRANCIS ANTHONY WOLAK, *Heat Dissipation in the M.I.T. Reactor* (June, 1958).

WILLIAM TAN YAP, *Mathematical Treatment of Batch Irradiation of Nuclear Fuels in a Non-Uniform Nuclear Flux* (February, 1958).

Department of Chemistry

DOCTOR OF PHILOSOPHY

JAMES REIS ARONSON, *Fluorination of Carbides* (June, 1958).

DONALD EMORY AYER, *I. The Structure of Dioscorine. II. Some Photochemical Reactions of Benzonitrile and Nitrobenzene with Olefins* (June, 1958).

RICHARD FREDERICK WILLIAM BADER, *Origin of Isotope Effects in Light and Heavy Water* (February, 1958).

ROBERT CALVIN BERTELSON, *Preparation and Properties of Cycloalka-1,2-Dienes* (February, 1958).

JOHN WARREN BLAKER, *I. Attempted Synthesis of 1,8-Diarylnaphthalenes. II. Studies in the Composition of Glycidic Esters* (June, 1958).

RICHARD ALLEN DAY, *I. Synthesis and Cyclization Studies of New Penicilloic Acids. II. Condensation of Thio Acids with Amino Acids Under Oxidative Conditions* (February, 1958).

LINCOLN EKSTROM, *Optical Study of Ferric Ions in Water* (September, 1957).

MONROE VAUGHAN EVANS, JR., *Vibrational Spectra and Structure of Tropilidene and Related Molecules* (February, 1958).

RICHARD WARREN FESSENDEN, *Analysis and Interpretation of High Resolution Nuclear Magnetic Resonance Spectra* (June, 1958).

EARL JULIAN FORMAN, *Thermometric Studies of Acids and Bases in Acetonitrile* (February, 1958).

DAVID HAINES FREEMAN, *Anion Exchange Studies* (February, 1958).

JOHN WARREN GEORGE, *Chemical and Structural Studies of Sulfur Tetrafluoride* (June, 1958).

RICHARD NORMAN GRIFFIN, *Isotype Effects in the Decarboxylation of β-Keto Acids and Hydrolysis of Alkyl Halides in Light and Heavy Water* (February, 1958).

DAVID MICHAEL HERCULES, *Spectrofluorometric Studies of Mono- and Di-Hydroxy Naphthalenes* (September, 1957).

JOSEPH JOHN HLAVKA, *New Methods of Peptide Synthesis* (September, 1957).

JOHN EMMETT JORDAN, *Scattering of High-Velocity Neutral Particles: Some Monatomic and Diatomic Systems* (February, 1958).

ELTON PAUL KATZ, *Heat Capacities of the Zinc and Ferrous Tutton Salts* (June, 1958).

DAVID KNUTSON, *Base and Photodimers of 3-Substituted Cyclohexenones* (September, 1957).

ALEXANDER MACLACHLAN, *Effect of Solvent on the Rate of Solvolysis of Alkyl Halides* (September, 1957).

CHARLES FREEMAN MORRISON, JR., *Electrodeposition Behavior of Nickel in Trace Amounts* (September, 1957).

ELIZABETH ELLEN PEGUES, *Mechanism of Methanolysis of Triphenylmethyl Chloride in Benzene Solution* (September, 1957).

JACK JOSEPH PIGLIACAMPI, *Osmotic Pressure of Mercaptalbumin and Carboxyhemoglobin Solutions* (February, 1958).

ARTHUR M. POSKANZER, *Solvent Extraction of Inorganic Complexes* (September, 1957).

WILLIAM HENRY REINMUTH, *Selected Topics in Polarography* (September, 1957).

FRANK GEORGE SATKIEWICZ, *Vapro-Liquid Equilibria from Measurements of Pressure, Temperature, and Over-All Composition: the System Ethanol-Cyclohexane* (June, 1958).

LLOYD DAVID TAYLOR, *Alkali Metal-Sodiocarboxylates and their Use in the Polymerization of Butadiene* (February, 1958).

GILDEN RAMON VAN NORMAN, *Investigation of Some* Ortho-*Substituted Benzoyl Peroxides* (September, 1957).

JAY HENRY VREELAND, *Dielectric Relaxation of Chlorostyrene Polymer Solutions* (February, 1958).

FRANCIS KERNAN WARD, *Effect of Triethylamine on the Reactions of Amylsodium* (February, 1958).

NORMAN ERNEST WESTON, *Structural Studies of the Sodium-Lead System* (September, 1957).

ROBERT ALLAN WILES, *Mechanism of Oxidation of Alcohols by Bromine* (February, 1958).

GRANT MC DONALD WILSON, *Vapor-Liquid Equilibria from Measurements of Pressure, Temperature, and Over-All Composition: the System Water-2-Butoxyethanol* (June, 1958).

YING VICTOR WU, *Binding of Small Anions by Protein* (February, 1958).

MASTER OF SCIENCE

ROBERT EUGENE KERWIN, *Photochemical Kinetic Study of Aqueous Ceric Perchlorate Solutions* (February, 1958).

THOMAS JOHN PORRO, *Spectroscopic Study of the Dimerization of Caprolactam* (June, 1958).

Department of City and Regional Planning

MASTER IN CITY PLANNING

PETER LEE ABELES, *Design Techniques for the Development of Rural Characteristics in Suburban Residential Areas* (June, 1958).

LORENZO RUBEN FINOCCHIO BERTOZZI, *Planning in Uruguay* (February, 1958).

BERNARD BRENNER, *Racial Integration and City Planning* (June, 1958).

DENNIS WESLEY BROWN, *Evaluation of Enabling Legislation for the Control of Subdivisions* (June, 1958).

DIANA MARGARET COLLINS, *Guides to the Administration of Special Exceptions to the Zoning Ordinance* (June, 1958).

WILLIAM AUSTIN HALL, *Proposed Redevelopment of Neighborhood 5, Cambridge, Mass.* (February, 1958).

MELVIN STANLEY KRAUSE, JR., *Commercial Facilities for Subdivisions* (June, 1958).

AW TAIK MOH, *Model Town in Burma* (September, 1957).

BRIGITTE GERTRUD ORENT, *Re-Use of Vacated Commercial Sites in Downtown Boston* (June, 1958).

JOSEPH SAVITZKY, *Approach Towards Redeveloping the Downtown Shopping District of Boston* (February, 1958).

OVADIA R. SIMHA, *Urban Planning Assistance in New England* (September, 1957).

ALBERT ANTHONY TAPPÉ, *Apparel Industry in Boston* (February, 1958).

GORDON DOMINIC WAGNER, *Alternative Pattern for Urban Growth* (June, 1958).

RICHARD WILLIAM WHITE, *Study of the Relationship Between Mental Health and Residential Environment* (September, 1957).

Department of Civil and Sanitary Engineering

DOCTOR OF SCIENCE — CIVIL ENGINEERING

JAN MALAN JORDAAN, JR., *Mass-Transfer Rates in a Turbulent Fluid Body* (June, 1958).

JACOBUS MARIUS LOUW, *Dynamic Response of Continuous-Span Highway Bridges to Moving Vehicle Loads* (February, 1958).

RONALD ELLIOTT NECE, *Effects of Roughness and Chamber Dimensions on the Induced Flow and Surface Resistance of Enclosed Rotating Disks* (June, 1958).

ALEXIS OSTAPENKO, *Behavior of Short, Concrete-Filled Steel Pipe Columns* (September, 1957).

HOWARD SIMPSON, *Design and Construction of a Machine for Large Dynamic Load Tests* (June, 1958).

DOCTOR OF SCIENCE — SANITARY ENGINEERING

ROBERT AMIS LAUDERDALE, JR., *Mechanism of Ruthenium Removal from Fission Product Wastes* (June, 1958).

CIVIL ENGINEER

JACQUES NAAR SIDES, *Simulation of Vehicular Flow* (June, 1958).

WALTER JOHN TUDOR, *Slope-Area Concept for Determining the Wave Resistance of a Ship* (June, 1958).

SANITARY ENGINEER

GERALD NORMAN MC DERMOTT, *Heat Treatment and Aerobic Stabilization of Excess Activated Sludge* (February, 1958).

MASTER OF SCIENCE — BUILDING ENGINEERING AND CONSTRUCTION

PAUL EUGENE BLANCHARD, *Unit Building Cost Indices* (June, 1958).

RICHARD EVERETT CHAMBERS, *Laminate Behavior as Determined from Internal Strain Measurements* (February, 1958).

NICHOLAS DOMINIC DE MARTINI, *Problems of a Suburban Housing Development* (June, 1958).

DONALD LEO DE SORCY, *Study of Masonry Construction Exposed to Wet and Dry Conditions Together with Changes of Temperature on One Face Only* (June, 1958).

FRANK GOLD GOODLETT, *Coordination of Construction Subcontractors* (September, 1957).

HARRY LOUDÉRE GUZELIMIAN, *Theoretical Analysis of Shear Wall Dynamic Loading Machine* (June, 1958).

WILLIAM THORNE LANG, *Contract Disputes and their Alleviation* (September, 1957).

ROBERT ELMER PLATTS, *Bond Studies in Reinforced Plastics* (September, 1957).

ROBERT GEORGE SUTTON, *Fundamentals of Building Management* (June, 1958).

RODOLFO CAMAQUIN VIDAD, *Package Building Service* (June, 1958).

DEMETRIOS GEORGE VINTZELAOS, *Analysis of Two-Span Folded-Plate Roofs* (September, 1957).

MASTER OF SCIENCE — CIVIL ENGINEERING

JOSÉ HENRIQUE ALBIERO, *Swelling Pressure in Compacted Clay* (June, 1958).

IGNACIO ARANGO-GREIFFENSTEIN, *Chemical Modification of Soil-Cement* (June, 1958).

HARVEY LOUIE ARNOLD, JR., *Characteristics of Intakes Near a Density Interface* (September, 1957).

PETER ROBERT ASHJIAN, *Prestressed Concrete Composite Floor Slabs* (June, 1958)

VALENTIN CLEMENT BERGER, *Effects of Geological History on the Engineering. Properties of Marine Clays* (with Markus Galler, June, 1958).

CHRISTOPHER REUBEN CALLADINE, *Theoretical Analysis of the Post-Elastic Dynamic Behavior of a Reinforced Concrete Shear Wall* (February, 1958).

GAETANO ANTONIO CARBONE, *Inelastic Behavior of Arches* (June, 1958).

JEAN MARIE CHARRON, *Swelling of Compacted Clay* (June, 1958).

WILLIAM BURSON DAVIS, *Transition Phenomena in Radial Free Surface Flow* (June, 1958).

MAKARAND BALAVANTRY DESAI, *Bond Study in Reinforced Plastics* (February, 1958).

JOHN MANUEL DE SOUZA, *Compressibility of Quartz Sand at High Pressure* (June, 1958).

GUY MARCEL DIONNE, *Design of a Cantilever Roof for a Very Large Stadium* (June, 1958).

PATRICK JOSEPH DONOHOE, *Characteristics of Inlets Near a Density Interface* (February, 1958).

JOHN VINCENT FOLEY, *Behavior of Welded Wire Fabric Reinforcement in Bituminous Concrete* (with John Garnett Waggener, February, 1958).

RALPH GARETH GRAY, *Effect of Girder Stiffness and Plasticity on Dynamic Response of a Multi-Story Building* (September, 1957).

ALLEN FREDERICK GRUM, *Investigation of the Dynamic Strength of Shear Walls as Affected by the Relative Strength of Frame Reinforcing to Panel Reinforcing* (with Elvin Ragnvald Heiberg, III, February, 1958).

GEORGE JAMES HAGGARTY, *Measurement of Shrinkage Strains in Clay* (September, 1957).

KENNETH EARL HOLFORD, *Method of Analysis for an Idealized Gravity Dam Under Shock Loading* (February, 1958).

LEWIS HENRY HOLZMAN, *Analysis and Design of Rigid Frames by Digital Computer* (June, 1958).

LARRY ERNEST HURWITZ, *Investigation of Pore Water Movements in Saturated Soils under Thermal Gradients* (June, 1958).

BENIAMINO ANTHONY INSERRA, *Study of the Feasibility of Extending the Cambridge Subway* (June, 1958).

HAYRETTIN KARDESTUNCER, *Preliminary Design of a Suspension Bridge Over the Bosphorous Strait* (September, 1957).

ABDUT TAWWAB KHAN, *Use of Lime to Prevent Erosion of Soil* (June, 1958).

HAROLD GEORGE KIZNER, *Experimental Investigation of the Vibration of a Rigid Frame Bridge* (February, 1958).

LOUIS JOSEPH LEE, *Preliminary Study of Corrosion in Boston Soils* (June, 1958).

PETER WILLIAM LIKINS, *Lattice Shell Analysis* (June, 1958).

WILLIAM ALBERT LITLE, *Reinforced Concrete Members Subjected to Biaxial Bending and Axial Load* (September, 1957).

JOSEPH GILLES MARINIER, *Determination of Absolute Roughness for Open Channel Flow* (June, 1958).

JOAQUIN ROBERTO MENDOZA, *Applicability of Plastic Design to Multi-Story Frames* (June, 1958).

CHARLES LESLIE MILLER, *Theory and Application of the Digital Terrain Model* (June, 1958).

EDWARD LILE MURPHREE, JR., *Directional Shear Strength Properties of Kaolinite Clay* (June, 1958).

MIGUEL PRIMO VELEZ RODRIGUEZ, *Experimental Investigation of Fine, Uniform Sand in Relation to Stability Failures* (September, 1957).

RICHARD THOMAS SCHWAEGLER, *Elastic Analysis of a Fixed End Reinforced Concrete Arch by Digital Computer Methods* (June, 1958).

EDGAR LEROY STOLFER, JR., *Investigation of the Validity of a New Dynamic Pile Driving Formula* (June, 1958).

THAIPUCK THAMMONGKOL, *Preliminary Design of the Power Plant for Yanhee Project* (February, 1958).

MAN-CHUEN YUEN, *Technique for the Study of Motion of the Joints of the Foot* (June, 1958).

MASTER OF SCIENCE — SANITARY ENGINEERING

KIRTIKUMAR JAGJIVANDAS AJMERA, *Economic Comparison of the Complete Mixing Process with the Conventional Activated Sludge Process* (June, 1958).

DONALD JOHN BAUMGARTNER, *Functional Study of the Agencies Responsible for Water Pollution Control in Massachusetts* (June, 1958).

THEODORE BERNHARD BURGER, *Procedures for the Determination of the Anaerobic Treatability of Organic Industrial Wastes* (June, 1958).

ROBERT THOMAS BURNS, *Fixation of Zirconium Bearing Radioactive Wastes in Glass* (June, 1958).

EUGENE ALAN CASSELL, *Procedure for Starting High-Rate Type Digesters* (June, 1958).

EUGENE JOSEPH DONOVAN, JR., *Reduction of Commercial Alkyl Benzene Sulfanate in "Hi-Lo" Activated Sludge Process* (June, 1958).

HERBERT HENRY HASSIS, *Procedures for Determination of Aerobic Treatability of Organic Industrial Wastes* (June, 1958).

GOVINDARAJU JAGAN MOHANRAO, *"Hi-Lo" Activated Sludge Process for Subdivision Sewage Treatment* (June, 1958).

JOSEPH EDWARD O'BRIEN, *Activated Sludge Processes and the Warburg Respirometer* (June, 1958).

PARKER CRAMER REIST, *Effect of Synthetic Detergents on Reaeration in Heaving Bodies of Water* (September, 1957).

SEIN-HLA, *Metabolic Pathways of Microorganisms* (February, 1958).

JAMES ALBERT SERVIZI, *Fixation of Fission Products in Glass* (June, 1958).

GEORGE WILLIAM WALSH, *Effect of the Metallic Chelates of Ethylenediaminetetraacetic Acid on Synthetic Ion Exchange Resins* (September, 1957).

Department of Economics and Social Science

DOCTOR OF PHILOSOPHY

VICTOR LEE ANDREWS, JR., *Investment Practices of Corporate Pension Funds* (June, 1958).

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DANIEL HALE GRAY, *Toward a Theory of the Interior of the Business Firm: the Dynamics of the Employment Relationship* (February, 1958).

EDWARD PECK HOLLAND, *Analog Model for Studying Economic Development Problems* (February, 1958).

PAUL MICHAEL HORVITZ, *Concentration and Competition in New England Banking* (June, 1958).

EGON SOHMEN, *Economics of Flexible Exchanges* (June, 1958).

BABETTE SONIA SOLON, *International Trade in Automobiles During 1946–1956: A Study of the Changes in the Composition of Trade* (June, 1958).

JAROSLAV VANEK, *Natural Resource Content of the United States Foreign Trade, 1870–1955* (September, 1957).

ARNOLD ROBERT WEBER, *The ICWU: A Study in Structural Adjustment* (June, 1958).

FRED MEINHARD WESTFIELD, *Static and Dynamic Optimization Problems in the Multi-Plant Firm with Particular Reference to the Electric Power Industry* (September, 1957).

MANUEL ZYMELMAN, *Economic History of Argentina (1933–1952)* (June, 1958).

MASTER OF SCIENCE

ALBERT VICTOR GEORG HAHN, *Inflation and Economic Development* (June, 1958).

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FREDERICK LAWRENCE MOREFIELD, *Study in Capital Investment* (June, 1958).

GILBERT JOSÉ WEIL, *Terms of Trade and Economic Development with Special Reference to Brazil* (September, 1957).

Department of Electrical Engineering

DOCTOR OF SCIENCE

LUIZ VALENTE BOFFI, *Electrodynamics of Moving Media* (September, 1957).

MARTIN BARRY BRILLIANT, *Theory of the Analysis of Nonlinear Systems* (February, 1958).

DUDLEY ALLEN BUCK, *Superconductive Electronic Components* (June, 1958).

SHELDON GRUBER, *Ionospheric Scintillation of Cosmic Radio Noise* (June, 1958).

ELIAS PANAYIOTIS GYFTOPOULOS, *Fundamental Electrical Processes in High Vacuum* (February, 1958).

JOHN VINCENT HARRINGTON, *On the Statics and Dynamics of Magnetic Domain Boundaries* (February, 1958).

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ELECTRICAL ENGINEER

JOHN NELSON ACKLEY, *Magnetic-Core Test Storage* (February, 1958).

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GILBERT WILLIAM BETT, *Sound-Ray Tracking in Fused Quartz Prisms* (June, 1958).

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CHARLES THOMAS KIRK, JR., *Investigation of Semiconductor Devices as Gated Amplifiers for Digital Computers* (June, 1958).

GEORGE CROSWELL MALING, JR., *Analysis of Filters with Linear Phase Characteristics* (June, 1958).

RICHARD S. MARCUS, *Discrete Noiseless Coding* (June, 1958).

HIDEO MORI, *Analysis of Numerical Solutions for the M.I.T. Flight Simulator* (February, 1958).

RICHARD MORGAN MORONEY, JR., *Digital Computer Rating of Blast-Cooled Generators* (June, 1958).

CHARLES ROBERT NIXON, *Transient Respones of D-C Motors Supplied through Controlled Transistors* (June, 1958).

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