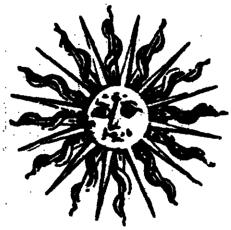

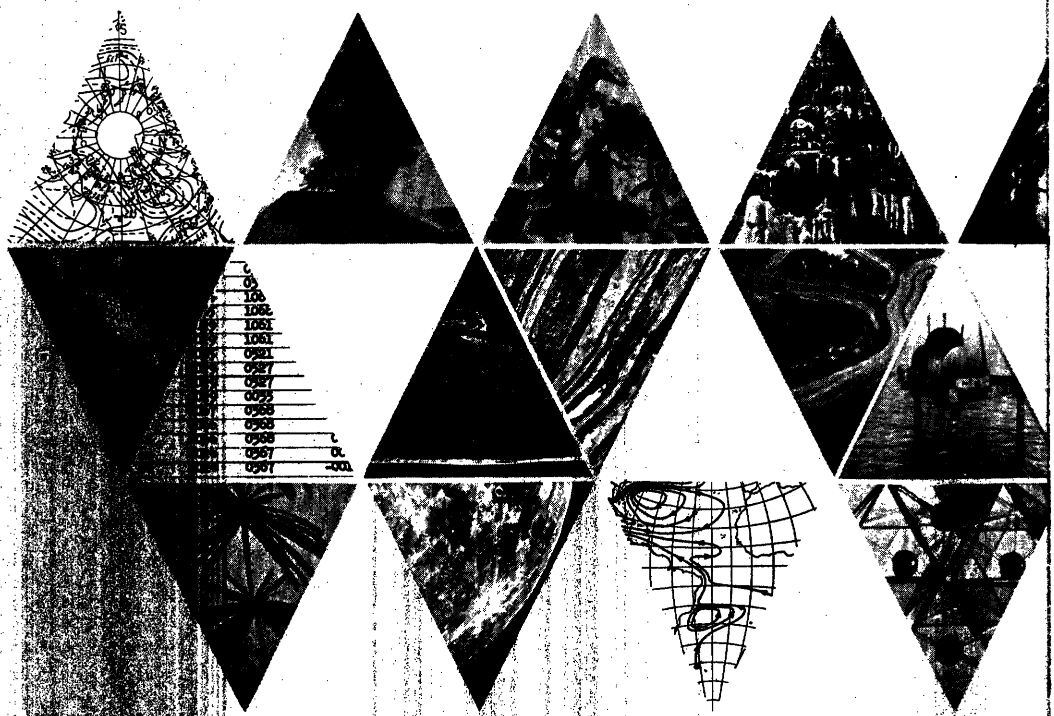

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President's Report Issue

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the **SUMMER SESSION CATALOGUE**
the **GENERAL CATALOGUE**
and the **UNDERGRADUATE CATALOGUE**

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THE COVER is representative of the growing diversity of teaching and research in the earth sciences at the Massachusetts Institute of Technology. The strength and potential of this program have been greatly augmented during the 1958-59 year.

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Report of the President

To Members of the Corporation:

THIS HAS BEEN A NOTABLE YEAR for education in the United States. Although there have been few dramatic changes in either the character or the support of our schools, the fruits of much discussion and self-appraisal are clearly beginning to mature. In many quarters there are signs of a growing consciousness of the full import of education for our future welfare and security. The enactment of the National Defense Education Bill and a multitude of other measures currently under consideration by committees of Congress and by state legislatures reflect in part this broad concern.

It would be false to conclude that a new awareness and understanding have pervaded all segments of the American public. Nonetheless, it is highly encouraging to observe in how many communities parents, school boards, and teachers have quietly and effectively joined forces to strengthen the quality of our schools, to give greater substance to the curricula, and to elevate the status of our teachers. At the same time our needs in education are so great and there is such urgency and opportunity for improvement that many are impatient with the slowness of progress. Certainly time is of the essence. But no great movement of revision and upgrading of a system that is so much a part of our tradition will enjoy material success unless it is deeply rooted in the family and the community. Responsibility for the excellence of our schools and colleges falls directly upon the American family. The attitudes of parents toward learning and scholarship, the values they place upon intellectual achievement, and their willingness to make material sacrifices in support of their schools will largely determine the progress of education in this country. In this endeavor government acts only as the agent of individual citizens; it offers no substitute for private conviction and understanding.

Throughout the past twelve months, comparisons of our school system with that of the Russians have continued to occupy a prominent place in public discussions. But fortunately observers have viewed these comparisons in better perspective. The freer exchange of visitors between the two countries has contributed greatly to a clearer understanding of Soviet methods and to more balanced judgments of their results. There is little in these more penetrating observations to lessen our respect for Russian zeal for education or their record of accomplishment. But it is becoming more apparent that their system has its defects as well as virtues.

It is salutary to match American aims and methods against those of antagonists and allies alike. There is much that we can learn by example. However, we must work out our own problems in conformity with our own ideas, our own history and traditions, our own national genius. We must also recognize that the United States has concluded a rather free and easy epoch in our national history. There lies ahead a new order of competition, a challenge to our mode and standards of living — not only from the Soviets but also from newly developing countries on every continent, each awakening to fresh hopes and aspirations.

To meet this rising tide of competition, we shall have to rely even more upon the quality of our products and services than upon their bulk. For our schools and colleges this means that a moderately good education for all is still a necessary, but no longer adequate, national aim. We now must make greater efforts to provide opportunity and facilities for the superb education of that relative few who are highly gifted and who give promise of creative leadership. One of the most inspiring statements on this need was made in 1958 by a panel of the Rockefeller Brothers Fund, Inc., Special Studies Project under the chairmanship of John W. Gardner. The theme of their report was "The Pursuit of Excellence." I think it the most significant development of this year that these words have been echoed again and again in countless other reports and speeches throughout the country.

IT IS WITH A FULL AWARENESS of national needs that M.I.T. has shaped its course these past twelve months. We are endeavoring to respond to the vast responsibilities and to the great opportunities of the times. The report that follows is a partial account of progress. As a prelude to that review, I should like to touch upon several matters of broad academic and administrative policy affecting our future plans.

NO TASK MAKES GREATER DEMANDS on the joint wisdom and foresight of faculty and administration than that of containing and directing the forces of expansion and growth. Avenues of opportunity open in many directions. Among many possibilities we must make choices, and some of these choices are hard. There was a day when great universities spoke of all knowledge as their province. No university in fact was ever entitled to make such a claim. In these times of rapid scientific and technological advance, M.I.T., even in its own more limited domain, cannot take unto itself all fields nor seek to be supreme in every promising endeavor. Out of the total range of possibilities for growth and development, we must single out certain areas for our own special concentration. These choices ought to be the natural consequence of a plan and of a philosophy. The shaping of that plan is a matter of the utmost concern for the Corporation, for the faculty, and for the administration. It is an appropriate subject for continuing discussion and the interchange of views.

Concentration on Quality

Of all the questions of growth and size, the most critical — and certainly in these times one of the most perplexing — is that of fixing the number of students that shall be admitted to the Institute. For several years past, we have maintained the freshman class at approximately a constant size, and for the present at least we propose to adhere to that policy.

M.I.T. is keenly sensitive to the urgent need for scientists and engineers at every level of professional competence. Our ties with industry and government are such that we have frequent occasion to observe this need at firsthand, and we have felt acutely the pressures for increased enrollment. Our national responsibility under these circumstances is great, and every decision with respect to admissions policy must rest upon considerations more serious than institutional convenience.

At best, M.I.T. can offer to the nation only a small fraction of that total number of young men and women destined for careers in science, in engineering, in architecture, and in the management of industry. As a private institution we draw upon limited resources, but in compensation we enjoy great freedom of action in the development of our educational plan and in establishing our own academic standards. Accordingly, it is the best judgment of all concerned that M.I.T. will contribute most to the national interest by an even greater concentration upon the quality of our undergraduate school before venturing to expand it materially in size.

The Model of Excellence

Many colleges of limited enrollment have flattered themselves from time to time that they are concerned only with the training of "leaders." For most this is an illusion, if not an arrogant presumption. No college can be so wise or skillful as to compose a freshman class exclusively of young people indelibly marked for success.

There is, however, a kind of leadership to which M.I.T. may very properly aspire. The modern world holds out extraordinary opportunities to graduates in science and engineering. Yet the rate of advance on every front has of late been so swift, the impact of science upon society so profound, that both the substance and the processes of education are in many areas totally outmoded. There is at present in the United States the most urgent need to examine the premises upon which we build the professional education of a scientist or engineer. The demands in rigor and in depth upon purely technical competence have never been so great. At the same time, the desirability of further dimensions in breadth become increasingly apparent. We must consider the possibilities of new syntheses in the entire plan of professional training at the undergraduate level. We must be prepared constantly to experiment, to revise, and to innovate. Our aim at M.I.T. is to lead in the exploration of these many new paths and to provide the model of excellence for undergraduate as well as graduate education in an age in which science and technology have become the dominant forces of culture.

These are high and worthy goals. Their achievement will be by no means easy, and many of the remedies that are perennially suggested for the improvement of instruction will prove utterly inadequate or unfeasible. It goes without saying that there must be fine teachers and good laboratories. There must be understanding and a sincere concern for the problems of the undergraduate — and that concern very definitely does exist in our faculty. But the environment and methods of a great university will always differ profoundly from those of the secondary school to which the student has been accustomed. By no conceivable means can it be arranged that each individual student throughout his undergraduate years shall be the object of constant attention and supervision by senior professors alone. It is, nonetheless, those senior professors, renowned in many fields of scholarship, who set the tone, the temper, and the standards of the entire institution. The best that any university can offer is the opportunity to learn in the company of scholars.

Major Forces of Change

Actually the problems of undergraduate education that now loom before M.I.T. — and indeed that confront every institution seriously concerned with the teaching of science and engineering — are of a new nature. Three major forces are working to make obsolete large segments of the traditional curricula and methods of instruction.

First, there is the stupendous accumulation of new knowledge and principles flowing from advances in every field of science and engineering.

Second, the nature of these advances is such that it becomes increasingly important that students of science and engineering have a thorough command of modern physics, chemistry, and mathematics.

Third, the traditional boundaries that have long compartmentalized one professional field from another are rapidly dissolving away, with the result that the foundations of a sound professional education are constantly broadening.

These influences are, as I have said, of major proportion. We shall be unable to cope with them by the simple expedients of small adjustments and gradual change.

A Venturous Departure in Education

In this regard, and for many other reasons, the work of the Physical Science Study Committee has been an illuminating experience. This group, with leadership from M.I.T. but with effective participation of representatives of universities and high schools all over the country, has undertaken to make available to secondary schools a course in physics in keeping with the progress of recent years and with the importance of the subject for the future. The magnitude of such an enterprise is revealed from the fact that over $5 million have already been granted the project by national foundations. The basic lesson, however, is that a significant advance was possible only by attacking the problem almost completely *de novo.* Textbooks could not be revised; they had to be written. Out of the tremendous mass of new material and the accumulated knowledge of the past, it was necessary to make a new selection and effect a new synthesis. The problem, moreover, has had to be viewed in all its parts. The text, the laboratory, the demonstration equipment, and the collateral reading are all parts of an integral whole. The skills of outstanding experimentalists have been turned to the perfection of simple teaching aids, and the uses and potentialities of films are being thoroughly explored.

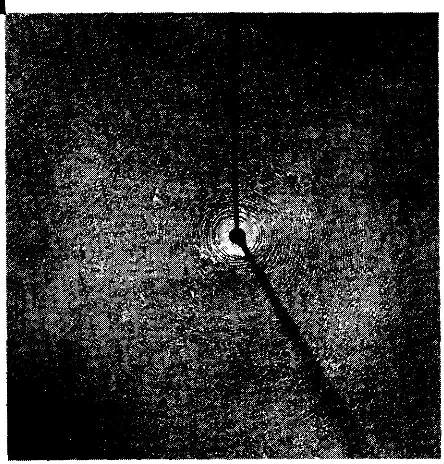
Whether any particular text, film, or experimental equipment developed by the Committee ultimately meets all criticism is of relatively minor importance. The significant accomplishment of this project, one that surely will leave a deep impression on education at every level and hopefully in many fields, is the example of a venturous, imaginative departure from the deep furrows of the past. In the teaching of science, every institution of higher education in the country can learn from that example.

Cultivation of the Individual

For an institution such as M.I.T., the task of keeping pace with the advancement of knowledge is wholly comparable in kind, if perhaps not in magnitude, to the work of the Physical Science Study Committee. The enormous mass of new and relevant material in every field can be incorporated into the curriculum only in company with drastic revisions of existing subject matter. Otherwise the student will most certainly succumb to complete intellectual indigestion.

The problem of providing excellent instruction to a steadily increasing number of students at every level in the basic subjects of physics, mathematics, and chemistry is presenting a new and critical challenge to our methods and capacity for teaching. The problem of numbers, indeed, occupies the current attention in one way or another of almost everyone in the world of education. For the public schools and larger universities it arises because of swelling enrollments. As one looks ahead, the gap between the number of teachers needed and the number most probably available widens rapidly, and it appears that some drastic measures will be essential. For this reason in part, there has been a good deal of public questioning over the past year or two of certain traditional and cherished academic ideals. The emphasis upon individual attention to the student has come under particularly strong attack from a number of quarters. It has been said that our schools and universities apparently

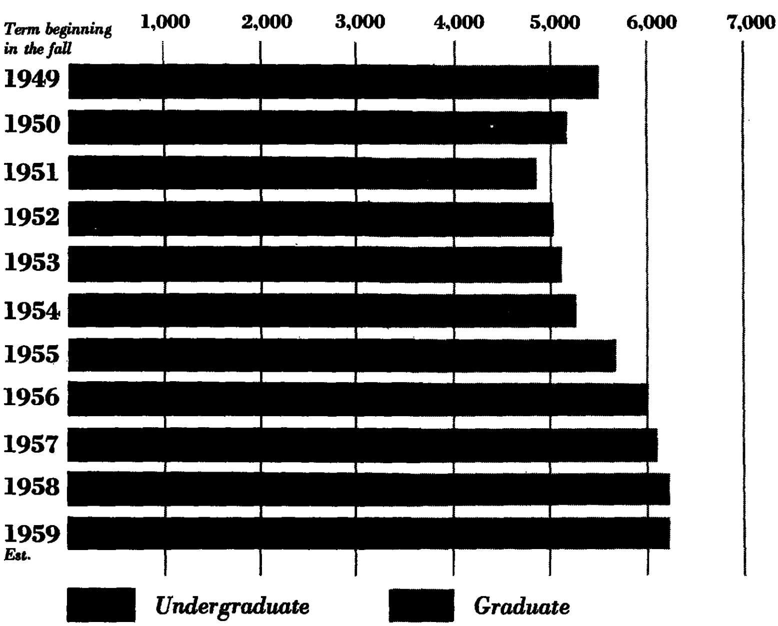
Projects of the Physical Science Study Committee include an extensive series of motion pictures, National Science Foundation summer institutes (*left:* at East Lansing, Michigan) to prepare teachers to use these important new materials, and new teaching aids (*below:* a simple demonstration of the magnetic field around a current-carrying wire).



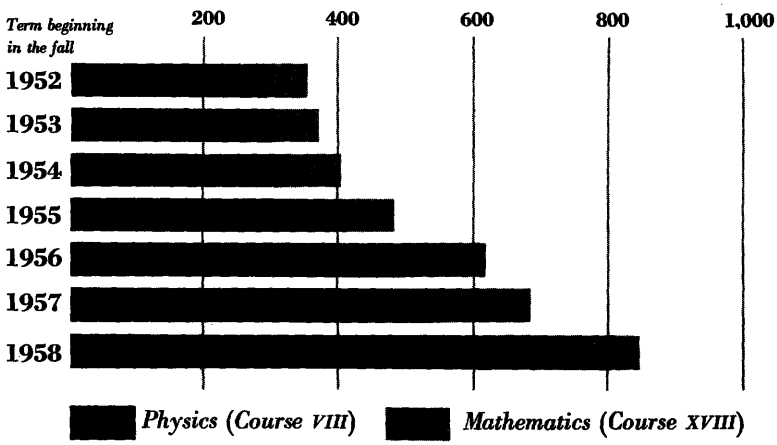
have learned little from industry toward organizing educational processes for larger and more efficient operation. A recent book by Beardsley Ruml with Donald H. Morrison (*Memo to a College Trustee,* McGraw-Hill Book Company, 1959), for example, analyzes the basis of teacher-student ratios and questions the value of some traditional recitation practices in an effort to find solutions to the economic problems that beset the colleges.

As might have been anticipated, there have been quick and sharp rebuttals from the academic profession to some of these suggestions and particularly to the unhappy comparison of the processes of mass production in industry with the education of human beings. There is, I suspect, more to be said on the side of our critics than many college administrators would like to admit. In these days of deepening inflation, inadequate faculty salaries,

ENROLLMENT, 1949-1959



UNDERGRADUATES IN MATHEMATICS AND PHYSICS



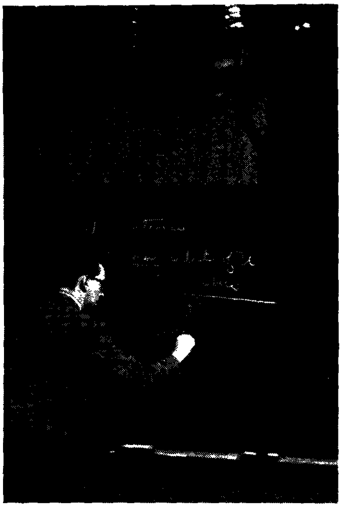
and rising tuitions, it behooves us to scrutinize most thoroughly every part of the academic operation. There are indeed areas properly subject to the methods of cost accounting.

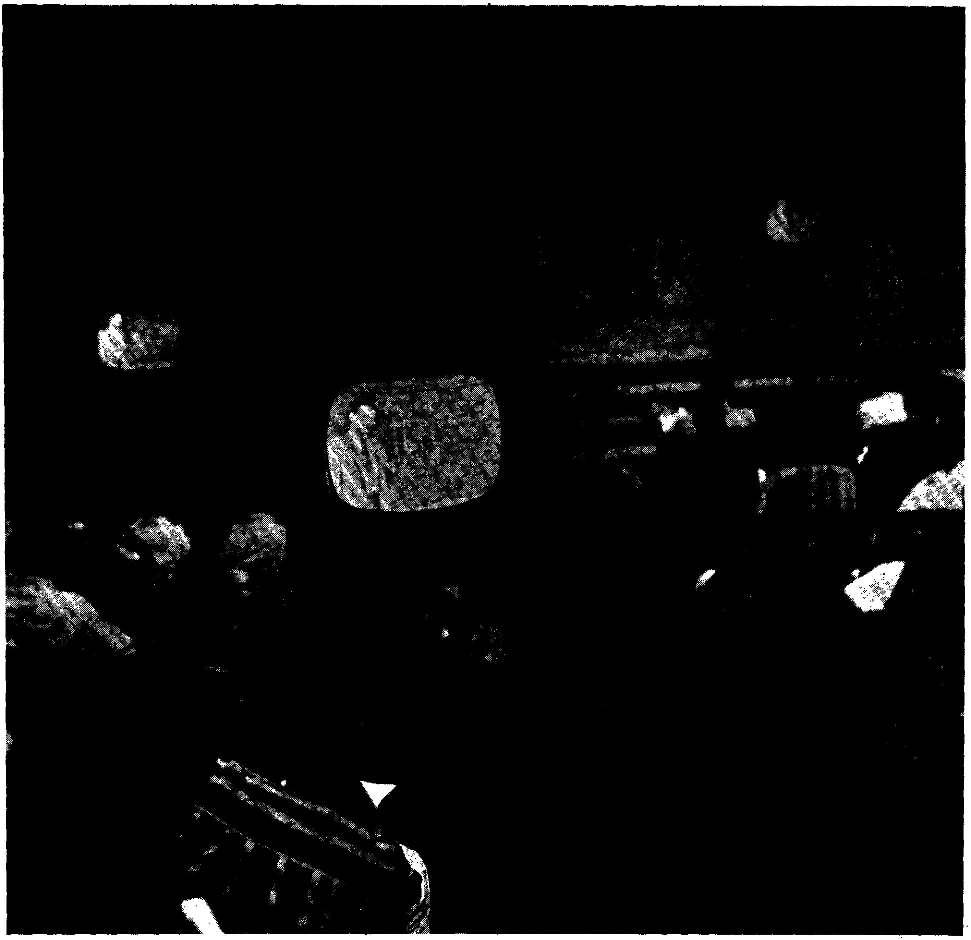
Nonetheless, we must keep ever in mind that the cultivation of the individual is our single goal, the sole reason for our being. Consequently, every change and development contemplated in the methods of education must be judged in the first instance according to its effectiveness in achieving this purpose.

New Methods and New Subjects

M.I.T. is now endeavoring to cope with its own "numbers problem" in certain vital areas. In our case this arises for reasons quite apart from expanding enrollment. Let me take the pressing situation in mathematics by way of illustration. From the earliest days of the Institute we have held all our undergraduates to the same high level of achievement throughout both the freshman and sophomore years. Formerly, however, registration in junior, senior, and graduate-level mathematics subjects was

The Department of Mathematics has experimented with lectures delivered through the medium of closed-circuit television. The microphone (*below*) made it possible for students to ask questions in the usual classroom manner.





relatively small, as was the number pursuing advanced degrees in this field. Now the mounting demands upon mathematical ability of a high order in every science and in widening areas of engineering have resulted in a dramatic growth of enrollment in all our advanced mathematics subjects. The difficulty of providing a constant high quality of instruction is compounded by the greatly increased interest in mathematics as a profession. Thus in 1952 the formal teaching responsibilities of our Department of Mathematics were represented by 2,663 enrollment cards. This coming fall there will be an estimated 4,300, and a conservative prediction for 1963 indicates a number in excess of 5,000. In 1952 there were 63 undergraduate mathematics majors and 53 candidates for higher degrees. We shall register this fall some 280 undergraduate majors and 100 candidates for graduate degrees. Within the same period of 1952-59, the total M.I.T. enrollment rose only from about 5,000 to approximately 6,200.

To alleviate the pressures resulting from this rapid upsurge of interest and to anticipate future demands, the Institute has undertaken heroic measures to increase both faculty and facilities. However, as I have endeavored to suggest earlier, the real problem will not be resolved by an increase of sections and instructors alone. We shall be faced in the future at M.I.T., and at comparable institutions all over the country, with the need to teach difficult, basic subjects to larger groups of students. We may be compelled to break with conventions of the past. Certainly it is a time for bold and creative thinking about the methods and processes of instruction as well as about the substance. We should re-examine with an open mind the relative merits of the lecture, recitation, tutorial, and seminar methods, and we should be progressive in the use of every modern technique for the effective presentation of subject matter in classroom and laboratory.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There is nothing easy about the introduction to calculus, to physics, or to chemistry, and no one should be deluded into believing that the process of acquiring these fundamentals can be made painless. It is, however, reasonable to believe that a student can be made to feel the freshness, the relevance, and the importance of his subject. We can aim to excite him, to capture his mind and enthusiasm. We can hope to divert his obsession with grades to a consuming interest in his field. We can do much to develop and encourage fine teaching, but we must also be clear and firm that the ultimate responsibility for learning rests with the individual student himself. It cannot be shifted to the teacher.

These are ideas that I believe to be widely current among members of our faculty. There is discussion within the School of Science, for example, on the feasibility of establishing an experimental center for the development of aids to teaching, of films and demonstration equipment, and for an intensive, practical study of ways and means of keeping pace with the advance of science itself. Although attention would be focused initially on some subjects of the first two years, the techniques evolved would most certainly find application elsewhere.

Our departments of engineering are equally concerned with these very same issues. Moreover, there are other basic questions with respect to engineering education that are pressing for an answer. The recent advances in technology are, if anything, more revolutionary than those of science. Our faculty has recognized the need to examine carefully our future role as a school of engineering. This past year has again been marked by intensive discussion of such questions as the relative emphasis

(opposite) ***". . . the model of excellence for education in an age in which science and technology have become the dominant forces of culture."***

to be placed upon basic science in the curriculum, the teaching of design in the context of modern industry, the incorporation of expanding new fields — such as that of materials — into the curriculum, the interlocking of departmental interests in common areas such as mechanics or thermodynamics, and the emerging role of research as a career for engineers and as an activity of the school.

These have proved to be difficult and complex issues. However, I am confident that the many studies and discussions of the past months, with the active participation of almost every member of the engineering faculty, will now rapidly bear fruit and that we shall soon have much to report in this domain.

TURNING NOW TO THE AREAS of graduate study and research, I call attention first to the fact that for some years there has been a steady growth in the size of the Graduate School. We have endeavored to control the rate of this increase rather than to halt it. As President Eisenhower's Science Advisory Committee has accurately pointed out, the facilities for advanced professional education in science, engineering, and related fields are grossly inadequate for our national need. There is, moreover, an almost irresistible force for expansion at the graduate level arising from the explosive advances on every frontier of science and technology. Within a decade we have seen the advent of a multitude of new fields, almost nonexistent at the outset of the second World War and now of crucial importance to both science and industry.

No educational institution can remain aloof from all these developments and keep pace with the leaders. But each venture into a new area brings with it new faculty, new laboratories, and new students. The influence of each advance is felt first at the graduate level but rapidly penetrates to the domain of the undergraduate, bringing new material into the curricula and affecting many aspects of instruction. There is no greater popular misapprehension about the nature of science than that it is built upon a fixed and permanent structure.

Interdisciplinary Centers

A significant feature of these postwar developments has been the emergence of interdepartmental centers of research. Important advances continue within the old, established branches of science and engineering, but many new fields cut boldly across these traditional boundaries. Consequently, new groupings have appeared, new organizational forms have been devised to allow faculty in several departments to work advantageously together.

In a number of respects the Research Laboratory of Electronics, which was formed immediately after the war as a successor to the Radiation Laboratory, has set the pattern for the establishment of other centers. R.L.E. represented a pooling of faculty interests in a large domain of physics and electrical engineering and touching also certain areas of biology and chemistry. Later the Laboratory for Nuclear Science was also conceived on broadly interdepartmental lines, and in a quite different area our Center for International Studies functions on a comparable plan.

There has been notable progress during the past year toward the development of further interdisciplinary centers for teaching and research.

The most comprehensive of these plans encompasses the field of materials. The critical importance of metals, alloys, ceramics, insulators, and plastics for industrial development has been widely recognized. Moreover, it is a field in which M.I.T. occupies a unique position. In no other academic institution is there so large and so strong a group in solid state science and materials engineering.

Nearly one hundred faculty members are active in the field. In all, over five hundred people drawn from nine different departments, including graduate students, are participating in this work. Our annual budget for research in materials is now in excess of $4 million. The strength of M.I.T.'s program arises not merely from its size but from its distinction and from the wide span of its interests – ranging from the most theoretical studies to work of immediate engineering significance. Our plan is to draw these diverse efforts into a large and integrated laboratory which will facilitate cooperation between the scientific and engineering departments, both in research and in the education of students. A materials center of this quality and on this scale would provide a major new resource in the research program of the nation.

A year ago I reported the organization at M.I.T. of a Center for Communication Sciences. The Institute has

This seminar conducted by members of the Laboratory for Insulation Research is one example of M.I.T.'s many educational activities in the field of materials.

long been pre-eminent in the field of communications, and the progress of information theory has opened wide new horizons for investigation. This Center expresses the common interest of a group of electrical engineers, mathematicians, physicists, linguists, psychologists, and physiologists. Again it arises from a spontaneous faculty desire to focus effort upon a central theme, to pool facilities such as shops, library, and major equipment, and to organize a comprehensive plan of funding. Yet as long as the several parts of the program remain widely scattered, the concept is hardly more than an organizational fiction. We have, therefore, the immediate task of providing adequate space in a single location for the Center for Communication Sciences in order that it may soon become a more effective working entity.

It is a pleasure to report signal progress this past year in the broad area of the earth sciences. The Department of Geology and Geophysics, with the cooperation of the Department of Meteorology, is developing an integrated instructional and research plan in the earth sciences designed to bring the geosciences (geology, geochemistry, and geophysics), the atmospheric sciences, and oceanography closer together. To this end we have continued to expand over the past year the cooperative exchange of faculty and students between M.I.T. and the Woods Hole Oceanographic Institute. Of major importance to our total program was a gift in excess of $2.5 million from Dr. and Mrs. Cecil H. Green of Dallas, Texas, for the establishment of a center to house all teaching and research facilities in the earth sciences. This magnificent grant assures us of the much-needed building that will give unity to the entire program.

Widening Departmental Horizons

Although the growth of these new centers is one of the most characteristic developments of this period, it should be recognized that each department individually is extending the range of its interests and inevitably in the process links more closely with its neighbors.

The Department of Aeronautical Engineering, which this year changed its title to Aeronautics and Astronautics, affords an outstanding example of this widening scope. Here is a branch of engineering initially focussed on aerodynamics, the theory and design of structures, and the improvement of the internal combustion engine. However, the modern airplane involves some of the most advanced problems of electrical power conversion. The success of turbojets and rockets puts a whole new emphasis upon the chemistry of fuels. The navigation and control of missiles and satellites can be mastered only through a highly sophisticated understanding of electronic devices and of inertial systems of mechanics. A more extensive knowledge of the physics of the upper atmosphere must precede the first journeys of man into outer space. The design of space vehicles will be critically influenced by medical research into the physiological effects of radiations, of high accelerations, and of travel in regions free of gravitational fields. Moreover, while meeting the spectacular challenges of the space age we must continue to give attention to the increasingly complex problems involved in the operation of conventional airplanes for traditional purposes. For example, the mounting density of air traffic, coupled with increasing speed, has created a situation which can be resolved only by the joint efforts of the engineer, the lawyer, and the city planner.

In concluding these examples, I should like also to mention briefly the highly satisfying developments that have been taking place in our Department of Biology.

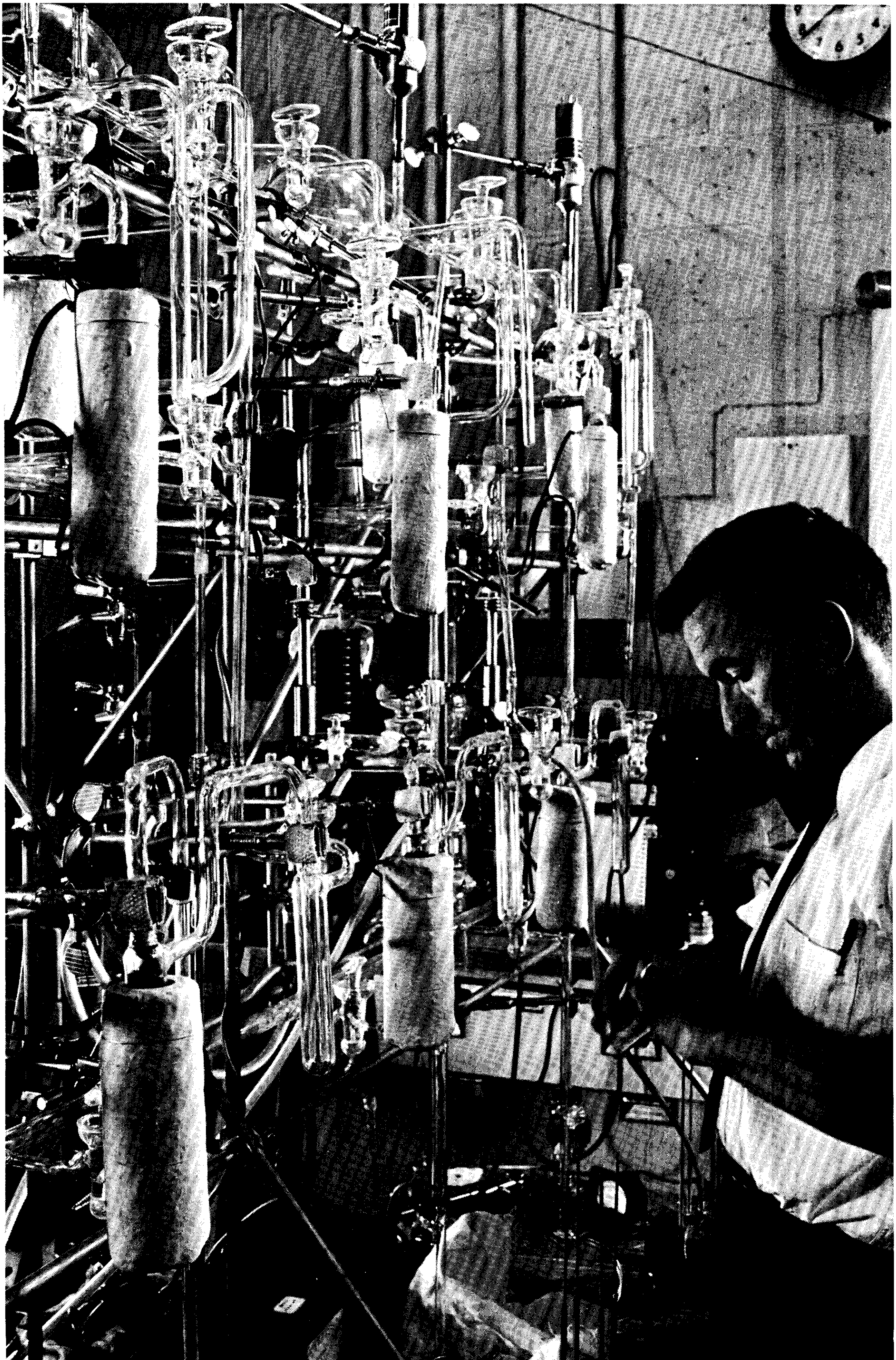
The life sciences are everywhere in the ascendancy, and it is manifest that M.I.T. in the future has an important role to play in this domain. Our particular lines of emphasis and the quality of our effort will be influenced by the character of the Institute as a whole. It is, therefore, most encouraging to observe the very cordial and productive working relations in areas that are of common interest to the Departments of Biology, Food Technology, Chemistry, and Physics, and to the Research Laboratory of Electronics.

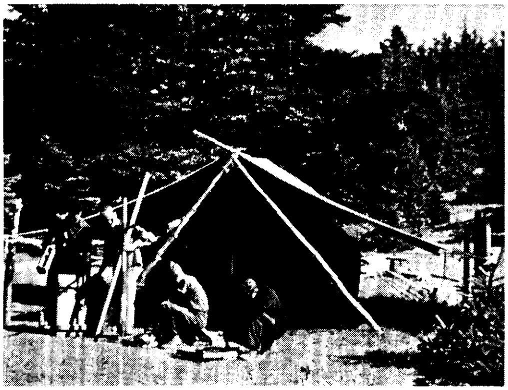
EARLIER IN THIS REVIEW I commented upon the problem of expansion, the need to moderate the pressures of growth and to single out areas for concentration. Each of the examples that I have cited – and the list is by no means inclusive of all our needs and interests – has the potential for major development at M.I.T. In each instance there is a record of substantial activity and accomplishment at the Institute. There has been a spontaneous interest and desire on the part of a considerable group of the faculty. Already in existence are important laboratories and equipment around which expansion can take place. And in each instance the future import of the field to the whole of science and industry seems clear. These are areas to which we propose to give vigorous support for further development.

Finally, I suggest that in the formation of these centers of study and research we are beginning to see something of the future organization of a modern scientific university. I have remarked that each has been the product of a spontaneous faculty interest that draws upon a number of the traditional disciplines. If a university were to be started completely afresh, it might conceivably be organized along wholly different lines.

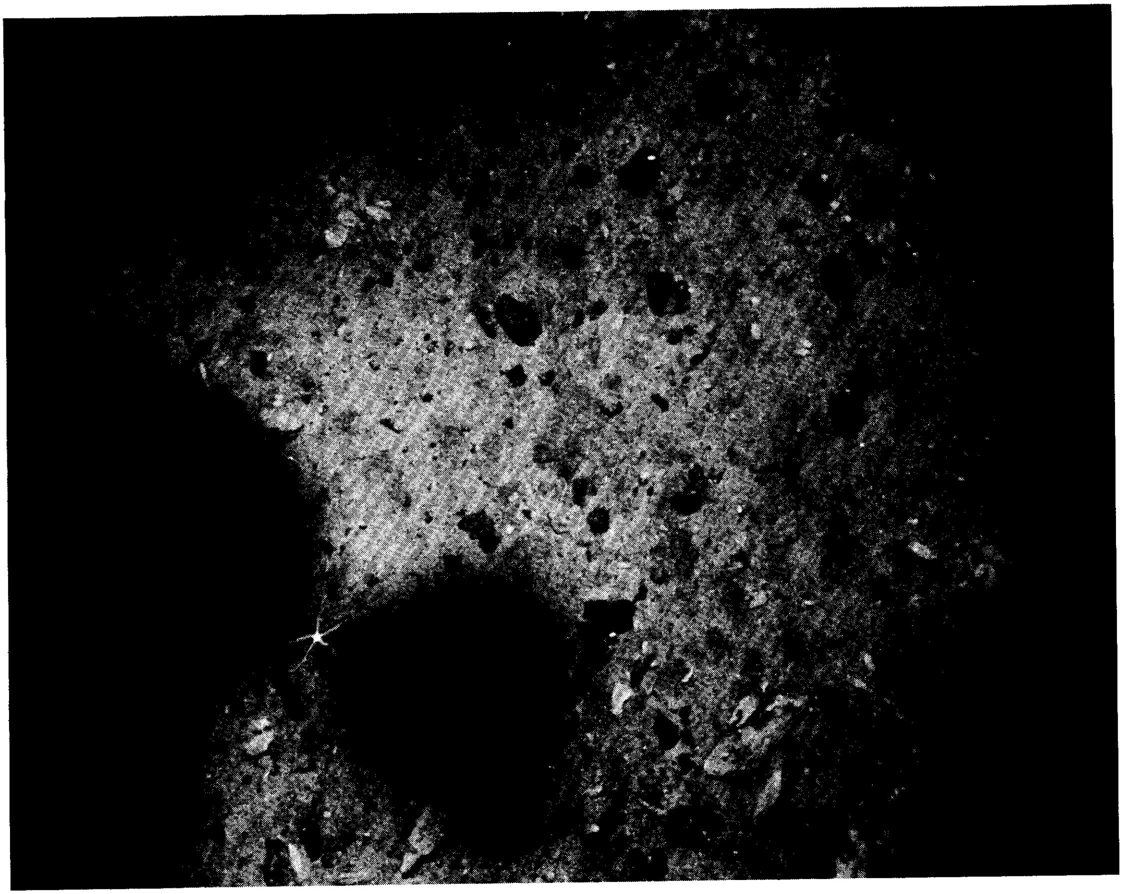
But no organizational structure, however new, can escape the problem of overlapping fields, the fact that knowledge is a continuum. The result is an organizational dilemma that is proving as baffling for industry and the Department of Defense as it is to the university. Quite clearly there must exist some permanent, structural form that assures stability and continuity of normal operations. It is the responsibility of administration to maintain that structure in a healthy condition. At M.I.T. our present system of schools and departments admirably serves that purpose. But this conventional plan must now be supplemented by avenues of escape from the arbitrary boundaries of a traditional discipline. The new interdepartmental groupings have been devised with that intent. They expand our opportunities; they do not replace the older structure. It follows that many members of our faculty will maintain a dual affiliation — one with a department, involving formal responsibilities of teaching, and the second with a center or laboratory. There need be no conflict of authority. The management of such a laboratory is the management of its shops, libraries, and facilities on behalf of the faculty. There is no "director of research." The program of the center is the sum total of the individual programs of senior staff, their junior colleagues, and their students. Initially these laboratories were conceived principally as centers of graduate and postdoctoral research. It is now quite apparent that because of their size, the availability of equipment, and the character of their financial support, they also afford to M.I.T. our most challenging opportunity to introduce students to the problems and spirit of research in their undergraduate years.

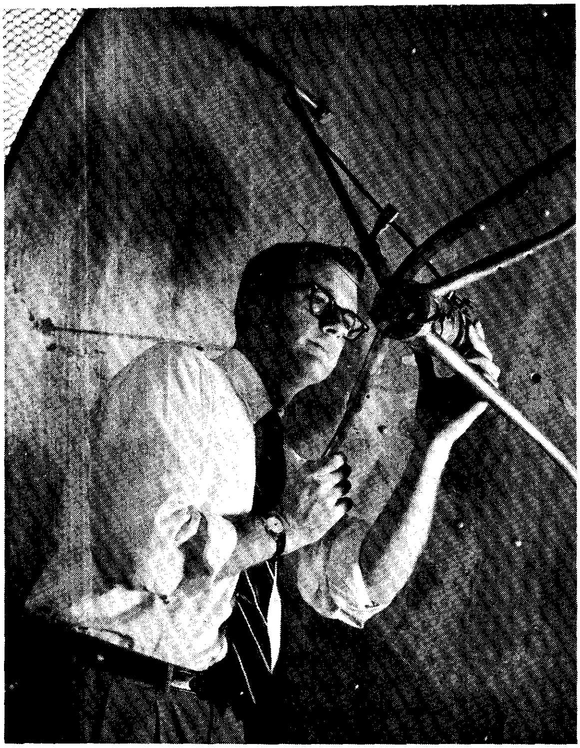
(*opposite*) This study of the age of rocks by measuring traces of radioactivity exemplifies the synthesis of physical and earth sciences which will give exceptional strength to the new Center for Earth Sciences.





The earth sciences at M.I.T.: (*top*) the geology summer camp near Antigonish, Nova Scotia; (*center*) the Cabot Spectrographic Laboratory, pioneer in applying spectrography to geology; (*above*) measuring rainfall radioactivity; (*below*) an instrument to study the size of water droplets in clouds; and (*right*) the ocean floor at a depth of 25,000 feet, photographed from the French oceanographic research vessel *Calypso* using lights developed in the M.I.T. Electrical Engineering Department.





". . . an integrated instructional and research plan designed to bring the geosciences, the atmospheric sciences, and oceanography closer together."

THE YEAR IN REVIEW

THE PAST YEAR has been characterized by a long list of notable achievements. In addition to the developments I have already discussed, I select out of many the following for special mention:

Some Educational Advances and Opportunities

To meet the challenges of new frontiers in science and technology and to advance professional education, there has been at the Institute this year, as I have already indicated, a steadily increasing ferment of re-examination and experimentation in all departments.

1. In the School of Engineering, the Department of Civil and Sanitary Engineering this year reorganized part of its educational program, notably in structures, transportation, and surveying. I mention with pride the pioneering work being done in the Department combining photogrammetry, machine computations, and operations research. This research has resulted in a revolutionary new approach to surveying, particularly promising for highway location and design.

The Department of Mechanical Engineering has proposed a new option, Engineering Sciences, for those students desiring a program more analytical than its current curricula, which emphasize engineering applications. The new program will include an additional year of both physics and mathematics and a two-term sequence of electrical circuit theory and electromagnetic field theory. It should prove particularly attractive to students who plan to take graduate work.

The Department of Electrical Engineering has nearly completed the evolution of its core curriculum;

only a few subjects are now being added. Atomic and Nuclear Physics is now required of all undergraduates majoring in electrical engineering, and Structural Chemistry of all majors in Electrical Science and Engineering (Course VI-B). The Department has continued to offer studies in new engineering specialties, the most notable being Introduction to Automatic Computers for freshmen and Molecular Engineering for students interested in materials research.

Of major importance to our total educational effort has been approval by the faculty of a graduate program in materials at the engineer and doctoral level. We do not contemplate the establishment of a separate department for such work but plan to enroll students in the existing engineering departments with programs tailored to their particular interests in materials science and its application.

The "school of the future" may come from this model, designed in the Department of Architecture, of a building which would be built largely of plastics. The structure uses light-weight plastic panels on a modular plan which allows for frequent changes in layout to meet a community's changing needs.

2. The School of Science strengthened its facilities and curricula in the earth sciences and the life sciences during the past year with important new advances in both fields. In addition to the major developments in the earth sciences which I discussed earlier in this report, the Department of Meteorology has undertaken a substantial revision of its curriculum during the past year. In the same period its enrollment has increased by 35 per cent. In view of the national need for atmospheric research, these are encouraging developments.

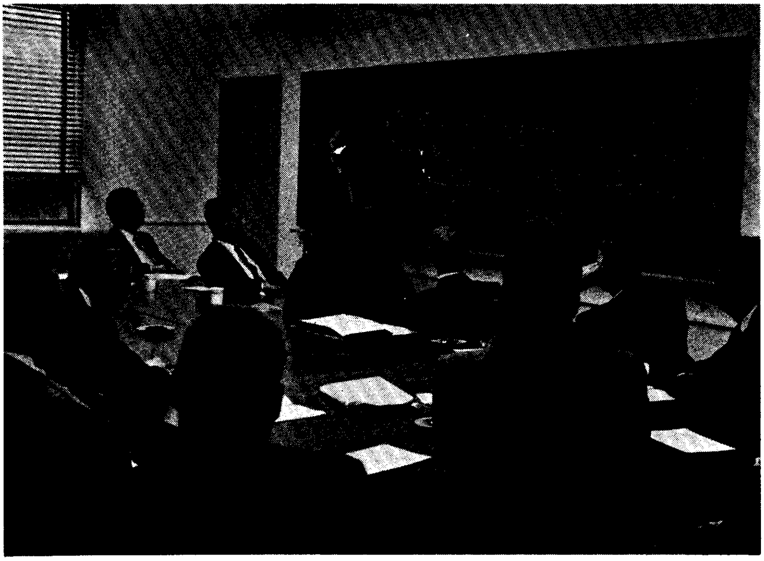
While continuing to expand its undergraduate and graduate enrollments, the Department of Biology is also becoming an important center for postdoctoral medical research. Of special importance to our work in the life sciences has been the appointment of Dr. Salvador E. Luria, one of the world's leading virologists, as Professor of Microbiology. We are also making extensive modifications in the Dorrance Building to meet the needs of new programs in microbiology, biochemistry, and biophysics.

During the past year steps have been taken to help in establishing closer communication and collaborative efforts between the Physics Department and that part of the Lincoln Laboratory involved in fundamental research, mostly on solid state physics. Particularly noteworthy were joint ventures in low temperature physics spearheaded by Visiting Professor Emanuel Maxwell, who was on leave from the Lincoln Laboratory to work on the M.I.T. campus; joint colloquia which took Institute students and staff to Lincoln on several occasions; and the collaboration of the solid state group at Lincoln with Professor Francis Bitter of the Physics Department in planning for extended magnet facilities.

In the Department of Chemistry, Professor David P. Shoemaker taught for the first time an elective in Structural Chemistry to a selected group of sophomores in Electrical Science and Engineering. The experiment was so successful in providing needed background for advanced study in materials that it will be offered again next year to students in physics and electrical and mechanical engineering.

3. In the School of Humanities and Social Science, the teaching and research programs in the social sciences, languages, and humanities are taking increasing advantage of our scientific and technical environment. This was particularly evident in the political science graduate program, in the laboratory for language teaching created this past year, and in the application of quantitative techniques to the analysis of problems in social sciences. There has been a gratifying increase of 50 per cent in the number of students registered for modern languages, especially Russian and German, reflecting the growing awareness among Americans of the importance of foreign languages.

Tape recording equipment is used to its best advantage in this Linguatrainer, which teaches students how to pronounce foreign languages. One student may be practicing Russian, another French, and yet another German. The machine was completed this year in the Department of Modern Languages.



Several hundred alumni of the School of Industrial Management's two Executive Development Programs returned to the campus in April and May, 1959, for stimulating convocations which included seminars such as this with members of the School's faculty.

4. The School of Industrial Management has continued to expand its educational program and to give increasing attention to research in the field of management. Generous support from philanthropic and industrial organizations has enabled individual faculty members to carry on research in such varied fields as the use of high-speed computers, economic forecasting, study of policy determinants, fiscal policies of both government and industry, and a host of other fruitful areas.

5. With substantial aid from The Ford Foundation, we established with Harvard University this year a Joint Center for Urban Studies designed to exploit the rich resources of both institutions. The focus of the new Center's research will be the physical environment of cities and regions, the forces that shape them, and the interrelations between urbanization and society.

6. A program of enriching student life outside the classroom is of paramount importance. This year we established the Housemaster system on an experimental basis for the express purpose of providing more faculty participation in the guidance and counseling of students. Professor and Mrs. Howard R. Bartlett served in this capacity in Burton House, and their work was so effective that we are extending the Housemaster Plan to the Senior House during the coming year. Equally gratifying has been the work of Professor Richard L. Balch and his associates in the Athletic Department in making their activities in both intercollegiate and intramural sports an integral part of the Institute's educational program.

New Facilities

During the year the Institute made several important additions to its physical resources for education and research.

Alumni Day, June 15, witnessed the dedication of the Vannevar Bush Room, honoring our long-time friend and colleague. This room, made possible by the many friends of Dr. Bush, will provide students and faculty members of the Department of Electrical Engineering with needed facilities for seminars, staff meetings, and other professional activities.

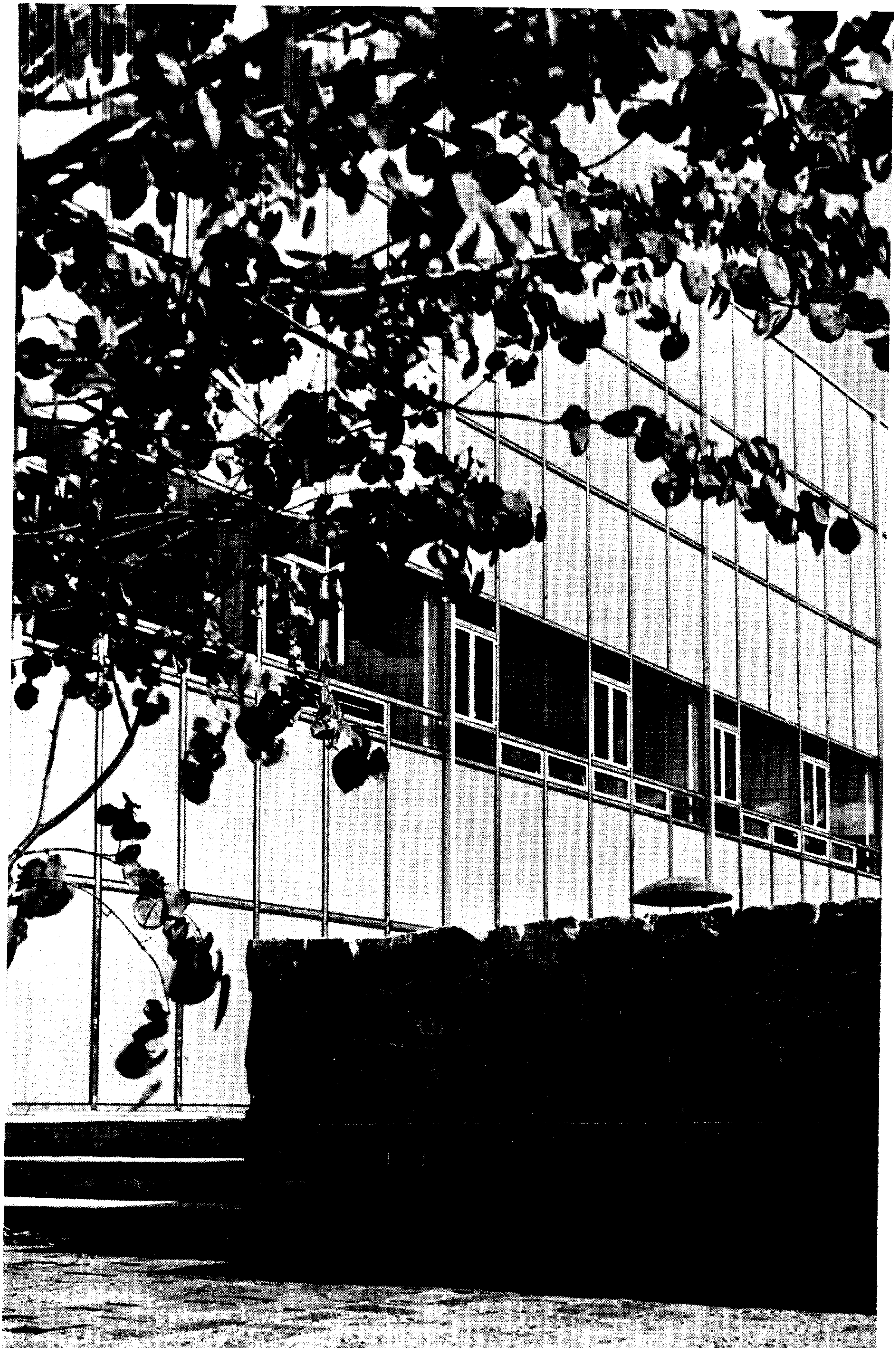
This fall we will open new quarters for commuting students in a former private dwelling at 318 Memorial Drive. The house has been furnished for comfortable study and will also have some kitchen equipment and a few beds so that non-residents may occasionally remain on the campus overnight. Quarters for a resident tutor have also been provided so that the total facility will give to our commuting undergraduates some of the advantages now enjoyed by students living in the dormitory system.

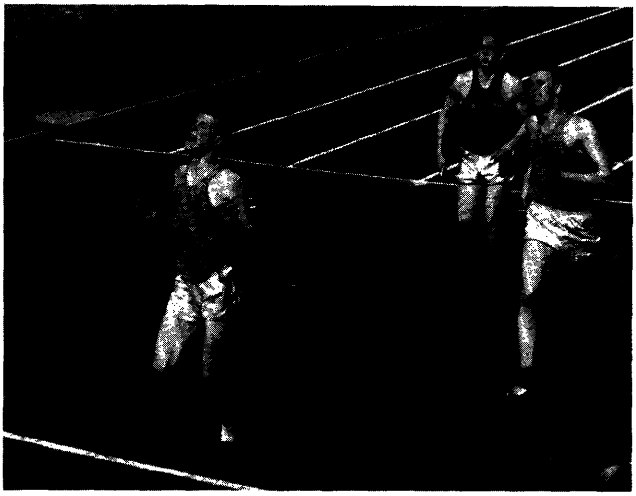
Construction of the David Flett du Pont Athletic Center will be completed by early fall. This addition, adjoining Rockwell Cage and the recently acquired Armory building, will give the Institute for the first time in its history a fully adequate center for its physical education program. The new building will be dedicated with appropriate ceremony on October 5, 1959.

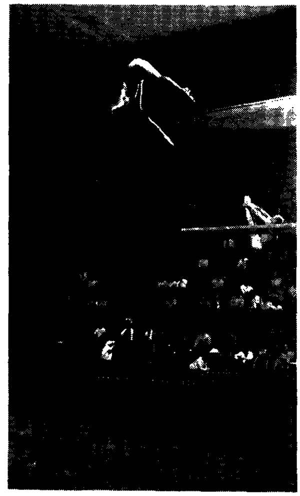
In addition to these completed or nearly completed projects, three other facilities are now being planned with expectation that construction will be started some time during the coming year. Of major importance will be the Center for Earth Sciences, mentioned earlier in this Report, which will be located just east of the Dorrance Building and which will extend almost to Ames Street.

Through the generosity of the Alumni Fund Board and many thousands of alumni contributors, we will add a dining hall to Burton House, one of the undergraduate dormitories. This addition, initially recommended by the Ryer Committee, will make Burton House a self-contained unit and will also provide a large and pleasant meeting room for lectures, discussions, dances, and other social and cultural affairs. This is an important step in increasing the effectiveness with which our residential system can contribute to the educational and personal development of our students.

M.I.T., like all urban institutions, faces critical problems in the use of its land. We have been extremely fortunate in the past in being able to provide adequate on-campus parking space for all those of the Institute community who had a real need for it. Now it has become clear that open-lot parking is a luxury we can no longer afford in view of the increasing demands on the present campus for additional educational facilities. To meet this situation, we have decided to erect a series of self-amortizing parking structures, the first of which will be built during the coming year on the east end of the campus adjoining Vassar Street.







The David Flett du Pont Athletic Center (*left*) will provide a much-needed headquarters for M.I.T. athletic activities, which extend from the Charles River Basin and Briggs Field to the Alumni Swimming Pool. More than 750 students took part in intercollegiate athletics at the Institute this year, and nearly 2,500 participated in intramural competition. The improved facilities of the du Pont Center should attract still more students to this recreational program.

This fall will also see the final demolition of Westgate and Westgate West, temporary wooden structures which have been used since 1946 for the housing of married students and their families. This step has been necessitated by zoning rulings of the Cambridge Board of Appeals and by the deterioration of the buildings themselves. We are now studying plans to determine whether we can find an economic way to build permanent housing for some portion of our 1,400 married students.

Sponsored Research

It is clearly evident that in today's world, institutions like M.I.T. have a heavy responsibility not only to provide educational leadership but also to foster and to advance research in science and technology. This responsibility includes the duty to undertake on occasion research sponsored by industry and government which in our opinion is in the national interest and which in all likelihood will benefit our educational program.

During the past year, reflecting the growing national interest in basic research, there has been a dollar increase of over 20 per cent in sponsored research in our campus laboratories, mainly from added government support. Despite our intellectual interest in this work, its educational value, and its national importance, it seems imperative that the present short-term funding of government-sponsored research programs be revised to meet more adequately the special requirements of an academic institution.

While every department and laboratory at the Institute has shown an increase in sponsored research this year, our growing strength in the general field of materials and in the communication sciences is particularly noteworthy. I have already discussed developments in these two fields in detail and now cite for additional attention the following:

The Servomechanisms Laboratory, a leading research center at the Institute since 1940, has changed its name to the Electronic Systems Laboratory to describe more adequately the nature of its activities in research and education. The Laboratory announced this year the development of the "APT" (Automatically Programmed Tool) system, a new method of automatically controlling machine tools through the use of a unique language that can be read by a computer. This work, sponsored under an Air Force contract, has received world-wide attention and acclaim.

Mention must be made also of our growing efforts in the general field of plasma dynamics. Generous support from the National Science Foundation to Harvard and M.I.T. establishes Cambridge as one of the world's leading centers for research on electrical plasmas and their uses. This work should eventually add new knowledge of basic importance to such areas as fusion power, propulsion of space vehicles, space travel, and re-entry problems.

The importance of M.I.T. as a center for basic and applied research was reflected in the new heights of interest shown by industry in our Industrial Liaison Program. Nearly one thousand company representatives attended the fourteen symposia conducted during the year under the Industrial Liaison Program to present new ideas, concepts, and experimental results of research at M.I.T. Of particular interest was the meeting on research organization in decentralized companies, which reviewed the results of a two-year study of this subject in the School of Industrial Management.

At Lincoln Laboratory, a major reorientation in programs and objectives has been achieved concurrently with a disengagement from SAGE System responsibilities, made possible by the establishment one year ago of the independent Mitre Corporation. The Laboratory has

This 18-ton centrifuge is used by the M.I.T. Instrumentation Laboratory to simulate the forces of acceleration which missile-borne inertial guidance equipment must withstand. The operator in the center measures distortion in the centrifuge arm while it whirls at high speeds.

deepened its research program in physics and electronics, particularly as related to defense. Its technical achievements during the past year have included interplanetary radar measurements and significant advances in solid state research and component development. Invention of the Cryosar and research on thin magnetic films hold promise of great usefulness for high-speed computers.

The Instrumentation Laboratory has continued its national leadership in research and development in guidance and control systems for missiles, including the Air Force's "Titan" and the Navy's "Polaris." Under the leadership of Professor Charles S. Draper, Director of the Laboratory, a major program is being undertaken on the future needs of astronautical navigation.

Corporation, Faculty, and Administration

With sorrow I record the passing of Paul W. Litchfield '96, a member of the Corporation from 1918 to 1923 and from 1926 to 1931. Throughout his entire life Mr. Litchfield remained a true friend of the Institute.

Several changes have affected membership of the Corporation during the past year. We look forward with pleasure to long and pleasant associations with the following men: Russell DeYoung, Sloan Fellow '40, President of the Goodyear Tire and Rubber Company; and George Peabody Gardner, Jr., General Partner of Paine, Webber, Jackson and Curtis, have been appointed Special Term Members. The alumni have elected three of their number to Alumni Term Membership: John J. Wilson '29, Director of Minneapolis-Honeywell Regulator Company; William Webster '23, President of the New England Electric System and of the Yankee Atomic Electric Company; and James B. Fisk '31, President of the Bell Telephone Laboratories. Expiration of term membership has cost us the association of Theodore V. Houser, Horatio L. Bond '23, Ray P. Dinsmore '14, and William J. Sherry '21.

I should like to pay special tribute to the highly effective service rendered by members of the Corporation throughout the year. More than two-thirds of the active members attended each of the four regularly scheduled meetings. In addition, twenty of the twenty-four visiting committees under their direction met to discuss and examine the affairs of the several academic and service departments. I take this opportunity to express my deep appreciation, and that of my associates, for the superb measure of trustee responsibility rendered by these very able men in both guiding and stimulating the many activities of the Institute.

It is with regret that I report the death of four members of the faculty and two members of the administration during the year: Assistant Professor Dudley A. Buck of the Department of Electrical Engineering; Professor W. Rupert Maclaurin of the Department of Economics and Social Science; Associate Professor Alvin Sloane of the Department of Mechanical Engineering; Arthur

L. Townsend, Associate Professor Emeritus in the Department of Mechanical Engineering and Director of the Lowell Institute School; Dr. LeMoyne White, Psychiatrist, a member of the Medical Department; and R. Colin Maclaurin, Assistant to the Chancellor.

Two members of the faculty reached the Institute's mandatory retirement age at the end of the past academic year: Professor Shatswell Ober '16 of the Department of Aeronautics and Astronautics, and Associate Professor Stephen G. Simpson '16 of the Department of Chemistry. Happily, both will continue their services to the Institute as Lecturers in their respective fields of interest.

I am very happy to report the appointment this spring of Dr. Norbert Wiener, renowned mathematician and member of the Department of Mathematics for forty years, as Institute Professor. This distinguished post, recognizing outstanding achievement and breadth of interest, will allow Dr. Wiener to do advanced teaching and research without regard to departmental boundaries in pursuance of his own wide interests.

Among the honors which have come to members of the faculty during the past year are the following: the Lamme Medal of the American Society for Engineering Education to Professor Gordon S. Brown (electrical engineering); the Charles Frederick Chandler Medal awarded annually by Columbia University in recognition of achievements in pure or applied chemistry to Professor Arthur C. Cope (chemistry); the selection as the outstanding New England engineer of 1958 by the Engineering Societies of New England of Professor Harold E. Edgerton (electrical engineering); the American Chemical Society Award in Industrial and Engineering Chemistry to Professor Edwin R. Gilliland (chemical engineering); and the American Chemical Society Award for creative work in synthetic organic chemistry to Professor John C. Sheehan (chemistry).

Professor Manson Benedict (nuclear engineering) was appointed by President Eisenhower to a four-year term on the General Advisory Committee to the Atomic Energy Commission; Professor John Chipman (metallurgy) was elected President of the Metallurgical Society of the American Institute of Mining, Metallurgical, and Petroleum Engineers; and Professor Henry G. Houghton (meteorology) was elected Chairman of the Board of Trustees of the University Corporation for Atmospheric Research. Professor Charles S. Draper (aeronautics and astronautics) was made an Honorary Fellow of the Institute of the Aeronautical Sciences. Dean C. Richard Soderberg received the exceptional honor of Knight of the Order of the North Star, bestowed by the King of Sweden.

At the beginning of this summer, several important administrative changes were made, including the appointment of Professor Gordon S. Brown, Head of the Department of Electrical Engineering, to succeed Dr. Soderberg as Dean of Engineering. Dr. Soderberg will now devote full time to teaching and to research as Institute Professor. He served with distinction as Dean, and the Institute owes him a deep debt of gratitude for his unstinting loyalty and leadership.

Professor Howard W. Johnson has been chosen to succeed Professor Edward Pennell Brooks as Dean of the School of Industrial Management. This appointment will be effective on November 1, 1959. Professor Brooks was appointed first Dean of the School of Industrial Management in 1951, and through his wise and effective leadership the School has achieved outstanding stature. We are delighted that he will continue to be actively associated with the School as Dean Emeritus and Professor.

Dr. Carl F. Floe has been appointed Vice President, Research Administration. In this new post Dr. Floe will coordinate the interests of the faculty with the over-all administration of sponsored research.

The M.I.T. Community

One of the most important developments at the Institute in the present 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 attend professional meetings, 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: George P. Sutton, a leading research engineer in the field of space flight and rocket propulsion, as Jerome Clarke Hunsaker Professor of Aeronautical Engineering; Dr. Paul F. Chenea, Associate Dean of Engineering at Purdue University, as Edwin Sibley Webster Professor of Electrical Engineering; Professor Laurel J. Lewis of the University of Washington, Visiting Professor of Electrical Engineering; Nathaniel Rochester, Manager of the Department of Information Research of International Business Machines Corporation, as Visiting Professor of Communication Sciences; Dr. Herman Schlichting, Professor of Hydraulics at the Technische Hochschule Braunschweig, West Germany, in the Department of Civil and Sanitary Engineering; Professor Frederick S. Dainton of the University of Leeds, England, as Arthur D. Little Visiting Professor of Chemistry; and Dr. Erik H. Erikson, Senior Staff Member of the Austen Riggs Center in Stockbridge, Massachusetts, as Visiting Professor of Communications.

This spring Grover Loening, one of the country's pioneers in aviation, gave the inaugural Lester D. Gardner Lecture on the history of aeronautics, vividly showing how experiences of the past may contribute to solving today's aeronautical problems.

The year's most charming visitor was Queen Frederika of Greece, whose stamina at sightseeing outdid that of many of her hosts.

In addition, more than six hundred other guests representing foreign governments, industries, and educational institutions have enjoyed the hospitality of M.I.T. during the past year. These many visitors from fifty-two different countries continue a tradition of interchange which is at the heart of our professional advance. The not insignificant number of Soviet visitors reflected the new reciprocal arrangements concluded by the Department of State and the Russian foreign office.

As usual, it has been the Institute's pleasure to entertain a number of professional conferences and meetings. During the past year the American Mathematical Society and the American Physical Society held national meetings on the campus. Of special interest was a conference at Endicott House on Science and Public Policy last fall, attended by some fifty leaders of American science who have played important roles in the determination of our national policy. A Space Environment Symposium, consisting of thirteen lectures by nationally recognized authorities on the nature of space and presented by the Department of Aeronautics and Astronautics, drew record crowds this spring. At the beginning of this summer some one hundred experts from twenty-four nations attended the International Symposium on the Radiation Preservation of Foods, at Kresge Auditorium.

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. The fact that the Little Theatre and large auditorium are already fully booked for the coming year suggests the creativity and vigor of various Institute Groups interested in the arts.

Rave reviews followed Dramashop's 1958 presentation of *The Alchemist,* in Kresge Little Theater.

Particular mention must be made of the work being done at M.I.T. by our student dramatic groups, under the direction of Joseph D. Everingham. Major productions included Ben Jonson's *The Alchemist* and Richard Brinsley Sheridan's *The Rivals.* Highly successful were four one-act workshop evenings for which students directed, designed, acted, costumed, and produced the plays. After each performance an on-stage critique was conducted with the entire company and the audience. This year's program for the workshop included plays by Ionesco, Giraudoux, Chekhov, and O'Casey. In addition, the Celebrity Series brought to the campus outstanding personalities and events of the theater, including the world première of *The Doctor and the Devils,* written by Dylan Thomas with scenario by Mr. Everingham.

Our musical life continues to be enriched by the excellent programs offered by student groups and various professional organizations, including the Boston Symphony Orchestra. The Choral Society maintained its traditional high standards in five performances, including Bach's *B Minor Mass* and an excellent presentation of *The Fairy Queen,* in commemoration of the birth of Henry Purcell.

As usual, the Museum Committee brought a number of distinguished exhibits to the galleries of the Institute. Besides the regular educational shows, the series included the most comprehensive presentation of Charles Sheeler's work ever to be shown in this area and a distinguished display of pictorial weavings by Anni Albers.

A Statistical Abstract

In 1958-59 the student body numbered 6,259, as compared with 6,179 in 1957-58. We estimate that enrollment this fall will be about 6,300. Veterans numbered about 5 per cent of the total enrollment as compared with 6 per cent the year before. In 1958-59, 22 per cent of our students were married, an increase of 1 per cent over the previous year. One hundred and twenty-five women were enrolled, 63 of whom were graduate students.

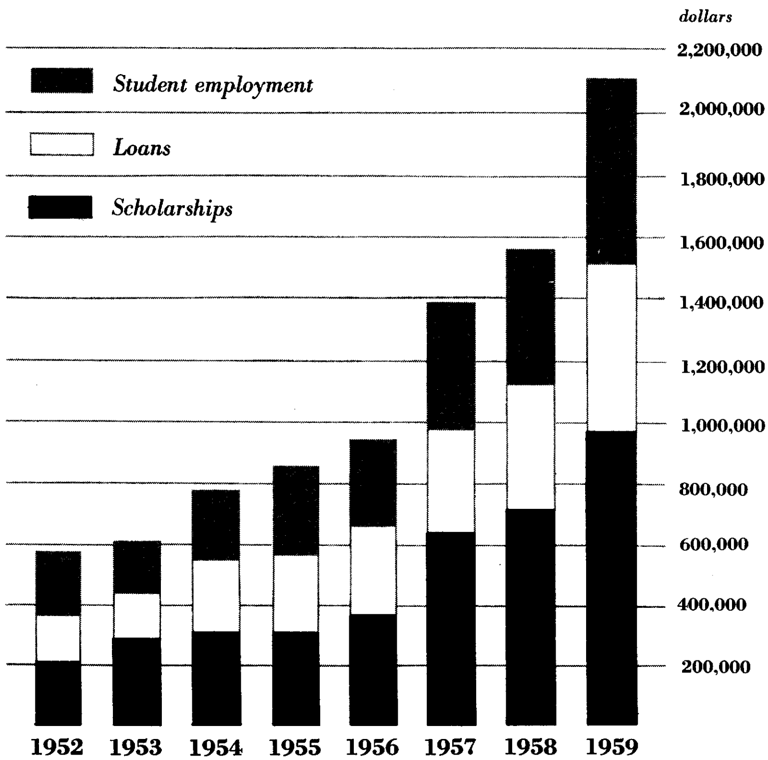
Enrollment in the Graduate School was 2,671. There were 163 officers from the United States armed services enrolled for advanced degrees.

Students enrolled at M.I.T. during 1958-59 held degrees from 504 other colleges and universities, 309 American and 195 foreign. Total foreign student population was 765, representing some 12 per cent of the total student body. These students were citizens of seventy-seven different countries.

Student Aid

During the past decade the Institute, like other privately endowed colleges and universities, has been forced to make successive increases in tuition in an attempt to keep pace with the constantly mounting costs of operation. This spring it was necessary to announce that the annual tuition would be advanced to $1,500 as of July, 1960. With these prevailing conditions the Institute's resources

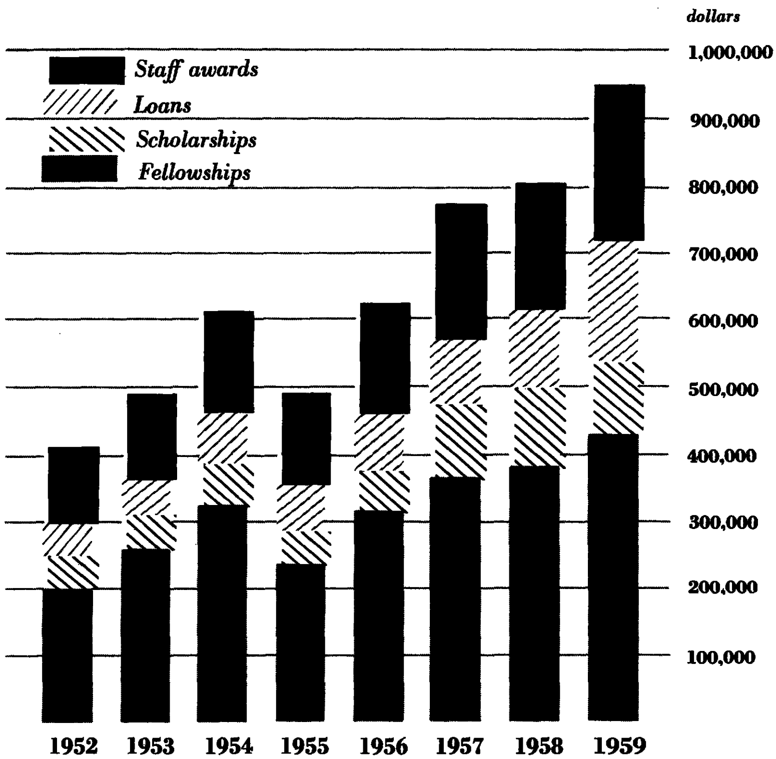
FINANCIAL AID TO UNDERGRADUATE STUDENTS



for student aid are being taxed to the utmost; nevertheless, it is gratifying to note that financial aid to the student body during the past year amounted to over $3 million, an increase of 28 per cent over the previous year. This marked increase was due to the cumulative effect of several important factors, including gifts and bequests from donors and friends and the use of unrestricted funds to meet special demands.

Financial assistance to undergraduates amounted to $2,118,575, bettering by some $500,000 the record help for the previous year. Specifically, $969,901 was granted in scholarships; $547,674 in loans; and $601,000 earned in part-time employment on the campus.

FINANCIAL AID TO GRADUATE STUDENTS



At the same time financial support to our graduate students showed an increase of 18 per cent. In all, the Institute awarded 210 fellowships totaling $437,933, and 83 scholarships valued at $104,750. Loan funds assisted 273 graduate students to the amount of $180,131. Including staff awards for teaching and research, grants last year totaled $961,052.

At the close of the fiscal year (June 30, 1959) the capital of the undergraduate scholarship endowment funds totaled $5,682,742, an increase of 6 per cent over a year ago. This growth resulted from various gifts and bequests, including capital funds from Jason E. Bailey, James R. Glazebrook '28, Otto Lindberg, Paul W. Litchfield '96, Mrs. Langdon Pearse, Frederick J. Shepard '12, Albert F. Sulzer, Archer E. Wheeler '95, and the Class of 1934 for the Karl T. Compton Memorial Scholarship.

Although scholarship endowment funds have increased 42 per cent during the last six years, the tuition fee has increased 62½ per cent in the same period. Of the total of $969,901 granted this year in undergraduate scholarships, some $670,000, or 60 per cent, was generously furnished by 117 contributors, including industrial organizations, foundations, fraternal groups, individual alumni, the M.I.T. Alumni Fund, M.I.T. clubs, and other friends of the Institute. It does not seem wise to depend upon "outside" sources for such a high percentage of our assistance, inasmuch as some companies and foundations are planning either to close their scholarship programs or to limit the amount of their awards.

Although we have carefully planned and checked our graduate enrollment, there is a serious shortage in funds for fellowship purposes, particularly at the first-year level in engineering and in architecture. Our industrial fellowships, together with our teaching assistantships and research assistantships, provide support after the first year of graduate study. But in engineering, adequate fellowships are needed to attract more of the able new engineering graduates whose natural inclination is toward industrial employment. A somewhat parallel situation exists in science, but here we need funds to meet the competition from other schools in order to attract the outstanding students. In short, our fellowship resources are becoming inadequate to match our academic resources.

Of prime importance to our total student aid program and also a source of much pride is the Technology Loan Fund, which during the past year made 1,023 loans totaling $727,805, about 43 per cent more than 1957-58.

It is anticipated that during the coming academic year total loans may well exceed $800,000 and that for the year 1960-61 we must be prepared to loan at least $1 million. Clearly, young people and their parents are now readily accepting the loan principle as a means of financing higher education.

At the time of the announcement of the tuition increase effective in 1960, we outlined a new credit plan to begin in September, 1959. This plan provides an extension of credit on any tuition in excess of $1,000; i.e., for 1959-60 amounts up to $300 and for 1960-61 up to $500, with a maximum of $2,000 to any one student in a four-year period. Repayment begins six months after the first credit is extended, with interest at 5 per cent on the unpaid balance. Semi-annual payments will be set to insure that payment will be complete within six years after graduation. This plan will be available to all degree candidates in good standing who are U. S. citizens and who are not simultaneously receiving grants from the Technology Loan Fund. There are no data from which to forecast the demand for this plan, but the experience of the next few years will supply the information on which to judge the usefulness of this credit-extension experiment.

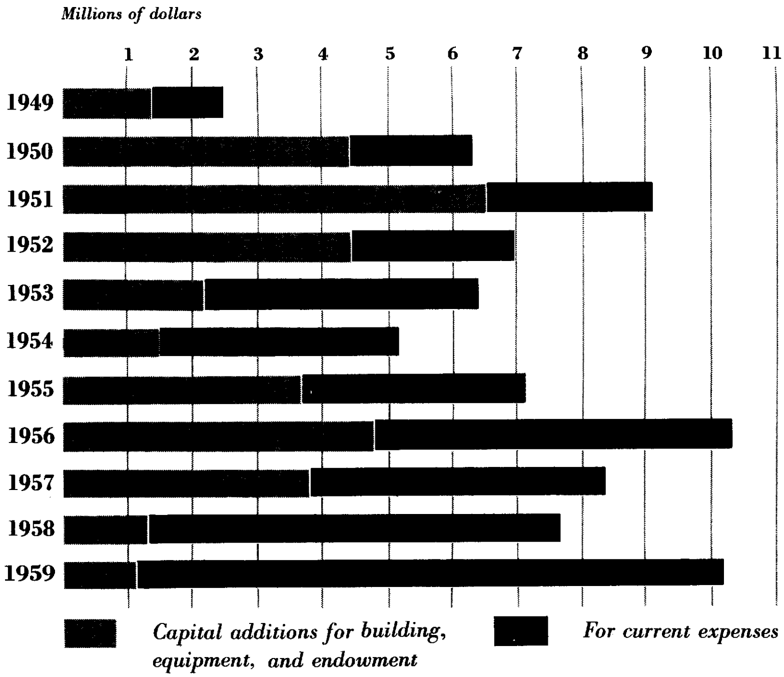
Gifts

Gifts during the past year amounted to $10,006,000, an increase of nearly 30 per cent over the preceding year. This is the second highest sum received by the Institute over the last ten years.

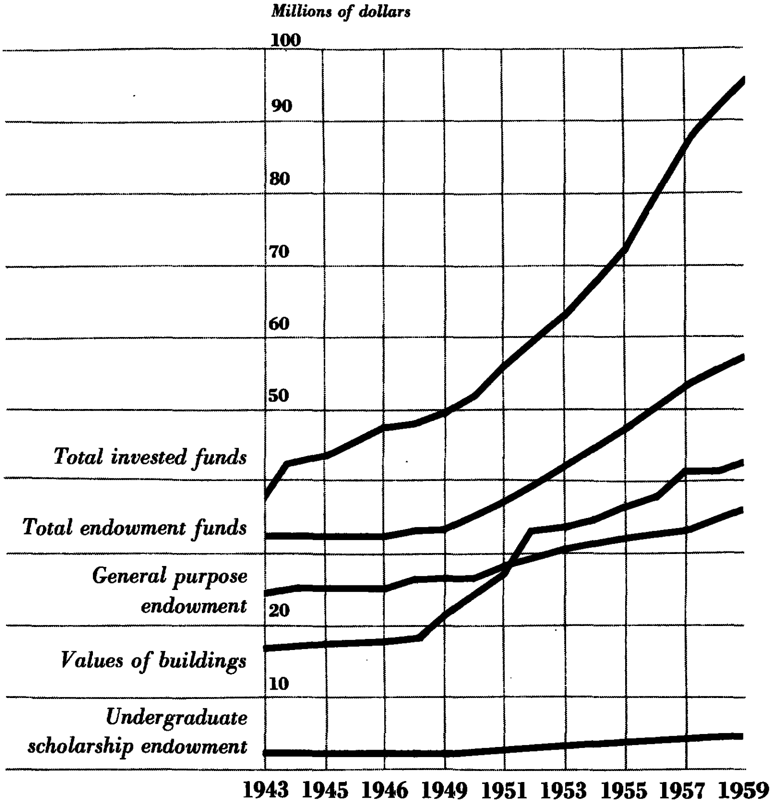
This splendid record of giving included the first receipt of the gift of Dr. and Mrs. Green for the earth sciences program, contributions to the Faculty Salary Fund of $1,991,000, and support of the Donner Chair of Science by the Donner Foundation of Philadelphia.

I would like to make special mention of the Alumni Fund, through which some 15,000 alumni contributed $569,000 for current use of the Institute. This sum is the largest annual total ever given during the twenty-year history of the Fund and marks an increase of about 32 per cent over last year's record.

GIFTS, 1949-1959



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



Corporate support of the Industrial Liaison Program totaled $1,185,000, given by 89 different companies. It is very heartening to receive such generous support, reflecting the Institute's role as an educational leader and industry's confidence in M.I.T. as a center of basic research in science and technology.

Finances

During the year 1958-59, the Institute's academic expenses, not including funds expended on sponsored research, amounted to $23,125,000, approximately 10.6 per cent more than the preceding year. This increase resulted primarily from wage and salary adjustments for faculty and other employees of the Institute.

Sponsored research represents an expenditure of $59,627,000, an increase of nearly 10 per cent over the fiscal year 1957-58. In the campus laboratories, the largest increases have occurred in the Laboratory for Nuclear Science and the Research Laboratory of Electronics. The Department of Nuclear Engineering, with its nuclear reactor operating at full power during 1959, has also shown a large increase in sponsored research over the previous year. In our off-campus laboratories the increase of sponsored research reflects the growth of activity in the fields of missiles and space technology. New projects have been sponsored by the Department of Defense and by the National Aeronautics and Space Administration, as well as by the three military services.

The Institute's investments have a total book value of $97,865,000 and a market value of $155,777,000 as of June 30, 1959. Educational plant assets stand at $44,-179,000.

The rate of income earned in 1958-59 on the funds sharing in the general investments was 6.22 per cent on the average book value compared to 6.20 per cent the preceding year. Of this, 5 per cent was allocated to the funds. The total income on the general and special investments was $4,767,000 as compared to $4,548,000 in 1957-58.

IN CONCLUSION

NO BRIEF ACCOUNT OF PROGRESS such as this can capture adequately the spirit of M.I.T. The quality of this or of any other educational institution is derived from the character of the men and women associated with it. There are many who serve M.I.T. On this occasion I should like to pay particular tribute to our faculty. The pressures of this great enterprise fall largely on them. On the record, we can be confident that in their generous devotion to our common task, we shall reach new heights of achievement.

J. A. STRATTON

PERSONNEL CHANGES TO JULY 1, 1959

CORPORATION

TERM EXPIRATIONS

THEODORE V. HOUSER, *Special Term Member*
HORATIO L. BOND, *Alumni Term Member*
RAY P. DINSMORE, *Alumni Term Member*
WILLIAM J. SHERRY, *Alumni Term Member*
JOHN J. WILSON, *President of the Alumni Association*

APPOINTMENTS

RUSSELL DEYOUNG, *Special Term Member*
GEORGE P. GARDNER, JR., *Special Term Member*
JAMES B. FISK, *Alumni Term Member*
WILLIAM WEBSTER, *Alumni Term Member*
JOHN J. WILSON, *Alumni Term Member*
EDWARD J. HANLEY, *President of the Alumni Association*

CHANGES

VANNEVAR BUSH, *Honorary Chairman*
JAMES R. KILLIAN, JR., *Chairman*
JULIUS A. STRATTON, *President*

FACULTY

Deaths

GEORGE OWEN, *Professor Emeritus in Naval Architecture*
GEORGE A. SWETT, *Professor Emeritus in Mechanical Engineering*
JAMES L. TRYON, *Professor Emeritus*
ARTHUR L. TOWNSEND, *Associate Professor Emeritus in Mechanical Engineering and Director of the Lowell Institute School*
W. RUPERT MACLAURIN, *Professor in Economics*
ALVIN SLOANE, *Associate Professor in Mechanical Engineering*
DUDLEY A. BUCK, *Assistant Professor in Electrical Engineering*

Retirements

SHATSWELL OBER,* *Professor in Aeronautics and Astronautics*
STEPHEN G. SIMPSON,* *Associate Professor in Chemistry*

Resignations

ASSOCIATE PROFESSORS

ALBERTO P. CALDERON, *Mathematics*
ROBERT H. CANNON, JR., *Mechanical Engineering*
JOHN NASH, *Mathematics*
JOHN B. RAE, *Humanities*
JAMES B. RESWICK, *Mechanical Engineering*
MARVIN E. SHAW, *Industrial Management*
HOWARD SIMPSON, *Civil Engineering*
COMDR. JOE W. THORNBURY, U.S.N., *Naval Architecture*

*Will continue as Lecturers, part time, in 1959-60

ASSISTANT PROFESSORS

DENYS O. AKHURST, *Electrical Engineering*
ROBERT R. ARCHER, *Mechanical Engineering*
ALLAN H. BONNELL, *Chemical Engineering*
JAMES H. BROWN, *Metallurgy*
DAVIS J. CHAMBLISS, *Economics*
GREGORY C. CHOW, *Industrial Management*
FRANK B. CUFF, JR., *Metallurgy*
JOHN GRANLUND, *Electrical Engineering*
ROBERT H. GREGORY, *Industrial Management*
LAWRENCE C. HOAGLAND, *Mechanical Engineering*
HENRY C. HORNIK, *Modern Languages*
HOWARD P. JENERICK, *Biology*
PAUL R. JOHANNESSEN, *Electrical Engineering*
JOHN D. LINSLEY, *Physics*
JOSE M. NAVARRO, *Metallurgy*
RONALD E. NECE, *Civil Engineering*
ALBERT H. NUTTALL, *Electrical Engineering*
MAHMOUD RIAZ, *Electrical Engineering*
VINCENT J. ROGGEVEEN, *Civil Engineering*
ALBERT H. RUBENSTEIN, *Industrial Management*
MIGUEL A. SANTALO, *Mechanical Engineering*
H. STEPHEN SPACIL, *Metallurgy*
BERNARD P. SPRING, *Architecture*
GEORGE O. TOTTEN, *Economics*
ROY M. WEINSTEIN, *Physics*
BERNARD WIDROW, *Electrical Engineering*
JOSEPH V. YANCE, *Industrial Management*
WILLIAM A. YOUNGBLOOD, *Electrical Engineering*

Promotions

TO INSTITUTE PROFESSOR

C. RICHARD SODERBERG
NORBERT WIENER

TO PROFESSOR

MARTIN A. ABKOWITZ, *Naval Architecture*
MORRIS A. ADELMAN, *Economics*
RICHARD B. ADLER, *Electrical Engineering*
NORMAN C. DAHL, *Mechanical Engineering*
SAMUEL A. GOLDBLITH, *Food Technology*
EVERETT E. HAGEN, *Economics*
DAVID N. HUME, *Chemistry*
HOWARD W. JOHNSON, *Industrial Management*
T. WILLIAM LAMBE, *Civil Engineering*
SALVADOR E. LURIA, *Biology*
FRANK A. MC CLINTOCK, *Mechanical Engineering*
SAMUEL J. MASON, *Electrical Engineering*
PAUL PIGORS, *Economics*
BRANDON G. RIGHTMIRE, *Mechanical Engineering*
LLOYD RODWIN, *City Planning*
LOCKHART B. ROGERS, *Chemistry*
PAUL N. ROSENSTEIN-RODAN, *Economics*
CHARLES N. SATTERFIELD, *Chemical Engineering*
ISADORE M. SINGER, *Mathematics*
PATRICK D. WALL, *Biology*

TO ASSOCIATE PROFESSOR

EUGENE BELL, *Biology*
LINCOLN P. BLOOMFIELD, *Economics*
EDWARD H. BOWMAN, *Industrial Management*
NATHAN H. COOK, *Mechanical Engineering*
HARALD A. ENGE, *Physics*
CARL W. GARLAND, *Chemistry*
GEORGE N. HATSOPOULOS, *Mechanical Engineering*
HERBERT O. HOUSE, *Chemistry*
LOUIS N. HOWARD, *Mathematics*
VERNON M. INGRAM, *Biology*
EDWIN KUH, *Industrial Management and Economics*
SHIH-YING LEE, *Mechanical Engineering*
ARTHUR L. LOEB, *Electrical Engineering*
JAMES W. MAR, *Aeronautics and Astronautics*
CHARLES L. MILLER, *Civil Engineering*
LOUIS S. OSBORNE, *Physics*
THEODORE H. PIAN, *Aeronautics and Astronautics*
HARTLEY ROGERS, JR., *Mathematics*
FREDERICK SANDERS, *Meteorology*
WILLIAM M. SIEBERT, *Electrical Engineering*
ABRAHAM J. SIEGEL, *Economics*
IRVING SINGER, *Humanities*
ALEXANDER SMAKULA, *Electrical Engineering*
ALFRED K. SUSSKIND, *Electrical Engineering*
GREGORY TUCKER, *Humanities*
H. PHILIP WHITAKER, *Aeronautics and Astronautics*
ROBERT V. WHITMAN, *Civil Engineering*
ROBERT C. WOOD, *Economics*
ROBERT S. WOODBURY, *Humanities*
HERBERT H. WOODSON, *Electrical Engineering*

TO ASSISTANT PROFESSOR

GORDON E. AGAR, *Metallurgy*
CHARLES BATTERMAN, *Athletics*
ABRAHAM BERS, *Electrical Engineering*
KLAUS BIEMANN, *Chemistry*
PIERRE J. BROSENS, *Mechanical Engineering*
ALFRED R. COOPER, *Metallurgy*
JACK B. DENNIS, *Electrical Engineering*
ARTHUR E. FARNHAM, *Athletics*
KENNETH M. HOFFMAN, *Mathematics*
EDWARD M. HOFSTETTER, *Electrical Engineering*
WILLIAM F. HOSFORD, JR., *Metallurgy*
IRWIN M. JACOBS, JR., *Electrical Engineering*
GORDON M. JENSEN, *Humanities*
JAMES F. KAISER, *Electrical Engineering*
HAROLD C. KIRKER, *Humanities*
EDWARD S. KLIMA, *Modern Languages*
ALEXANDER L. LIPSON, *Modern Languages*
PERRY L. MC CARTY, *Civil Engineering*
LEONARD M. MARSAK, *Humanities*
WILLIAM G. MOFFATT, *Metallurgy*
RONALD E. ROSENSWEIG, *Chemical Engineering*
JAMES W. ROSS, JR., *Chemistry*
RICHARD L. SCHOENWALD, *Humanities*
DIETMAR SEYFERTH, *Chemistry*

THOMAS B. SHERIDAN, *Mechanical Engineering*
THOMAS G. STOCKHAM, JR., *Electrical Engineering*
YEHUDA STAVSKY, *Civil Engineering*
JAMES L. STOCKARD, *Aeronautics and Astronautics*
HERBERT M. TEAGER, *Electrical Engineering*
JOHN A. WELSH, *Mechanical Engineering*
WILLIAM M. WHITNEY, *Physics*

Appointments

VISITING INSTITUTE PROFESSOR
MORROUGH P. O'BRIEN

VISITING PROFESSORS
JOHN C. FISHER, 3RD, *Engineering*
ALAN W. BREWER, *Meteorology*
CARL T. DEVINE, *Industrial Management*
THOMAS B. DREW, *Chemical Engineering*
LAWRENCE K. FRANK, *Economics*
JACOB D. GOLDMAN, *Edwin Sibley Webster Professor in Electrical Engineering*
BENJAMIN S. KELSEY, *Jerome Clarke Hunsaker Professor in Aeronautical Engineering*
GEORGE E. LENT, *Industrial Management*
GIUSEPPE P. S. OCCHIALINI, *Physics*
LEONARDO RICCI, *Bemis Professor of Architecture*
JOHN P. ROCHE, *Economics*
TERKEL ROSENQVIST, *Metallurgy*
DONALD J. WHITE, *Industrial Management*

VISITING ASSOCIATE PROFESSORS
ROGER J. BLIN-STOYLE, *Physics*
ANDREW R. HUTSON, *Physics*
MURRAY C. KEMP, *Economics*
STANLEY M. JACKS, *Industrial Management*
JEROME Y. LETTVIN, *Biology*
EMANUEL MAXWELL, *Physics*
W. WESLEY PETERSON, *Electrical Engineering*

VISITING ASSISTANT PROFESSORS
JAMES G. CLUNIE, *Mathematics*
JOHN C. B. HAWKES, JR., *Humanities*
BURTON M. SAPIN, *Economics*

PROFESSORS
COLUMBUS O. ISELIN, *Geology and Geophysics*
WILLEM V. R. MALKUS, *Meteorology*
RICHARD D. SCHAFER, *Mathematics*
HENRY M. STOMMEL, *Meteorology*
WILLIAM S. VON ARX, *Geology and Geophysics*
GERALD B. WHITHAM, *Mathematics*

ASSOCIATE PROFESSORS
LT. COMDR. JOHN R. BAYLIS, *Naval Architecture*
WARREN G. BENNIS, *Industrial Management*
MARTEN T. LANDAHL, *Aeronautics and Astronautics*
WILLIAM F. SCHREIBER, *Electrical Engineering*
ALAN N. STROH, *Mechanical Engineering*

ASSISTANT PROFESSORS

ALI S. ARGON, *Mechanical Engineering*
PAUL H. COOTNER, *Industrial Management*
WALTER R. DAVIS, *Humanities*
ROBERT G. DEAN, *Civil Engineering*
JAMES C. EMERY, *Industrial Management*
ROBERT EVANS, JR., *Economics*
JAMES W. GRAHAM, *Electrical Engineering*
LEE GRODZINS, *Physics*
SIGURDUR HELGASON, *Mathematics*
DANIEL M. KAN, *Mathematics*
CARY J. KING, *Chemical Engineering*
ALAN L. MC WHORTER, *Electrical Engineering*
RONALD MELZACK, *Economics*
ANTHONY M. MLIKOTIN, *Modern Languages*
JOHN R. MYER, *Architecture*
ROBERT E. NEWNHAM, *Electrical Engineering*
GORDON C. OATES, *Aeronautics and Astronautics*
PHILLIPS W. ROBBINS, *Biology*
GIAN-CARLO ROTA, *Mathematics*
ABNER SHIMONY, *Humanities*
ARTHUR C. SMITH, *Electrical Engineering*
EGONS TONS, *Civil Engineering*
MICHAEL A. WALLACH, *Economics*

Air, Military, and Naval Science

RESIGNATIONS

CAPT. JOSEPH S. LEWIS, *Professor in Naval Science*
MAJ. JOHN E. KEATOR, *Associate Professor in Air Science*
LT. COL. LA MONTE A. TUCKER, *Associate Professor in Military Science*
LT. COL. JOHN A. VANDERPOEL, *Associate Professor in Air Science*
MAJ. JOSEPH M. WALTERS, JR., *Associate Professor in Military Science*
COMDR. ROBERT A. WEATHERUP, *Associate Professor in Naval Science*
LT. HERBERT O. BURTON, *Assistant Professor in Naval Science*
CAPT. NORMAN A. JOLIE, *Assistant Professor in Air Science*
CAPT. ALAN D. WHEELER, *Assistant Professor in Air Science*

APPOINTMENTS

CAPT. GEORGE L. STREET, *Professor in Naval Science*
COMDR. ALFRED C. EDWARDS, *Associate Professor in Naval Science*
MAJ. ROBERT A. IRELAND, JR., *Associate Professor in Military Science*
MAJ. CHARLES M. SHADLE, *Associate Professor in Military Science*
COMDR. ROBERT B. GIBLIN, *Assistant Professor in Naval Science*
LT. BASIL F. GRAY, JR., *Assistant Professor in Naval Science*

ADMINISTRATION

RESIGNATIONS

MERRILL J. BAUMANN, *Industrial Liaison Officer*
ROBERT D. HABERSTROH, *Industrial Liaison Officer*
WILLIAM R. WEEMS, *Director of the Industrial Liaison Office*

RETIREMENT

MARGUERITE CHAMBERLAIN, *Science Librarian*

DEATHS

R. COLIN MACLAURIN, *Assistant to the Chancellor*
LEMOYNE WHITE, *Medical Department*

CHANGES

JAMES R. KILLIAN, JR., *Chairman of the Corporation*
C. RICHARD SODERBERG, *Institute Professor*
VOLTA W. TORREY, *Editor of* The Technology Review

PROMOTIONS

GORDON S. BROWN, *Dean of the School of Engineering*
ROBERT J. DAVIS, *Director of the Office of Personnel Relations*
CARL F. FLOE, *Vice President, Research Administration*
VINCENT A. FULMER, *Director of the Industrial Liaison Office*
JULIUS A. STRATTON, *President*

APPOINTMENTS

MARTIN MEYERSON, *Director of the Joint Center for Urban Studies*
RYBURN M. ROSS, *Associate Director of Libraries*
ARTHUR L. SINGER, JR., *Assistant Dean of the School of Humanities and Social Science*
WILLIAM T. STRUBLE, *Assistant Director of Public Relations*

School of Architecture and Planning

DEPARTMENT OF ARCHITECTURE

Last year's report mentioned our sympathy with the proposal that a Junior Division be established at M.I.T. During the past year, the implications of such a proposal were given further thought by our staff, particularly as they might affect present admission policies to our School. It is becoming clear that the current situation in recruitment of students needs reviewing, so far as our School is concerned.

When a school like M.I.T. becomes superlatively well known for science and engineering, the public image created is not one to attract those seriously interested in serving society through creativity in the visual arts. Certainly it would be too much to expect a high school counselor to advise an artistically gifted youngster to come here. It is, of course, desirable that our teaching have its special flavor due to our emphasis on a sound scientific base and to the fullness of our related technical studies, and it is important that our graduates be sought and respected for their knowledge of the behavior of the natural forces at work in buildings; but in a way we are rediscovering the simple, all-important fact that architecture is first and above all a high art, that its field of action is the realm of the spirit, and that you cannot take short cuts or intensive courses to reach depth of understanding. Furthermore, no matter how important scholarly and theoretical considerations may be, the young architect, to become effective, must accumulate that store of experience and human associations which alone will enable him to seek and accept professional responsibilities, so that his education must encompass a wide range of cultural values.

It may be that liberalizing the undergraduate school will result in some change in the public image of M.I.T., so that the list of applications to enter will contain more students with interests outside of science and engineering. This would improve our recruitment in architecture. As it stands now, we are committed to a policy of high selectivity, but we do not have the means to attract superior students, and we lack a proper mechanism for selection. We are, in fact, forced to acknowledge that in the last ten years, although we have strengthened our teaching program and improved the quality of our teaching faculty, the number of students attracted to the curriculum has steadily declined, and their caliber has not improved. Nevertheless, and in spite of all, we remain convinced that it is appropriate to have an undergraduate Department of Architecture at M.I.T. We believe that the persistent efforts of the Institute's administration to broaden its interests are an indication that science and engineering need us, and certainly the reverse is true since architecture is ideally a union of science and art. Perhaps we have not yet fully exploited the advantage of this union here and must continue on both sides to look for profitable interaction.

The progressive advance of specialization in engineering, science, and architecture makes the interaction more difficult to achieve. Various possibilities exist for the improvement of our status through changes in emphasis or methods. Among these, the most promising seems to be a six-year (or longer) program, resulting from the proposal to have undergraduate majors instead of professional Courses during the first four years. Such a program, while having no status with the National Architectural Accrediting Board or with registration boards in the various states, would give students the opportunity to try themselves in directions that are not now permissible within our tight curriculum. Above all, the faculty teaching elementary professional subjects would have a chance to evaluate and encourage this work so that candidates for the professional graduate studies could be selected on the basis of some real proof of ability. This is important because architecture requires such a large portion of a kind of ability not measured by mathematical or verbal reasoning; the correlation between a student's ability to become a good architect and his scholastic aptitude, as measured by high school grades and test scores, is probably less evident for architecture than it is for science or law.

This proposal for an extended program would constitute a major change, and it might tend to exclude still more students who cannot afford so long a program; but there also seem to be many real advantages, particularly in allowing the existing influx from liberal arts colleges to grow and thus bringing variety and strength to the Graduate School. This would also conform with the general movement of most of M.I.T.'s professional studies towards the graduate level.

Research Activities

Under the direction of Professor Eduardo Catalano, advanced students were engaged in laboratory testing of full-sized structures with compound surface curvature, built of light metals, by methods similar to those used in airplane construction. Through this activity, we attempt to prepare our students to meet the challenge presented by new industrial processes, new materials, and new techniques. Aided by the Reynolds Aluminum Company, two aluminum shells were built on the Institute premises. They were prototype hyperbolic paraboloids built with straight extruded shapes, riveted along their edge-ribs, 25 x 25 feet in size, 1/16 inch in thickness, and 2.5 pounds per square foot in weight. They represent the first aluminum shells built through aeronautical techniques and are intended to be used for sheltering industrial plants. Present studies and industrial facilities allow for a maximum span of about 50 feet. As part of the same subject in Architectural Design, a small model, 4 x 4 feet, of reinforced concrete rule surface structure was tested to failure, and the stresses developed were measured by the use of strain gages.

Staff

This year, through the support of the Bemis Fund, we had with us again Joseph Hudnut and Lewis Mumford, and, for his first visit to M.I.T., Ludovico Quaroni of Italy. We gained a new staff member, Maurice K. Smith of New Zealand, and had as visiting lecturers on landscape design Dan Kiley, Hideo Sasaki, and Peter Walker. Also visiting was B. V. Doshi, architect from India.

DEPARTMENT OF CITY AND REGIONAL PLANNING

Teaching Program

Enrollment in the Department of City and Regional Planning has again increased to a new peak: 37 Master's candidates, 2 Doctor's candidates, and 4 special students, totalling 43 (of whom 41 were full-time). Since drafting-room and class-room space as well as faculty numbers have not been increased for several years, overcrowding of facilities is serious, and overburdening of staff is becoming so. (The ratio of full-time students to full-time teaching staff is about seven to one.)

In addition to the start of the Ph.D. program, the Department has completed the revision of the M.C.P. curriculum, begun last year when the core workshop subjects were revised.

The attempt has been to compress the requirements (except for workshop and thesis) almost entirely into the first year. Required subjects number twelve (plus thesis) instead of the previous fourteen and are intended to cover the professional core from which no M.C.P. candidate would be excused and for which few would have prior credit. These subjects deal with physical, social, economic, and legal aspects of the urban and regional environment — the forces that shape it, the goals and methods for its improvement.

Normally there would be no electives during the first term, one in the second, and two or three each in the third and fourth — a normal total of six elective subjects to be chosen from among the nine already offered in the Department, plus others elsewhere.

The Visiting Committee met in February, assisting in review of curriculum modifications as well as discussing problems of student recruitment and scholarship aid. Although applications for admission continue at a high rate (more than four times the Department's capacity for entering students), attempts to attract top-quality candidates are still hampered by the inadequacy of scholarship and fellowship resources, which is particularly acute in a field with almost no "industry" support.

Research Activity

This year saw the establishment of the Joint Center for Urban Studies of M.I.T. and Harvard, with a substantial Ford Foundation grant. This new research agency, now independent of the Department, was largely a product of the Department's efforts to expand much-needed urban research; it will contribute materially to both teaching and research in the Department and will draw heavily upon the Department's resources of faculty and advanced students.

Staff

Architect-planner Albert Mayer served as part-time Bemis Visiting Professor in charge of one of the workshop problems in the fall term. There have been no changes in permanent faculty personnel; Associate Professor Lloyd Rodwin was promoted to the rank of professor.

J. M. Fraser, recently retired manager of the Singapore Improvement Trust, visited the Department as the second distinguished foreign visitor under the grant of the Robert D. Kohn Fund.

Faculty members have continued to take significant part in the activities of the American Institute of Planners. (Two of the staff are past presidents.) Professor Frederick J. Adams was Chairman and Professor John T. Howard a member of the Committee on Functional Divisions; Professor Roland B. Greeley served on the Membership Committee, and Professor Howard on the Journal Advisory Board.

The staff has also contributed services to many civic endeavors in the Boston metropolitan area. Professor Adams was a member of the Advisory Committee of the Cambridge Civic Association and of the Traffic Committee of the Citizens' Action Committee of Cambridge. Professor Greeley was a member of the Standing Committee of the Massachusetts Trustees of Public Reservations. Professor Howard served on the Metropolitan Planning Committee of the Greater Boston Chamber of Commerce and with Professor Rodwin on the Research Advisory Committee of the Greater Boston Economic Study Committee. Professor Burnham Kelly was Vice Chairman of the Housing Association of Metropolitan Boston. Professor Howard addressed half a dozen local organizations on various planning subjects.

Within the Institute, Professor Rodwin was appointed chairman of the Joint Faculty Policy Committee of the new M.I.T.-Harvard Joint Center for Urban Studies, with Professor Howard also a member. Professor Greeley was chairman of the Faculty Committee on Student Environment; Professor Howard served on the Long Range Planning Committee and the Student Aid Board.

In other national professional activity, Professor Howard was a member of the Construction and Civic Development Committee of the U. S. Chamber of Commerce and the Committee on Priorities of the National Committee on Urban Transportation. Professor Kelly served on the Research Committee of the Building Research Institute, and Professor Rodwin as Associate Editor of *Daedalus*, Journal of the American Academy of Arts and Sciences.

Faculty members participated in many national and international conferences, delivering papers at such events as the following: The National Conference on Highways and Urban Transportation; the Cornell Planners Conference on City Planning and Highways; Harvard Conference on Urban Design; the Baltimore Chapter of the American Institute of Planners; the Canadian Town Planning Institute; the Building Research Institute; the Michigan Society of Architects; the American Institute of Architects — National Science Foundation Conference on Architectural Research; and the United Nations Seminar on Regional Planning in Tokyo.

All of the members of the Department faculty engaged in consulting activities during the year, ranging from professional work with Boston and its suburbs to advisory expeditions to Bangkok and Venezuela. Bernard Frieden, Instructor, spent the second term on leave working with the Rotterdam city planning department in Holland. This outside work has continued to enable the faculty to bring to the students current progress in professional practice and research.

PIETRO BELLUSCHI

School of Engineering

THE NATIONAL ENROLLMENT SITUATION in engineering continues to occupy the attention of engineering educators. It is impossible to avoid concern over the fact that engineering enrollment declined by about 8,000 during the academic year in question. Normally such changes in enrollment might be viewed as fluctuations in the statistical picture, but no real comfort can be derived from such conjectures. It is well to remember that the age class ready to enter college is now increasing by approximately 50,000 males per year. The national significance of science and engineering is also beginning to be sensed by large segments of our population. When in the face of such facts the enrollment in engineering drops, even during a single year, there is indeed reason for deep concern. The situation is under study by many agencies in engineering education. The statistics of the academic year 1959–60 will be watched with much interest. Whatever the results, however, it is a matter of good sense for the engineering profession to realize that it will be called upon to change its basic attitudes much faster than heretofore. This subject will be discussed further in connection with the comments on the philosophy of engineering education.

There was a decline of 150 students to 3,537 in the total enrollment in engineering at M.I.T. Undergraduate enrollment declined by 223 students to 1,992, but this drop was compensated by an increase of graduate enrollment of 73 to 1,545. The principal reduction in undergraduate enrollment took place in the departments of Chemical Engineering, Electrical Engineering, and Aeronautics and Astronautics.

At the doctoral level the position of the Institute continued to increase. The number of Doctor's degrees in engineering was 85, which represents 11 per cent of the total of engineering doctoral degrees for the nation as a whole.

As I noted in the report of last year, the class of 1957–58 encountered a marked change in emphasis and attitude on the part of companies seeking graduates. To a lesser extent this change has continued for the class of 1958–59. In 1956–57, 448 employers visited the Institute in connection with placement, an all-time high. The figure for 1957–58 was 404; for 1958–59 it had dropped to 335. However, the placement situation has also come to be viewed somewhat more realistically by these companies.

This situation has also brought about wholesome changes in the undergraduate student's approach to the search for a job, as reported by the Placement Officer elsewhere in this book.

The Committee on Engineering Education

The Committee on Engineering Education, under the leadership of Professor Edwin R. Gilliland, has continued its earnest work in forging a new path for engineering education at M.I.T. In an interim report which was submitted just before the close of my tenure as Dean of Engineering, the Committee emphasized particularly the need for students with a broader interest in scientific and engineering fundamentals. The phenomenon of falling enrollment in engineering marks a trend which may accelerate further unless the School takes bold action. With regard to the academic program, the Committee urges bold experimentation but is not yet ready to make specific recommendations. With regard to the staff, the Committee urges a wider and more regular program of sabbatical leaves to avoid the risk of intellectual obsolescence.

During the summer of 1959 the Committee is sponsoring an interdepartmental group for the study of a Course in undergraduate engineering thermodynamics. Another group will analyze the important area of synthesis and design.

Personal and Professional Notes

Most personal and professional information is given in the reports of the heads of departments. Only a brief resume can be given here.

During the year the School of Engineering suffered a great loss in the untimely death of Assistant Professor Dudley A. Buck, one of the most promising young men in Electrical Engineering. We also record the deaths of two long-time members of the mechanical engineering faculty: Professor Alvin Sloane, who taught applied mechanics at M.I.T. for thirty years and was Secretary of the Faculty at the time of his death; and Professor Arthur L. Townsend, a member of the department since 1919 and Director of the Lowell Institute School since 1944.

The following honors have come to department heads in the School of Engineering. Professor Manson Benedict was appointed by President Eisenhower to a six-year term on the General Advisory Committee to the Atomic Energy Commission. Professor Gordon S. Brown received the Lamme Medal of the American Society for Engineering Education. Professor John Chipman was elected President of the Metallurgical Society of the American Institute of Mining, Metallurgical and Petroleum Engineers. Professor C. Stark Draper was made a Fellow of the American Rocket Society and received the following awards during the year: the Blandy Medal from the American Ordnance Association; the American Honorary Fellowship for 1958 of the Institute of the Aeronautical Sciences; and the Godfrey L. Cabot Award of the Aero Club of New England. Professor Laurens Troost received, on behalf of M.I.T., a Medal of Merit from the Brazilian Federal Council for Engineering and Architecture, "For help in forming a school of naval architecture and marine engineering," (Brazil's first). Professor John B. Wilbur was appointed a member of the Steering Committee, National Transportation Policy Panel, of the Engineers Joint Council.

Associate Dean Stever presented the first T. A. Boyd Lecture at the College of Engineering, Ohio State University.

Dean C. Richard Soderberg was made Knight of the Order of the North Star by the King of Sweden.

Dr. John C. Fisher, 3rd, Visiting Professor of Engineering, was invited to give the H. W. Gillett Memorial Lecture of the American Society for Testing Materials.

Dr. George P. Sutton served during the year as Jerome C. Hunsaker Professor, and at the conclusion of this appointment was appointed Chief Scientist of the Advanced Research Projects Agency.

Professor Edwin R. Gilliland received the Award in Industrial and Engineering Chemistry of the American Chemical Society.

Professor Thomas K. Sherwood was invited to be the Priestly Lecturer at the Pennsylvania State University.

Professor Morris Cohen was invited to present the Carnegie and Seuveur Memorial Lectures of the American Society for Testing Materials.

The activities in the Research Laboratory for Electronics have continued to enrich the intellectual atmosphere of the School of Engineering. This year there were a number of first-rate Bachelor's theses, in addition to the usual Master's and Doctor's contributions.

The Communication Sciences Center, now in its second year, is an important part of this activity. This Center provides the agency for research pertaining to the human communications system, including such diverse subjects as information theory and coding, artificial intelligence, biophysics, linguistics, and psychology.

Professors William P. Allis and Sanborn C. Brown of the Physics Department have had active groups working in the field of microwave gas discharge, supported by the Atomic Energy Commission. The national missile projects have encountered plasma problems both due to shock wave ionization and to the natural ionization in the ionosphere; this, added to the general AEC declassification of the thermonuclear project, has greatly increased the interest in plasma problems. Six departments (Physics, Electrical Engineering, Mechanical Engineering, Nuclear Engineering, Aeronautics and Astronautics, and Mathematics) are now concerned. As a result, the funds previously available in this field from the AEC and Air Force were insufficient; it became desirable to pull together the entire plasma effort at M.I.T., both to make the specialized knowledge of the separate departments available throughout the project and to be in a position to seek more funds. Accordingly, President Stratton has appointed a Plasma Dynamics Committee consisting of Professors Allis (Chairman), Sanborn Brown, David J. Rose, Ascher H. Shapiro, and Jerome B. Wiesner. This committee sought and obtained support from the National Science Foundation in the amount of $500,000 for two years.

A similar consolidation is soon due to take place in the field of materials at M.I.T. This field has been examined during the year by a group headed by Professors Nicholas J. Grant of Metallurgy, John C. Slater of Physics, and Arthur R. Von Hippel of Electrical Engineering. Their studies have resulted in a report which is the basis for an appeal for financial support in the field of materials.

Aeronautics and Astronautics, the new designation for Course XVI, has shown many significant developments. The immediate concern is to give adequate attention to the problem of propulsion, particularly as related to space exploration and military missiles. During the year the Department, under the chairmanship of Associate Dean Stever, gave a series of seminars on space exploration, in which leaders from a variety of fields lectured on their specialties.

Chemical Engineering continued in its development of a freer curriculum, affording a greater possibility of electives by individual students.

Civil Engineering has forged ahead in clarifying its mission in engineering education. Of particular interest are the activities in photogrammetry and in transportation.

Electrical Engineering has reached the near conclusion of its final plans of curricular development. Perhaps the most significant phase at present is the development of an engineering science option in Course VI-B, which has grown rapidly during the years. The Department received a special award of the Westinghouse Educational Foundation in recognition of the excellence of the Electrical Engineering curricula.

Mechanical Engineering is continuing its development toward a curriculum in the mechanical engineering sciences. In parallel with this, the Department is also making major efforts in the field of synthesis and design.

Metallurgy has continued in its efforts to broaden its base in relation to materials. As part of this, the Department initiated a graduate degree in materials engineering, for which students will be enrolled in the fall of 1959. The department has also continued its development toward a curriculum with greater freedom of electives.

Naval Architecture and Marine Engineering is giving attention to the new developments of this field, which is destined in the near future to undergo major shifts of emphasis. The most significant aspects are the development of nuclear propulsion, the altered outlook in marine transportation in general, and many new technical problems, such as that of structural design.

Nuclear Engineering, the newest of the departments, has examined the premises for its expansion in the years immediately ahead. Its major facilities, particularly the reactor, are now nearing their completion, and the problem is to establish the appropriate rate of expansion. A decision was made during the year to proceed at a somewhat slower rate than that which might be set by the availability of outstanding students. Even with this slower pace, the future of the department appears promising and exciting.

A PHILOSOPHY OF ENGINEERING EDUCATION

Since this report covers my last year as Dean of Engineering, it seems appropriate to take stock of the attitude towards engineering education which has evolved from the experience of the last five years.

The major points were developed in a report presented to the faculty in engineering at the meeting on March 21, 1959, in a report entitled, "A Proposal for Experimental Developments in Engineering Education." I wish to acknowledge the great contribution made to this report by the colleagues who labored with me on its preparation. The following discussion is based on this report but contains also points of emphasis expressing my personal opinions.

M.I.T. in the Postwar Years

The past two decades have been of unusual significance to M.I.T. as a whole. Broader objectives have been set for the undergraduate program; foundations have been laid for the development of strong graduate and research programs in all fields. In the same period, the Institute's increased involvement in industrial, social, and military issues at the national level has led to great changes in the intellectual way of life of both faculty and students.

Our scientific and technological environments have been enriched by interdisciplinary activities involving engineers, physicists, chemists, and mathematicians in common problems of research and development. This kind of activity began with the Radiation Laboratory and the Instrumentation Laboratory during the war and has continued in many other laboratories.

Our environment has been enlarged in scope by the founding of the School of Humanities and Social Science in 1950 and the School of Industrial Management in 1951, to supplement the older Schools of Engineering, Architecture and Planning, and Science. These actions were initiated by the Report of the M.I.T. Committee on Educational Survey of 1949, which proposed that the Institute should concern itself with a greater variety of the problems posed by our technological age. Perhaps the most important of the ideas fostered by this report was that the undergraduate school should provide a liberal education with concentration in some branch of science or technology, rather than a limited professional training focused solely on vocational ends. Thus there emerged the concept of M.I.T. as a university of special objectives.

In 1951 the university concept moved forward with the establishment of the Center for International Studies, where scholars in economics, humanities, international relations, and communications have federated to benefit from one another's expanding knowledge and to cope with larger problems of human need. This was the forerunner of a series of similar undertakings which appear destined to play a most important role in the future.

The School of Engineering

Within the School of Engineering, the most significant trend of the past two decades has been the expansion of graduate education and research. We have also greatly strengthened the interdependence between these activities and undergraduate education. A large proportion of our graduate students are also junior members of the teaching staff; as such, they participate as partners to the faculty in research, and aid in the teaching of undergraduates.

Many of the older specialized disciplines in engineering have been merged. Sanitary Engineering and Building Construction, for example, are now part of the Department of Civil Engineering. Some of the specialities have changed character in response to altered emphasis. Mining Engineering and Electrochemistry have been absorbed in Metallurgy. Nuclear Engineering has been added as a graduate department in response to the needs of the times.

Each engineering department has, in its own way, striven to adapt itself to the new technological scene. The Department of Electrical Engineering, for instance, has struck out adventurously on the theme of an "open-ended" education in the scientific roots of electrical technology as a preparation for continual professional growth and adaptation to ever-changing developments. Similar efforts with other directions of emphasis have taken place in the other departments of the School.

During my tenure as Dean of Engineering, we have endeavored to apply this initiative to problems which involve the School of Engineering as a whole. The School is a formidable instrument in engineering education, but its efforts tend to be fragmented by the rigid departmental structure. However, there is emerging a sense of common purpose and a climate of opinion through which the larger issues can be explored. I feel sure that this sense of common purpose will be strengthened during the coming years.

The Committee on Engineering Education has been studying, for the last three years, the means by which the School can develop in order to fulfill the functions of M.I.T. and to meet the needs of the nation in the years ahead. The Engineering Science Curriculum Study and the Materials Science Study, which were conducted in the summer of 1958, were significant efforts in interdepartmental activities. For various reasons the School as a whole was not quite ready to continue with the momentum thus gathered in this direction, but I look to renewed efforts of this kind in the near future.

From these activities we have gained a much clearer picture of our possibilities and our potentials as we strive to adapt the activities of the School to changing times. We have also come to see that schools of engineering everywhere have greatly underestimated the difficulty of developing as well as of implementing the new philosophy needed. The national developments of the last two or three years bear ample evidence that the position of the engineering profession may be weakened unless it finds it possible to respond by vigorous developments in professional education.

The Emergence of Professional Education in Engineering

We have already seen profound changes in the basis for the education of engineers, but few of us realize how far these changes have already taken us.

Engineering began to emerge from its vocational origin less than a hundred years ago. The major objectives of the early ventures in engineering education in the United States were to train useful servants to the emerging industry. The dominant point of view was that the School should make a young man proficient in current art and practice, so that upon graduation he could take his place promptly as a productive member of the industrial community.

The developments in technology during the nineteenth, and even into the twentieth century, were slow enough to give substance to the illusion that what a man learned in school would remain valid during his entire professional life. All education, of course, must have some such faith, and at the vocational level of activity there are still good grounds for it. The plumber, the carpenter, the mason have been trained in this spirit over centuries.

The professional outlook, however, must above all be related to the reality of continuous change, and on this level the facts of current art and practice may be outdated even while the young man is in school. It has become clear to us during recent decades that at the professional level, education must address itself particularly to competence in facing the unknown future. The future engineer must be encouraged to accumulate competence in facing completely unknown problems and developments, and in using scientific discoveries which were not even dreamed of when he went to school. In simple language, he must be equipped by temperament and training to learn throughout life. It is strange that in the seething atmosphere of America of the last century, this obvious conclusion should have been all but forgotten.

While this applies to all professional education, it seems that the engineering profession, which needs this faith more than any other, has been particularly deficient in its practical application.

Part of the trouble is due to the traditional adherence to vocational objectives; part of it is due to the illusion that real competence in engineering can be attained in four years of undergraduate study. Not only did undergraduate education fail to reach the assumed objective, but it also failed to provide the one competence needed above all: the competence to continue effective studies at the graduate level.

The most potent reason for the present situation, however, is the constantly accelerating pace of development in science and technology during the recent decades. By these changes the very structure of the engineering profession is undergoing profound alteration. The subdivision into mechanical, chemical, electrical engineering, and so on, which appeared as a logical answer to the needs of the nineteenth century, is already dissolving, but in many instances it still stands in the way of the broader objectives which are needed in the latter half of the twentieth century.

Changes in Patterns and Pace of Technology

The changes in engineering tempo that have invalidated the original premises on which engineering education had so long rested have obviously been great; how great can most easily be demonstrated by an historical example. Consider, for instance, the history of man's utilization of energy. Until about a century and a half ago the available sources of energy — human beings, animals, wind, and falling water — had remained unchanged, and the methods for converting this energy to useful work had scarcely altered, in a thousand years. The long period of stability was first interrupted by the introduction of the steam engine. This engine was in its first conception only an unpretentious application of simple mechanical ideas; but it happened also to be the first practically significant conversion of heat into mechanical work. The natural desire to understand this engine and to increase its efficiency was the seed from which grew the science of thermodynamics. It was well over a century, however, before the principles of the science could be lucidly described. In the course of this same century, the hot air engine, the internal combustion engine, the steam turbine, and the diesel engine all developed slowly but steadily. But these devices, like the steam engine, were not so much the product of thermodynamic principles understood and consciously applied, as of intuitive invention and empirical development. Not until the 1930's, more than one hundred and fifty years after the introduction of the steam engine, did the development of the technology and the formulation of principles appear complete. At that time there seemed little more to do in the field of energy conversion and utilization.

World War II and its aftermath upset precipitously this apparent plateau in development. For instance, there occurred the development of the gas turbine for jet propulsion of aircraft. The history of the jet engine is in some ways like the history of the steam engine in the past century. It too acted as a stimulant to investigation. By its existence it directed scientific curiosity into the fields of materials, internal aerodynamics, and combustion. It too displaced other existing forms; today all military aircraft and, increasingly, commercial planes are powered by jet engines. It too exerted an influence on other forms of energy conversion, in particular upon the older field of central-station power.

But the differences in the histories of the two engines are more illuminating than the similarities. The jet engine was not the invention of some intuitive individual working in ignorance of the scientific principles involved. The men who made it could draw upon a great reservoir of scientific and technical information. Familiar now with thermodynamics, they could draw also upon indispensable new findings in fluid dynamics and metallurgy. While the jet engine represented a more daring excursion into technological innovation at the borderline of feasibility than was ever faced by central-station prime movers or by piston engines, it was brought to a plateau of development, and indeed it began to dominate the field of aircraft propulsion in the brief span of about fifteen years.

Another example is afforded by the direct conversion of heat into electrical energy. The thermocouple was invented by Seebeck in the 1820's. Unwittingly, Seebeck achieved with the thermoelectric junction thermal efficiencies comparable to those of the then-contemporary steam engines, but the long-range significance of his accomplishment could not then be forecast. As an energy conversion device, the thermocouple lay virtually unused for a century. Not until certain theoretical developments had taken place in solid-state physics and quantum mechanics, not until certain devices like the semiconductor and the transistor had been invented, was it possible to think seriously of the thermocouple as the basis of a new and remarkable system for direct electric-power generation. While the essential new discoveries have occurred only within the past decade and a half, industrial applications are now imminent. The same is true of energy conversion by magnetohydrodynamic means and of fuel cells, which also have been known for a considerable period.

Perhaps the most striking example of the new pace of technological development relates to energy from nuclear fission. Here, the application of science and engineering on a vast scale compressed into a few years a development process which under the old conditions might have required many decades, or which might have been impossible altogether. We are now hopeful that energy from nuclear fusion will soon also become available as the result of a similar intensive effort.

It seems clear from these typical experiences that we are at the beginning of a new era in technological development, the signature of which is the organized forcing of development change, in the same sense that the concept of invention itself was the signature of the first industrial revolution. It is essential that the engineer's education enable him to participate in this process effectively. But he can do this only if he has a thorough grounding in the physical sciences. He must also be prepared in a turbulent profession to learn throughout his life. For example, the propulsion man who began with piston engines in the aircraft industry and went on to turbojet engines must now inform himself about rockets, and he is already facing the challenge of magnetohydrodynamic, ionic, and photon engines.

But the engineer is today not merely the agent of rapid change in his own profession; he is also the efficient cause of rapid change in the economic, social, and cultural environment that has been built on technology. Every shift in emphasis or direction within the field of engineering determines some shift of emphasis or direction in society. The education of the engineer today must prepare him to act intelligently and constructively as a determining influence in the shaping of the society of which he is a member.

The New Needs in Engineering Education

What kind of education will serve the new circumstances? A rapidly evolving technology has left the traditional forms of engineering education obsolete in several respects. The older engineering categorizations such as mechanical, civil, and electrical engineering are no longer as meaningful as they were in the past century; most engineering undertakings now cut across several of these fields and reach deeply into scientific and social areas as well. But even more important is the fact that all engineering activities, regardless of field, rest on an ever-increasing foundation of mathematics and science. While there is a clear need for a much more extensive scientific base for all engineering education, there is also an equally clear need for a much deeper penetration into the various aspects of the engineering specialties. These requirements can be met only by a broader undergraduate education, one which gives the future engineers adequate preparation for more penetrating graduate studies and research.

With the advance into a more intellectually based education, the engineer must still retain his essential motivation as a man of action. Above all, he must develop a high order of versatility in the application of new knowledge to practical problems.

It is not enough for the engineer to learn, or to discover, or to explain. He makes things, and he makes things that have to work. In earlier days, it was not as difficult to fit the training for this purpose into an educational program. When technologies were reasonably stable, during the one hundred and fifty years which were required to refine the machinery of the steam engine, it was possible to think of teaching students how to build things by indoctrination in the current practice. This is no longer possible. The new findings of science are acting steadily to change the shape of technologies. When an engineer sets out to build something today, he frequently builds something new, something never built before. To build something new that works reliably is very difficult. It requires the creative capacity to organize information and material into a particular system to do a particular job. This is an art — and art, whether in words, notes, paint, or material, is most difficult to teach. For this reason it is highly important to continue to search for new ways to teach this art in the academic framework.

But the most potent way to learn it is by doing it, and by doing it under real conditions in company with those who are themselves active in creative work. Unfortunately, authentic situations in engineering are difficult to produce in an educational institution without careful attention to the circumstances of academic work, and if they are produced, they may hinder the attainment of the real goals of engineering education. The concern for the finite, the particular, and the operational success works against the interest in the abstract, the general, and the speculative which also give life to the mind.

Fortunately, research on the one hand, and design and synthesis on the other play complementary roles. Both deal with a reality which refuses to be molded into the tidy packages of academic formalism. Both call for imagination and originality. Both require sustained and patient effort for success. Extensive programs of experimental research yield a store of real and purposeful problems. Students associated with such research and confronted with the job of designing and building the novel apparatus required can exercise the skill, the imagination, and the independence that are the very life of synthesis and design. They can also develop the habits of the inquiring mind and the intellectual excitement that are the assumed end of any educational institution. But to teach research and creative engineering in this way takes time and money, much more time and much more money than engineering schools have ever been able and willing to spend on this kind of education.

Engineers find careers in a great diversity of jobs: design, research, development, teaching, manufacture, management, sales. What binds these very different activities together is the common theme of technology. While the education of engineers for any of these careers necessarily includes many common elements, the variety of both talents and interests within our population, as well as the diversity of needs, justifies the existence of engineering schools having quite different objectives. Moreover, this diversity should find its expression also within individual schools: some young men have strong creative talents in design, others have the gift of grasping abstractions; some can profit from advanced graduate training, with others the undergraduate degree suffices for the needs of their careers; some have the gift of intellect to "leapfrog" the ordinary academic pace, the rest must follow the well-tried routes. The most important objective is that the educational process give scope for and encourage the development of the unique abilities and traits of character inherent in each young man.

To accomplish the new objectives and also to carry on the present tasks of our technology, the nation must find it possible to draw more fully upon its great diversity of intellectual and material resources in the service of engineering education. Of the more than two hundred engineering schools in the country, only a few have reached the point in their development where the educational program goes beyond the undergraduate training into graduate education and research. It is important to bring as many as possible to the point where they can serve effectively in training engineers who will improve technology and society, but it is equally important that the other engineering schools be given support for more limited objectives. The diversity of need, desire, and opportunity, educationally and professionally, is so great that no single statement of what our engineering education ought to be will serve the nation as a whole.

The new needs in engineering education imply also a willingness on the part of the nation to dispense with some of its outworn ideas of equality in education and to give serious attention to the highest development of qualities of intelligence and character.

Finally, one of the greatest needs in engineering education is a willingness to experiment in education and to forego the idea that the old academic traditions are immutable.

The reshaping of engineering education which must come about should, in summary, be guided by the recognition of the following facets of the problem:

1. The time period between fundamental advances in physics, chemistry, biology, and mathematics, and their useful exploitation, has been greatly compressed. Moreover, it continues to shrink.
2. New technological developments rest increasingly on a broad and deep command of scientific knowledge and on the capacity for creating new knowledge through research.
3. The massive research and development effort is now the hallmark of our technological environment. Research and development has in fact become a great new industry, one which desperately needs men whose education has not been bound by traditional and disciplinary barriers.
4. Effectiveness in engineering at the frontiers now depends strongly on training at the graduate level. Only a very few undergraduate programs in engineering now provide an adequate preliminary to graduate work.
5. The social and economic upheavals now brought about by scientists and engineers make it imperative to educate our young engineers with an awareness of the social and economic consequences of their actions.

The principal task, then, is to develop in our most promising young engineers the capacity to lead future technologies, the very nature of which is essentially unknown during their period of formal education.

The Task Ahead

Just as scientific and technological institutions were created a century or more ago in response to the Industrial Revolution, so they must now change drastically in response to the current technological revolution. The developments of the past decades at M.I.T. have in many respects anticipated the changes needed for this transition, but they must now be further accelerated and diversified. It is particularly in the field of engineering education that the changes must be far-reaching and, indeed, radical.

These changes must involve all facets of our activities. We must create several forms of new curricula. This requires a setting in which students and faculty can work as partners, where the learning process applies to the professor just as much as to the students.

We must also give more attention to the emotional needs of the undergraduate students. There has been apparent, among some of our students, a listlessness and lack of purpose which is in sharp contrast with the needs of the times. The important developments of the future in the direction of more demanding study programs might make this situation worse. The real solution, I believe, is to do much more than formerly in assimilating the undergraduates into the real M.I.T. environment, treating them as colleagues and partners, albeit junior partners, and not as boys and burdens. We must find ways to give students a life shared with other students and faculty members in a community of continuous scientific adventure.

No less important is the task of strengthening the general education of future leaders in engineering. There has been much progress at M.I.T. in this direction, but the process must go much further before it can be really effective. It is not so much a matter of changing the formal allotment of cumulative time for science, humanities, and social sciences as of interlacing these disciplines with the common theme of engineering and technology.

It has been clear for some time that the new objectives can only be attained by shifting some of the emphasis on professional matters to the graduate school. M.I.T. has led in the development of graduate education in engineering, and this must be the major direction of emphasis in the future. To give real strength to graduate education in engineering, however, it is necessary to develop an undergraduate curriculum which provides the best preparation for graduate work. Up to now graduate education has been no more than an extension of the undergraduate program. The experience of recent years has strengthened the conviction that the full development of graduate education in engineering is now hampered by lack of undergraduate preparation. For this reason, I believe it is entirely proper for M.I.T. to give much attention in the years immediately ahead to a superior undergraduate education as well as to continue the development of graduate education.

The major directions of emphasis indicated for the strengthening of engineering education appear to be as follows:

1. Develop undergraduate curricula of greater depth and breadth in the engineering sciences, both within and across departments.

2. Bring about the involvement of undergraduates as well as graduates in our research and engineering enterprises.
3. Create new research centers in those frontier areas in engineering which require the interaction of several disciplines.
4. Create special programs for highly gifted students.
5. Experiment with new methods of teaching and learning in such directions as wider use of classroom demonstrations, films, and tutorial instruction, and strengthening of the laboratory as an educational device.
6. Collaborate with sister institutions in the nation-wide problems of upgrading the education of engineers.

In the realm of curricular development, the most urgent of these at the moment is the creation of a strong interdepartmental program in the engineering sciences. While the Institute has always put special emphasis on the scientific aspects of the curriculum in engineering, it now runs the risk of losing its lead in this respect. The size and diversity of the School of Engineering mitigates against strong interdepartmental efforts. The experiences of recent years have given us an indication of the difficulty of creating such a program without serious conflicts of interest with the departments. It is also becoming clear that real strength in the engineering sciences can be attained only when the subjects are freed from the older fragmentation along departmental lines. After much study of this question, I have come to the conclusion that a department of applied science would most rapidly lead to the desired results. Whatever means are eventually chosen, I consider the resolution of the dilemma created by the problem of applied science in engineering to be one of the most urgent tasks at the present time.

When these objectives have been accomplished in the undergraduate program, we will face the real problem of professional education in technology and engineering. With graduates of the wider background afforded by a better undergraduate education, it will be possible to give real strength to the professional program. Such domains of technology as communications, energy, materials, and transportation already call for a broader approach, not only with respect to the underlying sciences, but particularly in the interrelated aspects of engineering, economics, and sociology. As these broader syntheses come into existence, they will also provide the inspiring material needed for the engineering component of undergraduate education. I consider it highly important that this task be carried on in parallel with the others.

It is impossible to contemplate the vistas ahead for the School of Engineering at M.I.T. without a nostalgic regret that the really exciting parts of the future must lie beyond the reach of one's own experience. Those of our youth who are destined for leadership in engineering can look forward to a future which is exciting beyond the wildest dreams of the older generation.

C. RICHARD SODERBERG

DEPARTMENT OF AERONAUTICS AND ASTRONAUTICS

Aeronautics and Astronautics has replaced Aeronautical Engineering as the departmental name for Course XVI. This change was authorized by the administration on January 1, 1959. It represents formal recognition of a major extension of the Department's activities to include the theory, design, and application of vehicles to operate in the space that lies beyond the earth's atmosphere. Vehicles of this kind belong to the realm of astronautics, a term which is used to suggest all forms of travel "among the stars" and which in this case also means beyond the earth's atmosphere. Recent demonstrations of ballistic missiles, satellites, and intended lunar vehicles, along with the publicity of forthcoming attempts to complete trips into space with human beings as pilots and passengers, have attracted much attention to the rapidly developing new field of astronautics.

Aeronautics, the art and science associated with vehicles that operate within the earth's atmosphere, has seen many advances since the Wright Brothers' flyer was successful in 1903, but the last few years have produced changes at a spectacular rate. Jet engines have made commercial operation possible at almost 600 miles per hour, with the next generation of airplane transports likely to travel at speeds over 2,000 miles per hour. Vertical take-off and landing craft covering the complete speed range from hovering to several times the velocity of sound, using configurations that differ from conventional helicopters, will surely become commonplace within the next few years. Wing-supported aircraft with improved turbine-powered propulsion systems, better performance, and improved passenger comfort will receive continued attention for commercial and private flying.

Flight vehicles of all kinds — from low-speed, low-altitude VTOL craft, through airplanes and including guided missiles, satellites, and interplanetary craft — can be effective only if they are properly integrated into suitable transportation systems. These systems must include the communications, means for guidance, services, logistic provisions, arrangements for passenger comfort, and all other elements required for profitable transportation in flight vehicles. It is the primary objective of the Department to provide professional education in the applied science and engineering needed to realize practical solutions for the problems associated with flight of all kinds.

Aeronautical engineering, in its beginnings, followed the pattern set by marine engineering; it dealt with ships by concentrating on the flight vehicle itself as the imperfect element which, because of its essential nature, required the greatest attention. Developments during the past few decades have changed this situation until many components other than vehicles themselves must be considerably improved before flight transportation systems can be considered satisfactory. The Department recognizes this situation and is increasing its attention to the over-all field of flight transportation. A grant from Commander H. Nelson Slater has made it possible to offer the H. N. Slater Fellowship in Flight Transportation for the next academic year. Professor Otto C. Koppen, assisted by a departmental committee including Professor Rene H. Miller, Associate Professors Joseph Bicknell, Robert L. Halfman and Walter McKay, and Assistant Professor E. Eugene Larrabee, has taken responsibility for building up the field of flight transportation in the Department. The efforts of this committee will be supported by Brigadier General (ret.) Benjamin S. Kelsey, who has accepted the Jerome Clarke Hunsaker Professorship for the 1959–60 academic year. General Kelsey has a wide practical experience in the design, production, and operation of aircraft; and as he is particularly interested in flight transportation, he can be expected to make strong contributions in this area.

Educational Policies

It is the considered educational policy of the Department to provide within the framework of the Institute a thorough grounding in the basic sciences, the engineering sciences, and mathematics, as well as opportunities for professional development in all the fundamental phases of the science and engineering of flight, with provision for advanced study in each field. The Department feels that humanities, other subjects of culture, and languages beyond the regular requirements of the Institute are also important, especially in the area of human relationships.

In order to equip students to deal with the new kinds of problems in aeronautics and astronautics, a complete review and revision of the undergraduate applied science and mathematics background subjects has been necessary. For example, large and expensive vehicles that operate under environmental conditions that make thorough pre-flight testing impossible must be designed with less than the usual assistance from experimental data. This makes it necessary to develop and use theory to the greatest possible extent. Yet the situations to be considered are often so complex that the extrapolations of earlier theories are no longer satisfactory. The re-entry of a ballistic missile nose cone, for instance, requires that hypersonic aerodynamics, heat transfer, and molecular dissociation be considered as essential parts of a single problem.

Curriculum revisions which recognize the engineer's need for methods which will help in problems of this type are well started and will be carried on to keep teaching in step with the rapidly advancing art of flight. Many consolidations and generalizations of material have been found possible that surely provide in the new curriculum many excellent courses that not only meet the requirements of aeronautics and astronautics, but also stand on their own merits in the general area of applied science. The complexity of the situations associated with flight vehicles to which science must be applied, the catastrophic penalties for incorrect conclusions, and the great rewards for accurate results, combine to provide excellent motivation for students to master thoroughly the details as well as the generalizations of the basic and engineering sciences.

For the reasons discussed, the science and applied science courses developed in the Department for undergraduate and graduate courses have reached a stage where they provide ample material for an undergraduate engineering science option in aeronautics and astronautics. A number of students particularly interested in the theoretical and research aspects of flight problems have, during the past years, requested and received permission to rearrange their required and elective courses to follow an educational plan that is especially strong in applied science. Results from these special cases have been so successful that departmental faculty members are now working out details for an applied science option to match the regular engineering curriculum. It appears that the educational objectives of the Department may be fulfilled by either of these options, and it is expected that formal curricula for both engineering and applied science degrees in aeronautics and astronautics will be ready for proposal in the near future.

Preparation of students for creative leadership is a primary educational objective of the Department. Teaching methods and the curriculum itself are continuously being changed to increase the opportunities provided for students to develop self-reliance in thought and action, with emphasis on originality, creativity, judgment, perseverance, and awareness of human relationships. Flexibility in the courses offered, without sacrificing any essential elements in background knowledge or professional education, is a basic consideration in all revisions of teaching material. Experiments in teaching methods are being carried out continuously. For example, faculty members are using comprehensive projects to integrate knowledge, develop judgment, and increase student motivation.

Educational Activities

Steady progress has been made during the past year toward the goal of providing a high-quality basic education in all scientific and engineering phases of design, construction, system synthesis, and operation for the full spectrum of flight vehicles from VTOL machines to interplanetary craft. The engineering science and professional courses have been drastically reorganized in the direction of generalization to include thorough treatments of the physical principles which are fundamental to flight vehicles and their environments. Mathematical subjects have been extended to include vector and tensor analysis as fundamental subjects in handling multiple-degree-of-freedom problems. Advanced subjects in mathematics have also been incorporated as required to provide the background to handle problems of space dynamics, fluid dynamics, heat transfer, solid state theory, communications, and other areas that are now essential for aeronautics and astronautics.

Applied science and professional engineering courses taught by well-qualified faculty members are now well covered and have good growth potential in most of the essential regions, although the situation is not completely satisfactory in some areas. The following divisions are well covered: Materials and Structures, under Professor Raymond L. Bisplinghoff; Fluid Dynamics, under the Fluid Dynamics Research Group headed by Professor Leon Trilling; Stability and Control, under Professors Joseph Bicknell and E. Eugene Larrabee; Measurement and Control, under Professors Walter McKay and Yao T. Li; Inertial Guidance, Weapons Systems, and Automatic

Flight Control, under Professors Walter Wrigley and H. Philip Whitaker; and Vehicle Engineering, under Professor Otto C. Koppen. Propulsion, a subject of the greatest possible importance for the practice of flight, is now receiving increased attention from the Department but surely requires additional stress, particularly from the standpoint of integrating new engine types and vehicles into entities with optimum performance. The Department of Aeronautics and Astronautics, the Department of Mechanical Engineering, and the Gas Turbine Laboratory, under Professor Edward S. Taylor, have provided basic coverage of propulsion problems associated with piston engines, turbine-propeller combinations, and turbojets but have not led in the very important new field of rocket engines. This situation was improved during the past year by the Department's good fortune in having George P. Sutton, a distinguished rocket engineer, as the Jerome Clarke Hunsaker Professor of Aeronautical Engineering for 1958–59. A subject on rocket engines, various seminars, several theses, and the Minta Martin lecture, entitled "Rocket Propulsion Systems for Space Flight," all given personally by Professor Sutton or carried out under his supervision, have stimulated interest in rocket propulsion from many students and faculty members. The Department plans to increase this interest by all the means at its disposal. Professor Myron A. Hoffman, who returns to duty in September after three years of active service as an Air Force officer at Wright Field, and Dr. Gordon C. Oates, who recently completed work for his doctorate in propulsion at the California Institute of Technology, will specialize in the field of propulsion. More faculty strength and facilities in this area will be added as changes in this direction become possible.

Flight control and guidance activities in the department hold positions of acknowledged leadership and continue to advance under faculty members who have achieved distinction in their fields. The important fields of communications, radiation guidance, telemetry, data handling, and data processing, are not now thoroughly treated and must be given more attention. Plans are now being worked out to cover these areas with the aid of subjects given by other departments, if not by ours.

Effective July 1, 1959, Assistant Professors James W. Mar and Theodore H. H. Pian will become Associate Professors. Mr. H. Philip Whitaker of the Instrumentation Laboratory (D.S.R. staff) will also become an Associate Professor. Dr. James L. Stockard, Research Assistant, and Dr. Oates have been appointed Assistant Professors.

Seminars and Lectures

Seminars have played an important role in the activities of the department during the past year. The regular departmental seminars included talks by Sir Geoffrey I. Taylor, who discussed the formation and disintegration of thin sheets of fluid; and Institute Professor William R. Hawthorne, who described the concept of plastic barges for marine transportation. In addition to the regular series, a committee consisting of Professors H. Guyford Stever (Chairman), Charles S. Draper, Bisplinghoff, Sutton, and Winston R. Markey organized thirteen weekly Space Environment Seminars. These were directed especially toward building background knowledge of the environmental conditions that will be encountered in the field of astronautics. The speakers included Dr. Herbert Friedman of the Naval Research Laboratory; Dr. Richard F. K. Herzog and Mr. Edward R. Manring of the Geophysics Corporation of America; Dr. Donald H. Menzel, Dr. Theodore E. Sterne, Dr. Fred L. Whipple, and Dr. Gerard de Vaucouleurs, all of Harvard University; Dr. Millett G. Morgan of Dartmouth College; Dr. Robert B. Leighton of the California Institute of Technology; Professor Clyde W. Tombaugh of the New Mexico College of Agriculture and Mechanic Arts; and Dr. Harold C. Urey of the University of California. The attendance was beyond the capacity of any room available in the Guggenheim Laboratory, so the lectures were held either in the Kresge Auditorium or the Compton Lecture Hall. The seminars generated a considerable interest in the problems of astronautics and introduced the new role of the Department within the Institute and to the public. For the future, the Department plans continuation of seminars on various subjects selected for rounding out faculty and student knowledge in the general field of astronautics.

Grover Loening honored the Department by accepting its invitation to present the first Lester D. Gardner Lecture. His talk, "Lessons from the History of Flight," attracted a good audience, including a group of pioneers with distinguished records from the early days of aviation.

Hunsaker Professor George P. Sutton's Minta Martin Lecture, mentioned previously, was presented at the Institute, at the University of Maryland, and at the Institute of the Aeronautical Sciences in Los Angeles.

Enrollment and Placement

A detailed study of undergraduate enrollment shows some variations in the size of individual undergraduate classes as compared with previous years, but the total number of undergraduates remains substantially unchanged. The number of students electing the Cooperative Course dropped slightly. Interest in this Course appears to be decreasing, and whether or not to continue it is now being discussed in the department. The enrollment of graduate students shows a definite upward trend. There is an even greater increase in the number of well-qualified applicants for the graduate school. Part of this increase results directly from students registered in a special program in astronautics recently organized for selected Air Force and Navy officers. The remainder of the growth of the graduate school comes from special interests of the faculty in the rapidly developing fields of science and engineering associated with flight. The upward trend of graduate enrollment is evidence of the increasingly important role being played by the graduate school in the activities of the department.

The Honors Course, a five-year program leading to both Bachelor's and Master's degrees, remained substantially the same size as last year. The membership during the year consisted of twenty-nine juniors, seniors, and graduate students, and seven social members. The scheme of inviting outstanding juniors to join this group appears to be eminently successful and is encouraging an increased flexibility by undergraduates in choosing elective subjects.

Graduates from the Department all easily found employment at good salaries. Civilians with Bachelor's and Master's degrees accepted most of their jobs from industry. It is of interest to note that of the five men awarded Doctor's degrees, two accepted teaching posts at institutions where they will be in positions to exert considerable influence on the development of teaching in the aeronautical sciences.

Research

The trend of research activities in the Department during the past year continued toward more fundamental investigations in all fields. Virtually every important research area associated with the science of flight was represented during the past year by some activity within the departmental laboratories. The past year also saw a pronounced change in emphasis from several of the older traditional research areas of aeronautical engineering to new fields that have become important for the science of astronautics. It is expected that this trend will continue until an appropriate balance of research interest within the Department is reached for the complete spectrum of flight. Integration of the laboratory research with the educational program continued to give the Department one of its main sources of strength. Almost every graduate student within the Department was associated in some manner or other with the laboratory research programs.

Instrumentation Laboratory activities have increased in dollar volume, in personnel employed, and in projects brought to the stage of definitive results. Gyro units and accelerometers designed in the Laboratory are now in wide production by industrial companies. The principles of submarine inertial navigation systems, first demonstrated by a project carried out in the Laboratory, have been widely accepted on the basis of practical successes and are being applied in production equipment. Similarly, the principles of inertial guidance for ballistic missiles, developed in the Laboratory and applied in the Thor missile, are being incorporated in several other systems. The Laboratory has recently assembled and is now testing the inertial guidance equipment for the Polaris missile, for which it has accepted the engineering development responsibility. Recent contract awards for inertial guidance equipment to be placed in Titan missiles are based on the features of a prototype developed in the Laboratory; this continues our work with the Air Force and the firms who have responsibility for production.

The Laboratory has completed design studies for an unmanned interplanetary reconnaissance vehicle intended to be used as the means for a trip to Mars, and will make presentations of its proposals to several government agencies in the near future. Efforts in the field of astronautics are absorbing an increasing portion of the Laboratory capabilities. Activities in this area on the national scene remain in such an unsettled state that it is impossible to predict the future with any certainty. The Laboratory has support for a few months ahead, but it is probable that in the future governmental and industrial laboratories will receive so much of the available funds that the Instrumentation Laboratory must face future reductions in all phases of its work.

The academic year now closing was one of considerable achievement for the Naval Supersonic Laboratory. A high level of student participation was continued with seven Bachelor's and nineteen graduate theses written in connection with laboratory projects. The breadth of the Laboratory's research interests can be gauged by noting that three of the theses were in the area of magnetohydrodynamics, two on the physics of infrared, two on infrared satellite detection, five on engine and rocket inlet and exhaust aerodynamics, three on heat and mass transfer associated with supersonic and hypersonic flows, two on the aerodynamics of supersonic wings, and several on wind tunnel development. A modernization program was instituted during the past year to convert the supersonic wind tunnel to a modern hypersonic tunnel. A Mach number 7.5 nozzle is ready for installation, and other nozzles of higher Mach number are being planned for the future. In addition, the tunnel has been modified to provide for testing at low pressures to simulate flight at extreme altitudes. Compressors, storage tanks, and heaters have been acquired to provide for the ultra-high Mach number temperature environment which is of interest in aerodynamic heating research. Other principal research activities during the year have included broad basic studies in the field of mass transfer, extensive investigation in the fundamentals of magnetogasdynamics, investigations of the unusual aerodynamic problems of ring-wing vehicles, a study of the basic laws relating pressure on high-speed wings to their flutter characteristics, and engine and rocket inlet and exhaust aerodynamics.

The Wright Brothers Wind Tunnel continued its dual role as an educational tool and a laboratory for industry and other M.I.T. groups. Funds from commercial testing were used to finance additions to this facility as well as for upkeep of the student wind tunnel and for the expenses of several theses and unsponsored research projects. Projects of particular interest carried out in the Wright Brothers Wind Tunnel complex included the development of a new laboratory experiment on a missile model in the blowdown supersonic tunnel, research on the power-spectral density of pressure fluctuations in the supersonic test section, studies of the unsteady lift forces on circular cylinders, and an investigation of wind tunnel blocking effects.

The Fluid Dynamics Research Group continued its research activities during the past year. This comparatively new activity has become one of the strongest elements of the Department and has already made several significant contributions at the forefront of gas dynamics. Particular mention should be made of the Group's research during the past year on shock-wave, boundary-layer interaction, rarefied gas dynamics, blunt bodies in hypersonic flow, unsteady flow, and noise generation mechanisms in a free-shear layer flow.

The Gas Turbine Laboratory continued during 1958–59 to receive the support of General Electric, Westinghouse, and the Allison Division of General Motors, as well as the Office of Naval Research. One of the noteworthy events of the year was a very successful conference held in December, at which time the laboratory's research program was reviewed with twenty-five representatives of the sponsoring companies. This event, which will be held annually, was typical of the laboratory's increased contact and closer collaboration with its sponsors. One of the sponsors now plans a meeting of its personnel in fluid mechanics from various company divisions to be held every year in Cambridge following the Gas Turbine Laboratory Conference.

The Aeroelastic and Structures Research Laboratory operated during the past year at a slightly reduced level of activity as compared to previous years. Seven faculty members acted as project supervisors of eighteen laboratory research projects sponsored by various Department of Defense agencies. A very strong program of research was carried on in the general area of VTOL aircraft. Research on aeroelasticity continued with emphasis on hypersonic speeds and aerodynamic heating effects. Structural research trends during the year were to problems associated with missiles and space vehicles. Of particular importance in this regard were studies of the stability of thin pressurized shells, the response of shells under impulsive loads, and hypervelocity impact phenomena.

The Aerophysics Research Laboratory ceased to function during the year as an entity. The residue of this laboratory consists of a single project still in force on mechanics for optimization of celestial trajectories, supported by the Air Force Office of Scientific Research.

Facilities

During the past two years the faculty of the Department of Aeronautics and Astronautics, realizing the need for new physical facilities, has made a comprehensive study of its requirements in the foreseeable future. The Department has as its central location at the present time the Guggenheim Aeronautical Laboratory (Building 33) which was constructed in 1928. This building is now barely adequate to house the undergraduate teaching functions, and it is surrounded physically by other M.I.T. activities in such a way that expansion is clearly out of the question. Most of the research effort and much of the graduate school teaching are scattered over the campus in at least four other buildings. In planning for the tremendous effort that must be undertaken in order to meet the demands of the future, it is clear that the present Department facilities should be integrated physically and that the available space should be significantly increased.

In surveying other locations on the M.I.T. campus, the possibility of consolidating the activities in a single new facility clustered about the Naval Supersonic Laboratory has many advantages. Large amounts of electric power are available; and compressors, vacuum pumps, dryers, and a heater which can supply large quantities of air at various temperatures and pressures are already in operation. In planning research equipment for the new facilities, considerable effort has been put into devising space arrangement and devices which have maximum flexibility and applicability in basic investigations. For example, the planned gas dynamics research facility will emphasize very complete measuring equipment and sources of high-pressure air in proximity to a first-class shop as opposed to a single large wind-tunnel facility. The same approach is being applied in the planning of the other research areas.

Efforts to bring to fruition these plans for a new Center of Aeronautics and Astronautics were intensified during the past year and will be carried on vigorously during the coming year.

C. STARK DRAPER

DEPARTMENT OF CHEMICAL ENGINEERING

The Department has discussed vigorously the movements in undergraduate education of engineers which are represented by "engineering science" on the one hand and "professional engineering" on the other. Two of our members have been intimately concerned with broad Institute consideration of these issues: Professor Thomas K. Sherwood, as Chairman of the faculty's Undergraduate Policy Committee, and Professor Edwin R. Gilliland, as Chairman of the Committee on Engineering Education.

In the case of chemical engineering, both of these movements have great merit and are not mutually inconsistent. Our undergraduate program has, of necessity, contained a higher content of science than other engineering curricula because of the chemical engineer's need for a sound background in chemistry. At the same time, the principles of engineering responsibility in applying science to new problems of industry have been notably emphasized in our

School of Chemical Engineering Practice. In the continual modification of our undergraduate program, these two features — science and the ability to apply it — are parallel objectives.

Research

This has been a thriving year in research, and sixteen men have completed their doctoral programs. Five of these accepted teaching positions in various universities. A few of the research topics are described below.

The development of systems analysis and the availability of advanced IBM computer facilities have stimulated attack on chemical engineering problems which had previously seemed too complex for practical solution. Radiation in gases, an important factor in high-temperature furnace design and performance, can now be evaluated by programs developed in a recent doctoral thesis. The control of distillation columns to approach optimum process performance despite variations in feed composition, temperature, and the like, has been analyzed and developed in another doctoral thesis. In cooperation with staff and graduate students in the Electrical Engineering Department, a comprehensive study of the application of systems analysis and computer techniques to a sensitive industrial chemical process is well under way. The Texas Butadiene Corporation is collaborating with us in this investigation.

Considerable research by medical teams has been directed towards the effects of intense flashes of thermal radiation on human skin, such as would be encountered under exposure to a nuclear blast. Skin temperatures may increase at rates of 150°C per second. We have constructed a device of copper and air which simulates the temperature-time-depth behavior of human skin. It has a depth factor of about 30, thereby permitting temperature-time measurements which correspond to a skin layer only 0.1 millimeter thick. With this simulator, the protective effects of different fabrics have been determined under radiation from a solar furnace, and a simplified mathematical treatment has been solved on the IBM 704 which accords reasonably with the data and allows extrapolation over a wide range of exposure times, materials, and moisture contents.

Increasing the recovery of oil in the ground by water-flooding of the sands is an important technique in many oil fields. Injection of chemical wetting agents to alter the interfacial forces between sand, oil, and water might greatly improve the efficiency of oil recovery. A doctoral thesis, employing wetting agents of different characteristics, showed that the action of the agents is chromatographic and that the haphazard results reported by earlier experimenters are understandable in this light. An economic analysis indicates that one of the wetting agents tested, hexylamine, may have distinct advantages, although field tests would be necessary to confirm this.

Turbulent mixing processes play a dominant role in many chemical engineering operations: for example, in tubular reactors, in fluidized beds, and in high-output combustors. Past theoretical and experimental studies of turbulence throw little light on the concentration fluctuations which are encountered in turbulent mixing. A new technique was developed in a recent doctoral thesis, using an optical method which employs smoke as a tracer and uses a phototube to give a continuous signal of the smoke concentration and its fluctuations. This technique avoids local disturbances of the flow which are encountered in other methods and promises to be widely useful in extending our basic understanding of turbulence phenomena.

Professor Edward W. Merrill has developed a viscometer for studying the flow characteristics of non-Newtonian fluids at very high rates of shear. This instrument, known as the Merrill-Brookfield Viscometer, has a clearance of only 0.005 inches between co-axial cylinders, rotates at speeds up to 5,200 RPM, and can control the temperature of the liquid under shear to within 1°C even at high shear rates. It is proving especially useful for studying the characteristics of high polymers such as polyisobutylene. Recent work with solutions of polyisobutylene in different solvents and various concentrations has shown that at high shear rates the intrinsic viscosity effect due to the polymer is independent of the shear rate, of the solvent, and of the concentration of polymer. These results, which have not previously been observed, suggest that the configuration of the polymer molecule is stabilized at high shear rates, and they open the way to direct theoretical analysis. It now appears that the viscometer may offer the most satisfactory method for determining the molecular weight of such high polymers.

School of Chemical Engineering Practice

Last year's report described the projected changes in our School of Chemical Engineering Practice, involving the establishment of two new stations at a central location in New Jersey and the liquidation of the three former stations. The new stations, at the Esso Refinery in Linden and at the Cyanamid plant in Bound Brook, have been markedly successful in their first year of operation. Both plants have interesting problems which afford many projects for student initiative in applying their training to practical results. The managements of both plants are most cooperative in this educational enterprise, and their interest is a strong motivation for the students.

The Engineering Practice School at Oak Ridge also had a productive year. Most of the students at Oak Ridge are enrolled in the Nuclear Engineering Department. Naturally, their undergraduate training is varied, with chemical engineers, physicists, and mechanical engineers predominating. This diversity of background encourages a great variety of projects and a blending of specialists in the group approach which characterizes modern industrial progress.

It is noteworthy that the use of modern computer facilities at all stations is a significant element in the student activities.

Staff Activities and Honors

Professor Gilliland received the American Chemical Society Award in Industrial and Engineering Chemistry for his notable achievements in fundamental research and in the application of chemical engineering principles to industrial processes.

Professor Sherwood delivered the Thirty-Third Annual Priestley Lectures at Pennsylvania State University this spring on the subject, "Mass Transfer Between Phases," a field in which his reputation is world-wide. He and Professor Raymond F. Baddour, accompanied by their wives, were guests at the Eighth Mendeleev Conference in Moscow in March, where Professor Sherwood delivered an invited paper on mass transfer.

Professor William H. McAdams received the Gold Medal of the Institut Français des Combustibles et de L'Energie in a special ceremony honoring his long leadership in the field of heat transmission.

Professor Harold C. Weber has been on partial leave during the year to serve as the chief scientific adviser for the research and development activities of the United States Army.

Professor Alan S. Michaels went to London in May at the invitation of University College to study and advise on chemical engineering education in England, and to confer with research leaders there and on the continent on research in applied surface chemistry.

The Future

It is difficult to make long-range forecasts at a time when national excitement and heavy government expenditure for missiles and space travel have created a feverish demand for young personnel in such endeavors. There are strong indications that high school students today are attracted to careers in these areas and that enrollment in chemical science and chemical engineering may be low in the immediate future. However, it seems certain that the process industries which produce the basic wealth for our economy — industries such as chemicals, petroleum, metals, and pharmaceuticals — will have increasing needs for chemical engineers to develop new methods and products and to direct their highly technical enterprises. The task of educating such men in an era of rapid technological change is both challenging and inspiring.

WALTER G. WHITMAN

DEPARTMENT OF CIVIL AND SANITARY ENGINEERING

This year has been marked by advance planning, with special emphasis on structures and upon transportation and surveying. The first of these areas is especially important because so much of the work of the civil engineer revolves around structures of some kind. The second, transportation and surveying, demands attention for two reasons: the problems of transportation are among the most important that face our country; and surveying is undergoing such revolutionary changes that it is becoming a significant new field. Because of the new significance of what used to be called surveying, this area of work, as of the beginning of next year, will be recognized as a separate division of the Department, to be headed by Professor Charles L. Miller, and carrying the name of data engineering.

Advance Planning Projects

This discussion of advance planning comes, therefore, under three headings: Structures, Transportation, and Data Engineering.

The Structural Division proposes that it continue along the broad front of its educational and research program, making at the same time a special effort toward developing the technique of using models as an aid to structural design. This approach, while used to some extent by a few European engineers, has not been developed to its possible potential, nor has any university directed attention to its importance for education, research, and actual engineering design. The proposed venture requires some investment in laboratory equipment; and more important, it requires additional faculty. It is not suggested, however, that any permanent additions be made at the present time, but rather that there be established, first, a rotating visiting professorship by which the services of some of the few eminent people in this field could be brought to the Department for a term or perhaps a year; and second, a series of lectureships by which a number of people who are outstanding in the field of analytical structures could be brought into the Department for shorter periods, such as a term or half a term.

The Transportation Division has given a great deal of thought to the direction which it should attempt to take. This is no simple problem, since transportation is such a very broad field that no single Department can reasonably strive for top standing in all of its facets. It is hoped that, in recognition of the importance of transportation in the national context, the Institute will ultimately give consideration to the formation of a transportation center so that the various disciplines represented at M.I.T. can be brought to bear in a joint attack. In the meantime, however, the Transportation Division of the Civil Engineering Department wishes to proceed with its own best effort. The Division believes that this can be done by introducing into its program the concept of a "Transportation Systems Engineer." Whatever this man might best be called, his background of a wide knowledge of the various forms of transportation, together with knowledge of the new technologies that can support the planning and engineering of total transportation systems, seems to be sorely needed. As this program develops, a further investment in faculty is indicated.

During the past several years, the developments in the general area of surveying have been rather astonishing. Photogrammetry and machine computation have been teamed together so that the procurement and processing of data for civil engineering projects is becoming one of the most important areas of civil engineering. The incorporation of operations research into these efforts is already under way. Nowhere has there been more progress in this total area — now being called data engineering — than at M.I.T. Here is a new field, one in which the Institute, as is so often the case, is doing pioneering work of first-order importance. Although other divisions of the Department are already incorporating the new technologies into their activities, this process will be materially aided by strengthening the Data Engineering Division. This strengthening will require two new faculty members, with perhaps half their time carried by research funds. In addition, the new division needs an IBM 650 computer to facilitate its work in both research and teaching. Preparation of space for the computer will require funds, and the cost of machine operation is also a factor. However, this development appears to be spearheading the attack of civil engineering in its effort to meet its future problems.

Other Departmental Activities

Further activities of the Department during the past year will now be discussed, division by division. The Building Engineering and Construction Division, headed by Professor Albert G. H. Dietz, has undertaken two noteworthy educational innovations. In conjunction with the School of Industrial Management, it has set up a program in construction management, leading to the Master's degree. It has also taken preliminary steps toward an investigation of the application of the methods of operations research to the improvement of construction methods. As this is written, Professor Dietz, who is a member of the Building Research Advisory Board of the National Academy of Sciences, is on his way to Moscow to supervise the erection of a reinforced plastics pavilion, part of the American exhibit that will be on display there next summer. This year's research in the Division of Building Engineering and Construction has included projects on sandwich construction in school design, plastics, reinforced plastics, and the use of welded wire fabric in reinforced concrete pipes.

The Hydraulics Division, under the direction of Professor Arthur T. Ippen, has introduced a change in its graduate program, replacing subjects in applied hydromechanics and hydraulic machinery with a two-term sequence in Advanced Hydromechanics. This change is the result of a growing need to strengthen the treatment in the areas of flow stability, separation, stall, and secondary motions, as well as turbulent transport and diffusion, all in relation to their roles in the behavior of hydraulic structures and fluid machinery. One of the highlights of the activities of this division during the fall term was a general lecture by the well-known fluid mechanics expert, Dr. Hermann Schlichting, Professor at the Technische Hochschule, Braunschweig. This year's research program of the Hydraulics Division has included projects on characteristics of flow with dilute fiber suspensions, sorting of beach sediments by shallow water waves, experimental study of wave mechanics, floating breakwaters, experimental study of erosion in curved channels, hydraulic model tests of the pumping station for Charles River elevation control, and the mechanics of waste water diffusion. Dr. Ippen, who was appointed Chairman of the Research Committee of A.S.C.E. in October, attended the Executive Council Meeting of the International Association of Hydraulic Research, in Paris, as Vice President of the latter organization.

The Sanitary Engineering Division, headed by Professor Rolf Eliassen, has revised its graduate curriculum to provide new subjects in Air Pollution Control, Solid Wastes Disposal, and the Disposal of Radioactive Wastes. More emphasis has been placed on the integration of the principles of organic and physical chemistry and biology into the processing of water, sewage, and industrial wastes. A more balanced curriculum, with equal stress on applied and basic sciences, has resulted. The research programs of this division have included studies on the disposal of radioactive wastes, the biochemical characteristics of synthetic detergents, radioactive tracers of endogenous metabolisms, ground water contamination, microbiology of anaerobic digestion, corrosion control in potable water systems, and radioisotope tracer techniques in waste disposal. Dr. Eliassen has continued his services as a member of the Health Research Facilities Council of the National Institutes of Health, U. S. Public Health Service.

During the past year, the laboratories of the Soil Engineering Division have been completely renovated and largely re-equipped. These new facilities place this Division, which is under the direction of Professor T. William Lambe, in an excellent position to conduct a first-rate program of education and research. The subject in Advanced Soil Mechanics has been revised to deal more effectively with the interaction of two phases of matter (solid and liquid), the implications of dealing with matter composed of discrete particles, and the "limit design" of large continuous masses. Research for this division has included projects on soil stabilization, high-pressure consolidation, stability of submerged slopes, dynamic properties of soils, and shear strength of soils. Dr. Lambe has served on three committees of the A.S.C.E. Soils Division, and Dr. Robert V. Whitman has been a member of the Senior Advisory Panel for Protective Construction for the Ballistic Missile Division of the Air Force.

A major accomplishment of the Structural Division, which is headed by Professor Charles H. Norris, has been the planning and development of a revised graduate program, which will be introduced next fall. This new program of sixteen subjects replaces the present program of fourteen Course I subjects and three Course XVII subjects, eliminating some duplication that has existed and improving the scope and coverage, particularly in the areas of structural behavior and of structural design. The research program of the Division has included studies of the form and function of the human foot, reinforced concrete shear-wall structures, dynamic behavior of gravity structures, dynamic shear and bond tests of reinforced concrete items, analysis of large space frameworks by partitioned stiffness matrices, potential of plastic materials for blast shelters, and effectiveness of spoilers on members subject to Karman vortices. Perhaps the most significant development of the academic and research program of this division during the past year has been the extensive use of the small model to assist in the design of a major structure. Several models of plastics have been designed and constructed and tested in our Structural Analysis Laboratory. In essence, the prototype structure was designed on the model, the model being successively evolved to attain a configuration adequate for the requirements of the prototype structure. The interest in this effort has been very high, on the part of both the staff and the students. An important book in a new area of knowledge, *Structural Design for Dynamic Loads*, was published during the year; it was co-authored by Professors Norris, Robert J. Hansen, Myle J. Holley, John M. Biggs, and Saul Namyet, of the M.I.T. Structural Division, and Professor John Minami of Waseda University, Tokyo.

The Division of Transportation and Surveying, under the leadership of Professor Alexander J. Bone, has made progress in each of its two basic areas. Two new subjects in transportation, Transportation Seminar and Transportation Management, were introduced into the curriculum. The curriculum has been further revised for next year to include as new subjects, Fundamentals of Transportation Systems, and Route Locations from the Economic Aspect. Research on asphalt technology and pavement performance has continued under the Joint Highway Research agreement with the Massachusetts Department of Public Works. The Economic Impact Study of Massachusetts Route 128, a federal-aid project with the Massachusetts D.P.W., was completed. The reports have been widely circulated to federal, state, and local highway engineering and planning agencies. In June, the Division cooperated with the Massachusetts Safety Council, the Massachusetts D.P.W., and the Boston Traffic Commission in sponsoring a seminar on the Fundamentals of Traffic Engineering.

The Division's efforts to pioneer a new type of academic program in surveying have already been touched upon. The Digital Terrain Model System, a development of the Photogrammetry Laboratory, was released for operational use during the year and is now being applied to major highway projects in a number of states. Over twenty electronic computer programs are involved in the system, the output of which permits automatic plotting of a set of preliminary construction plans. The system is currently being extended to include facility for computer simulation of a vehicle operating on the proposed roadway and computation of operating cost factors. The Photogrammetry Laboratory initiated two research investigations during the year, one on the procurement of meteorological data and a second on the measurement of radar structures by photogrammetric methods. An automatic instrumentation system for obtaining numerical terrain data from contour maps was completed.

This year marks the final retirement of Professor John B. Babcock, III, who, since becoming an Emeritus Professor five years ago, has been a Lecturer in the Department. Professor Babcock has been on the M.I.T. staff and faculty continuously since 1916, and as teacher, placement officer, and friend of the students, has earned a place in the affections of more than two generations of M.I.T. civil engineers that few, if any, can match.

JOHN B. WILBUR

DEPARTMENT OF ELECTRICAL ENGINEERING

On June 15 the Department dedicated the Vannevar Bush Room, honoring our distinguished and long-time colleague, Dr. Vannevar Bush, and made possible by many friends of Dr. Bush. This fine room adds about 2,000 square feet of space to the Department's facilities for seminars, staff meetings, and other professional activities of students and faculty. It is centrally located on the first floor of Building 10.

For the first time in seven years enrollment in electrical engineering last year was below the figure of the previous year. For the Department as a whole the registration was 1,244, down from 1,337. Almost the entire drop is represented by a reduction of about ten per cent in the enrollment of freshmen and sophomores. Since the large enrollment has fully taxed the facilities of the Department, no action has been taken to offset this trend.

The Department has reached a stage in the evolution of its core curriculum where time is needed to digest what has been done. The most recent addition to the core curriculum, Molecular Engineering, was taught for the first time to the seniors. The first two books of the series of new core curriculum texts were published during the spring: *Electromechanical Energy Conversion*, by Professors David C. White and Herbert H. Woodson, and *Electronic Circuit Theory*, by Professors Henry J. Zimmermann and Samuel J. Mason. Three others are expected during the coming fall term.

Only two curriculum changes of concern to electrical engineering majors were made during the year: Atomic and Nuclear Physics is now required of all undergraduates in Electrical Engineering; and Structural Chemistry is required of all students in Electrical Science and Engineering (Course VI-B).

As an example of the Department's continuing effort to bring relatively new fields within the reach of undergraduates, the subject on Introduction to Automatic Computation was designed specifically for freshmen and taught during the second term. Student interest greatly exceeded the classroom capacity.

The Generalized Machine

During the year production units of a generalized machine for laboratory investigation in electromechanical energy conversion became available. Developed by Professors White and Woodson, this machine affords students the opportunity to simulate and study most of the methods of rotary electromechanical energy conversion and control which are of practical interest. It was engineered and produced by the Westinghouse Electric Corporation. Because of the machine's great usefulness in the laboratory as well as the economies in space that its use affords, the Department procured seven units to meet its full teaching needs.

In response to widespread interest among professors of sister institutions, the Westinghouse Educational Foundation donated one of these machines to each of the approximately 150 accredited electrical engineering departments across the country. At the June meeting of the American Society of Engineering Education in Pittsburgh, Professor Woodson and his assistants, John Penhune and Paul Penfield, conducted a special four-hour laboratory session to illustrate the wide range of investigations that students may perform with these machines.

The* VI-B *Curriculum

The accomplishments and problems of the Course in Electrical Science and Engineering (Course VI-B), have proved to be of great interest. This Course was initiated in order to provide a group of specially talented students with opportunities for greater depth and challenge in their education. The educational advantages which have been gained are impressive. The stratification in the education of students who will probably go on to doctoral work has been minimized. Course VI-B sections have proved particularly stimulating to the faculty, with discussions carried on at an unusually high level. The students have continually shown initiative in the special laboratory sessions and seminars and offer the staff unusual opportunity to carry out educational experiments that promise further benefits.

Any assumption that Course VI-B sections would require somewhat less surveillance has not been realized. On the contrary, the pace and diversity that these students expect imposes great demands on the faculty who teach them. The effect of separating the VI-B students from others in the Department has not yet been fully assessed, but there is evidence to show that the students in Electrical Engineering (Course VI) show a wholly new kind of spark and achievement as a result of a slightly altered pace and emphasis in the core curriculum subjects and a recognition that these Course VI students have quite different talents and motivations.

Instruction in Materials

The Department continues to strengthen its teaching and research in materials. The action to require all electrical majors to study Atomic and Nuclear Physics and the inclusion in the Course VI-B program of the new subject on Structural Chemistry, taught by Professor David P. Shoemaker of the Department of Chemistry, was to provide a strong background in basic science for handling problems in materials and devices which promise to be important in the future.

The dominant theme of our new core subject, Molecular Engineering, taught for the first time last fall by Professor David J. Epstein and his colleagues, is thermodynamics and statistical mechanics. The lecture treatment of devices and general topic coverage have been sacrificed in order to gain depth; purposefulness and motivation are achieved in the laboratory portion of the subject, where students have the opportunity to appreciate the relevance of materials in devices and in engineering. We are now faced with the need for more advanced subjects at the elective level for those students who want to do more work involving professional specialization in this area.

A series of six lectures was given last April in the field of Molecular Engineering by Dr. Jacob E. Goldman, Manager of the Physics and Chemistry Departments in the Scientific Laboratories of the Ford Motor Company. Dr. Goldman was with us as Visiting Edwin Sibley Webster Professor of Electrical Engineering. The purpose of the lectures was to show, by examples that would stimulate student interest, the significance of a deeper scientific understanding of matter in relation to new engineering devices. We expect to repeat and expand on this series of lectures.

Graduate Studies

The Department continues to stress the importance of graduate study and research as a constant stimulus to the faculty, as a source of new material for the undergraduate curriculum, and as a means of training new faculty and research staff for the future. For many years we have been convinced of the benefit to the graduate student of a part-time assistantship — either research or teaching — during his study period, on the grounds that such a program offers opportunity for greater depth of study, more rigorous challenge of his own ideas, and better assimilation into the life and spirit of the Department than is afforded by full-time student status.

The growth of the number of graduate fellowships in recent years suggests that the number of full-time students in the Graduate School will increase in the future. To hasten student association with the faculty, each full-time student is required to register for Special Problems in Electrical Engineering during the first term. Here he associates with a research project under the guidance of a member of the faculty, as an approximation of the research assistant relationship.

To reduce the number of study areas for which the full-time student is accountable, most graduate subjects have been revised to rate twelve credit hours instead of nine. The full-time student will then carry four rather than five subjects and thereby achieve more in each.

During the summer of 1958 there were fifty-three participants in a two-week Special Summer Program on Switching Circuits, in which supervised problem-study sessions were substituted for afternoon lectures. This move markedly increased the confidence of the participants in their ability to perform synthesis. Also during the summer term and again in the first term, the new one-semester version of the graduate elective switching subject was taught with scarcely any omission of the material which formerly required two semesters for its presentation. A new senior switching elective was offered to meet the needs of students expecting to enter industry with no graduate study. In cooperation with the Research Laboratory of Electronics, the Switching Circuits Laboratory is being used for an experimental study of magnetic components and their applicability to general types of switching circuits in computers.

Interdisciplinary Study and Research

To an increasing extent, new areas of teaching and research cut across departmental boundaries. The activity in the area of molecular engineering is one significant example of this tendency, with electrical engineers, physicists, chemists, metallurgists, mechanical engineers, and others, all interested in the many unsolved problems. A second area is in the communication sciences, where interest ranges from the efficiency of actual communications media, to the mathematical description of various communications methods, and to the biological and psychological study of human communication processes. A third area is gas dynamics, which draws participants from most of the engineering departments and from the Departments of Physics and Mathematics. There is a trend toward interdepartmental research administration in all these areas.

Research Activities

MOLECULAR SCIENCE AND MOLECULAR ENGINEERING

Four divisions of the Electrical Engineering Department, drawn together by the bond of common interest in modern materials research and its applications, have formed by voluntary action "The Laboratory for Molecular Science and Molecular Engineering." The beginning of this action was reported last year in connection with a center for modern materials research, which is now becoming an Institute-wide endeavor. The partners are: The Laboratory for Insulation Research, dedicated mainly to fundamental research in molecular science; the Computer Components and Systems Group; the Energy Conversion Group; and the Solid State Devices Group of the Electronic Systems Laboratory. The last three are concerned with basic goals of molecular engineering that need molecular science for their realization.

Thus far the laboratories of this departmental federation, scattered at present over a wide variety of locations, have developed without much cognizance of one another's needs and potentialities. We have begun to change this and to create a structure of individual laboratories within our respective fields that reflect the broad aims of the Department. Such a federation of individual laboratories, each representing a special field of knowledge and centered around a faculty member and his group, is the logical answer to the rapidly changing demands of our times. The federation as a whole can respond with flexibility and vigor to new challenges and insights. Its faculty, meeting as a group of experts in council, acts through a steering committee.

LABORATORY FOR INSULATION RESEARCH

The Laboratory for Insulation Research functions as a cell structure organized around special tools and tasks. Eight section laboratories have developed. Two of them, "Crystals" and "Ceramics," produce materials and study the degree of their perfection. A third, "Chemistry," should be able when fully developed to analyze and synthesize inorganic materials, using every modern tool of chemical science. A fourth, "Structure Analysis," evaluates structures and phase transitions by means of diffraction methods (X-ray, electron, and neutron diffraction). "Magnetic Resonance," a fifth, acts as a "fine-structure" tool in identifying magnetic-spin carriers and in determining their arrangement and surroundings (nuclear, para-, and ferromagnetic resonance). A sixth, "Dielectric Spectroscopy," measures broadband the frequency response of moments and charge carriers to electric and magnetic fields from direct current through the electric and optical regions. "Ferromagnetics," a seventh, investigates the behavior of coupled magnetic dipole systems up to high magnetic fields. Finally, "Conduction and Breakdown" comprises research on the formation and action of charge carriers from low electric fields to the breakdown strength and final destruction of materials; included are electrolytic conduction, transitions from insulators to metals; field-emission, surface, and interface studies. Furthermore, this group shares with "Dielectric Spectroscopy" the responsibility for research on ferroelectrics.

An important event was the publication of Professor Arthur R. Von Hippel's book, *Molecular Science and Molecular Engineering*, in April, 1959. This book is the third volume of a trilogy on modern materials research. (Preceding volumes, *Dielectrics and Waves*, also by Professor Von Hippel, and *Dielectric Materials and Applications*, edited by Professor Von Hippel, were published in 1954.)

The research of the laboratory is continuing on a broad front as far as our financial resources allow. We still are compelled to take auxiliary contracts requiring specific developments and deflecting us from our principal aims, since long-range support for fundamental research has not yet been achieved.

ELECTRONIC SYSTEMS LABORATORY

The Electronic Systems Laboratory has been formed to take over the activities of the Servomechanisms Laboratory, which had conducted research within the Electrical Engineering Department for the past nineteen years. The new name reflects not only the broadened interests of its present research groups but also the importance of systems concepts in modern engineering and the interrelationship in many complex systems among computation, control, and instrumentation. The Electronic Systems Laboratory staff is currently engaged in research in these areas.

The Computer Technology Group, under the direction of Professor Alfred K. Susskind, continued its investigations of incremental computation, giving new insight into this technique, both analytically and experimentally. The work was greatly aided by simulation and experimentation on the TX-O digital computer. The availability of this machine has proved invaluable here and in other studies of computer technology. The work directed by Mark E. Connelly in optimum computer configurations for special purposes has yielded a design for a simple, compact, pulsed-analog computer for simulating the behavior of aircraft in flight. A portion of this computer is now being evaluated through use of the TX-O computer. Professor William W. Seifert has directed a study of a photomemory device which permits high-speed access to a very large quantity of stored information and thus has applications in digital machines. A related study indicates that a marked improvement in both the speed and accuracy of function generation in analog computers can be achieved by using the photomemory as a storage element in a combined analog-digital device. John E. Ward continued his experiments in programming for decision-making.

A highlight of the Laboratory's activities during the year was the successful completion and demonstration of a method of automatic programming for digitally controlled machine tools through use of general-purpose digital computers. A major drawback of digital machine-tool control to date has been the time and effort consumed in programming the machines. Substantial savings may now be expected through use of the Automatically Programmed Tool (APT) System, developed in the Laboratory by Douglas T. Ross. APT has been enthusiastically received by the aircraft industry; and in order to expedite its establishment in industry, the Laboratory served as technical coordinator of a cooperative programming effort by personnel from twenty major aircraft plants throughout the country.

A strong doctoral and postdoctoral program of research was conducted in the area of control. Professor Charles W. Merriam extended his mathematical analyses of adaptive control systems originally developed as his doctoral research. Under the supervision of Professors George C. Newton, Jr. and Leonard A. Gould, doctoral theses were completed by James F. Kaiser on "Constraints and Performance Indices in Analytical Design of Linear Controls," by Robert Kramer on "Effects of Quantization on Feedback Systems with Stochastic Inputs," and by Paul M. DeRusso on "Ultimate Performance Limitations of Linear Sampled-Data Systems."

Professor Gould continued his research on the control of chemical processes, in cooperation with Professor Harold S. Mickley of the Chemical Engineering Department. The work to obtain accurate models of chemical processes by correlating plant behavior as simulated on digital computers with data obtained in the actual plant is expected to progress to the point of yielding test results during the coming year.

The program in advanced radar techniques, under the supervision of Professor J. Francis Reintjes, again placed emphasis on the use of modern magnetic and semiconductor devices in radar circuitry and components as well as systems-type investigations leading to improved airborne equipment. An appreciable part of the circuits and components effort has gone into investigations of thin films as compact, light-weight, and highly reliable circuit elements.

The Laboratory research continues to have a strong influence on the content of several academic subjects in the Department. The radar systems subjects have benefited over the years from the research activities of Professor Reintjes' group and continue to be chosen by approximately fifty seniors of the Department and by Navy and Air Force officers assigned to the Institute for special study. Professor Susskind's subject, Digital Systems Engineering, was presented to approximately eighty students, mostly seniors and graduate students; Nathaniel Rochester, Manager of the Department of Information Research at International Business Machines Corporation, who served as Visiting Professor during the past year, participated in the instruction and contributed from his industrial research experience. As a result of advances in control technology, the graduate feedback-control subjects are being revised by Professors Newton, Seifert, and Gould. Approximately 140 graduate and undergraduate students registered for these subjects during the year.

Of the fifty-one junior research staff members of the Electronic Systems Laboratory, twenty-nine completed theses for three Doctor's, six Engineer, seventeen Master's, and three Bachelor's degrees during the past year.

ELECTRICAL ENERGY CONVERSION LABORATORY

The Electrical Energy Conversion Group has continued its activities in three general fields: 1) solid state energy conversion; 2) magnetohydrodynamic (MHD) energy conversion; and 3) electromechanical systems.

The solid state activity, under the direction of Professors White, Richard B. Adler, and Arthur C. Smith, is primarily concerned with studies of semiconductor materials and devices for direct thermal electric conversion. During the year the Laboratory has completed both crystal growing and evaluation facilities. Significant studies of two compound semiconductor systems are now under way. Problems of interest are the effects of composition and impurities on the thermal conductivity, electrical conductivity, and Seebeck voltage. Related studies of the importance of anisotropy, energy band structure, and scattering mechanisms on conversion properties are also underway. Along with the material investigation, design considerations of thermal electric devices are in progress. A coordinated program of materials and devices development is felt to represent the best approach to both understanding and exploiting the properties of thermoelectric semiconductors.

As part of the department's interests in solid state phenomena, Professors White and Adler attended the Solid State Summer School held during July and August, 1958, at the École Normale Supèrieure (Paris) under the direction of Professor Pierre Aigrain of that institution. In September, Professor Aigrain visited our Laboratory and gave a series of lectures on Thermoelectricity, open to all Institute faculty and staff. The continued cooperation during the year between Professor Aigrain and the group working on thermoelectrics has made significant contributions to our efforts.

The solid state activity has contributed to the undergraduate educational program in molecular engineering and is also cooperating with the other laboratories in the Department in the federation of the Laboratory for Molecular Science and Molecular Engineering. Currently, this area supports nine doctoral candidates and eight Master's candidates. The thermoelectric activity is thus serving as a major focal point for many of the students in electrical engineering whose primary interest is the understanding and exploiting of conduction and transport properties of solids.

Professors Woodson and William D. Jackson of the Energy Conversion Group are directing the research in magnetohydrodynamics (MHD) and its application to energy conversion and control problems. The work is divided into MHD of liquids and MHD of gases. In the study of liquids, turbulent flow of a conducting liquid in the presence of a magnetic field was undertaken to obtain a better understanding of practical devices such as liquid metal pumps and generators. This work has led to one doctoral thesis, "Hydromagnetic Channel Flows," by Lawson P. Harris. In the MHD of gases, interactions between flowing ionized gas and magnetic fields are being studied to better understand the coupling mechanism so as to devise new energy conversion devices for both propulsion and power generation. The research of this group is closely allied with the interdepartmental activity on magnetohydrodynamics and in particular with the work in the Research Laboratory of Electronics. The area currently supports four doctoral candidates and nine Master's candidates.

COMPUTER COMPONENTS AND SYSTEMS GROUP

The summer of 1958 was a period of intense evaluation by the Computer Components and Systems Group of its computer philosophy and its relationship to materials research. After many discussions and arguments, pro and con, a program of research in the physics of thin films and microminiature circuit printing was agreed upon. The ideas for greatly improving the capacity of computers, as developed by the group in the past year, are attracting much attention outside the Institute. In general, activities in the areas of superconductive components, materials handling, and fundamental physics of the thin film state have been amplified, while field emission and electroluminescent thin film work has been attenuated. Two important projects are concerned with magneto-optic rotation.

Computer system theory has continued in its pursuit of such subjects as efficient information storage, adaptive system studies, and computer applications to scientific problems. These activities have been sponsored by the Lincoln Laboratory and the Navy Bureau of Ships. Professor Arthur L. Loeb has furthered the research on thin films and microsystems. Professor Dudley A. Buck, before his untimely death in May, was proceeding along a broad front on vapor plating, electron etching, and cryotron circuitry. Professor Ewan W. Fletcher has studied the physical and logical possibilities of using glass fibers as information processing circuits. Professors Bernard Widrow and Philip M Lewis have been interested in the systems aspects of adaptive information processing and efficient information storage. Professor Ronald A. Howard has been interested in systems analysis of continuous Markov processes. The crystal models developed by Professor Loeb for molecular description and geometrical interpretation have attracted considerable attention.

STROBOSCOPIC LABORATORY

The Stroboscopic Laboratory was moved during the summer of 1958 to a new and more favorable location on the fourth floor of Building 4. It has been very active, with many thesis activities and laboratory experiences conducted in collaboration with classroom lectures in electronic instruments and control.

The focus of attention still remains in underwater instruments and principally in photography. The National Geographic Society Research Committee is financing the design, construction, and application of a 48-flash-per-second, 9-watt-second strobe for use with a motion picture camera. New still cameras are being designed for use on sleds to be towed over the mid-Atlantic ridge by Commander Jacques Y. Cousteau in the *Calypso* during the summer of 1959. The design of a stereo deep sea camera with sonar transducer is being perfected for use in the Puerto Rican Trench during September, 1959.

Considerable progress was made during the year in the development of reflected light photography apparatus in the ½ microsecond range and silhouette photography with exposures in the 1/100 microsecond range.

HIGH VOLTAGE RESEARCH LABORATORY

A two-year study of problems involved in the production of intense positive-ion beams is being supported by the National Science Foundation. Directed by Professor Elias P. Gyftopoulos and Dr. Sanborn F. Philp, the work is immediately concerned with the needs in experimental nuclear science for higher power for binding energy research. It is also relevant to thermonuclear processes and to interplanetary ion propulsion. A broad investigation of electromagnetic means of producing megavolt d-c power in compact, powerful units, directed by Robert W. Cloud, is being pursued as part of this study.

Physical and clinical studies using 2-million volt X-rays and up to 4-million volt electrons for the control of extensive superficial malignant disease have been continued in Building 28 with the medical cooperation of Dr. Magnus I. Smedal and his associates of the Lahey Clinic in Boston. The Damon Runyon Fund for Cancer Research in the U. S. Public Health Service is supporting the further development of this new form of therapy. An exhibit showing advances in administering megavolt X-rays and the protection of radiation-sensitive organs, such as the spinal chord and the eyes, has been prepared by Kenneth A. Wright and Basil S. Proimos for the Ninth International Congress of Radiology, to be held in Munich in July, 1959.

RESEARCH LABORATORY OF ELECTRONICS

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

Visiting Professors

The important contributions of Professor Aigrain and of Dr. Goldman as Visiting Professors have been mentioned elsewhere.

Dr. Paul F. Chenea, on leave from Purdue University where he is Associate Dean of Engineering, served a full academic year as Visiting Webster Professor. During the second term he gave a new subject, Foundations of Electromagnetic Theory. His subject was supplemented by a weekly staff seminar on the same topic.

Professor Laurel J. Lewis, on leave from the University of Washington in Seattle, served as Visiting Professor for the full academic year. He taught one of our graduate subjects in network theory and conducted research in computer and feedback systems.

As Visiting Professor of Communications Sciences, Mr. Rochester contributed significantly to the work of the departmental staff in the Center for Communication Sciences.

Dr. Herbert Freeman, on leave from Sperry Gyroscope Company, was Visiting Associate Professor for the academic year. He led a weekly seminar on control theory and taught Feedback Control Theory and Application as a member of the staff responsible for this large segment of activity in the Department.

GORDON S. BROWN

DEPARTMENT OF MECHANICAL ENGINEERING

The Mechanical Engineering Department has developed during the past year a new set of curricula for the guidance of the undergraduate student. The principal innovation is a program in Engineering Science which is intended for those students of better-than-average analytical ability who prefer to extend their study of science at the expense of some experience with subjects more directly related to engineering practice. These students will normally be among those who enter our Graduate School.

The program in Engineering Science differs from the other programs offered by the Department principally in that it includes one more year of physics, one more year of mathematics, and a two-term sequence of electrical circuit theory and electromagnetic-field theory.

Three other programs which include more material in engineering applications are offered in parallel to the one in engineering science. These are called Power and Propulsion; Design, Manufacturing, and Controls; and Materials, including Textiles. All four programs are essentially the same in the second year. The last three differ slightly in the third year. In the fourth year each is distinctive in the subjects listed and in electives.

An intensive examination of departmental subjects and programs entailed many improvements in subjects. The experiment of combining considerations of design and manufacture into a sophomore subject was tried this year with satisfactory results. Design, materials, and thermodynamics are subjects of continuing interdepartmental study. The role of laboratory instruction has been under study by a committee of the faculty. The first results of this study will be felt in considerable degree in the year ahead.

A new one-year laboratory subject, under the direction of Professor Kenneth R. Wadleigh, is included in the third year of all programs. Emphasis will be placed on the interplay of analytical and experimental work. Responsibility for development of material and for supervision will be shared by many members of the faculty. The laboratories of heat, power, and internal-combustion engines will all be involved. The Sloan Automotive Laboratory, under Professor C. Fayette Taylor, continues to be a major resource in both instruction and thesis.

Design, under Professors James B. Reswick and Robert W. Mann, is being taught as an art which draws upon the scientific disciplines. In the junior design course, each student was asked to design for his term project a visual teaching aid to explain or demonstrate a natural phenomenon. The awards so generously provided by Admiral Luis de Florez for examples of ingenuity in design or experiment have had a marked effect on the morale of the student body and the effectiveness of instruction through design, laboratory, and thesis.

Instruction in mechanics has taken a major step forward under Professor Stephen H. Crandall and his colleagues. The first course is based upon the concept of equilibrium in deformable bodies. An interchange of instructors between this Department and the Electrical Engineering Department has opened up interesting opportunities for coordinating instruction in mechanics with that in circuit theory.

Instruction in thermodynamics, under Professors James A. Fay, George N. Hatsopoulos, and Joseph H. Keenan, is also coming to be based on the concept of equilibrium. A new axiomatic treatment, due largely to Professor Hatsopoulos, promises a far better approach to this exacting and expanding science. In this instance, also, cooperation with other departments is in progress.

Revision of the undergraduate subjects in materials, by Professors Maurice E. Shank and Frank A. McClintock, has drawn upon the work of an interdepartmental study group working in the summer of 1958. The cooperation of the Department of Metallurgy in meeting our desire for a junior subject is gratefully acknowledged.

The most tangible product of this extensive ferment in undergraduate education is the number of textbooks which are in various stages of development. These include new texts in mechanics of solids, dynamics, thermodynamics, and fluid power control, as well as revisions of many existing texts. Probably no other educational device has so extensive an influence as a good textbook.

The Cooperative Course II-B, under the direction of Professor William M. Murray, continues to be an important element in our undergraduate program. A student may spend six months in industry while following any of the suggested programs discussed above. Interest in the program remains high among industrial firms. Student interest is substantial and is increasing.

The Graduate School

Enrollment in the Graduate School of the Department has tended to increase despite an attempt to apply an increasingly strict standard for admission.

The Graduate School is the testing ground for new developments in educational method. As these methods become perfected they find their way down into the corresponding undergraduate subjects. Much of the vitality of the undergraduate program is due to teaching by graduate students. A recent example of a development of this kind is a strong teaching program in magnetohydrodynamics.

Along with other departments, this Department has agreed to recommend for the degrees of Materials Engineer and Doctor of Science in Materials Engineering any of its students who successfully complete a program which was outlined during the year by an interdepartmental committee.

Summer Programs and Symposia

The Mechanical Engineering Department has exceeded all other departments in the number and variety of Special Summer Programs which it has offered. The mature audiences of the Programs have served as excellent sounding boards for the new and the tentative in research and exposition. The Programs have been attractive enough to the faculty member to make it possible to bring together interdepartmental groups, along with a few extramural experts, to concentrate for two or three weeks on a single subject.

Professor Murray has offered several subjects in experimental stress analysis, some of which he has been invited to repeat on the West Coast and elsewhere. Thermodynamics, direct conversion of heat to electricity, metal processing, bearing technology, parachutes, boundary layers in blading cascades, fluid power control, kinematics, metals at elevated temperatures, random vibrations, and some other topics have been the subjects of Special Summer Programs or symposia designed for practicing engineers and scientists.

Research

Space limitations will permit hardly more than a listing of research in progress. Professors Joseph Kaye and Hatsopoulos have made good progress with the development of the thermoelectron engine and have begun work with thermocouple devices for refrigeration. Professor Hatsopoulos has extended this work into a basic study of a plasma in a magnetic field and into diffusion of a gas through a porous solid with Knudsen-type flow.

Professor Kaye has produced results in a study of the effects of high-intensity sound fields on heat flux and is building an anechoic chamber in order to extend this work. He is publishing the results of his work on diffusion in boundary layers of a stream at a Mach number of 5.

Professor Warren M. Rohsenow, in cooperation with the Department of Nuclear Engineering, has supervised an effective attack on the problem of resistance to heat transfer at a metal-to-metal interface. With Professors Peter Griffith, Richard J. Nickerson, John C. Chato, and Lawrence C. Hoagland, he has extended his research on heat transfer to two-phase fluids, heat and mass transport in moist soils, heat transfer to fluids at supercritical pressures, heat transfer in non-circular ducts, and heat and mass transfer during the condensation of one component from a multicomponent gas.

Professor Fay has made notable progress in the understanding of heat transfer in combustion gases at temperatures of 3000 to 5000 K and has discovered a noncatalytic surface which reduces heat transfer to the surface by a factor of 3.

Professor Ascher H. Shapiro is working on the dynamics of rarefied gases. Professors Shapiro, Osman K. Mawardi, Fay, and Hatsopoulos are engaged in experimental studies of plasma dynamics and magnetohydrodynamics.

Professors Wadleigh and S. William Gouse, Jr., are working on heat transfer; small fluid machinery; two-phase flow, including fluidized flow and atomization; and a heart-lung machine.

Professor Tau-Yi Toong is studying some fundamental aspects of combustion instability and flame stabilization in boundary layers.

Professors Taylor and Augustus R. Rogowski are working on the measurement of instantaneous gas temperatures by sonic methods, combustion of liquid fuel sprays in the presence of controlled air motion, and fundamental aspects of combustion of liquid drops.

Professor August L. Hesselschwerdt, Jr., is cooperating with the Departments of Food Technology and Civil Engineering on projects ranging from structures to growth of mushrooms. He and Professor Chato are nearing the end of their work on condensing refrigerants in horizontal tubes. Their work has benefited from the presence of Claremont D. Engebretson, Research Associate on loan from the Whirlpool Corporation to the Committee on Space Heating with Solar Energy.

Professor Crandall is conducting research on the use of variational principles in heat and fluid flow, random vibration, and solution by means of computing machines of LaPlace's equation in cylindrical coordinates. Professor Thomas P. Rona has been working on the instrumentation of vibration.

Professor J. Lowen Shearer and his colleagues are studying basic approaches to the problem of dynamically interacting systems, system and component characteristics important to rational design of high-performance systems, the behavior of non-linear and quasi-linear systems, and new ways to achieve controlled conversion of energy for power control. A new multipurpose electronic analog computer has been leased. Professor Shearer promoted two important sessions, with an international flavor, at the Annual Meeting of the American Society of Mechanical Engineers on "The Role of Control Technology in Engineering Education."

Under Professors Mann and Shearer the Dynamic Analysis and Control Laboratory facilities have been moved from Building 20 into Building 31. Work is in progress there on the generation, utilization, and control of hot-gas power from solid fuels, unsteady flow in partial-admission turbines, non-stationary dynamic response characteristics of a human operator, dynamic loads in gearing, pressurized air bearings, automatic oxygen dilution in high-altitude breathing devices, photo-memory and character-recognition systems, and computer aids in design.

Professor Keenan has continued his cooperation with Professor Frederick G. Keyes (Chemistry) on the formulation of the properties of steam at high pressures and temperatures. He continues to serve on the A.S.M.E. committees dealing with this subject and as Executive Secretary of the United States Commission on the Properties of Steam. In July he attended the first formal conference of the International Coordinating Committee on the Properties of Steam, in Moscow. He is supervising a study of an application of polynomials to the development of a "fundamental equation" for the properties of steam.

A research project on cyclone dust separators, under Professor Keenan, has brought good results in the application of a separation curve for the size spectrum of a dust to the prediction of over-all separating performance. Professor Joseph L. Smith, Jr., has completed an analysis of three-dimensional, axially symmetric flow in a vortex chamber which accounts for the various regimes of flow which he has observed experimentally.

Professor Samuel C. Collins is working on a miniature helium refrigerator for producing superconductivity in computer elements. He has designed a large hydrogen liquefier for the Cambridge Electron Accelerator. In cooperation with the Massachusetts General Hospital and the Boston City Hospital he has worked on the development of a heart-lung machine; means for rapid freezing of cells, organs, and tissues; helium refrigeration of specimens for the electron microscope; and the maintenance of a bank of cultures and tissues in a bath of liquid nitrogen.

Professor McClintock is working on stress and strain around notches under plastic deformation and comparison of the mechanics of plasticity with dislocation mechanics. This work has strongly influenced some undergraduate teaching in materials.

Professors Milton C. Shaw, Brandon G. Rightmire, Nathan H. Cook, and Ernest Rabinowicz are engaged in research on rolling friction characteristics at extremely low temperatures; air bearings; friction and wear of sliders; wear of cutting tools; cutting and polishing of glass, ceramics, and other brittle materials; the effects of adding manganese sulfide and lead to steel; and chemical and physical action of fluids used in cutting processes. They are constructing a radioisotope laboratory with funds provided by the Atomic Energy Commission.

Professors Egon Orowan and Teruyoshi Udoguchi made important progress in the study of repeated strain-aging of low-carbon steels.

Professors Edward R. Schwarz and Stanley Backer are working on impact behavior of fibrous structures, design of textiles for space suits, air flow through parachute materials at high altitudes, prediction of mechanical behavior of fibrous webs from fiber properties and distribution of orientation, an operations-research study of parachute damage, applications of textiles to therapy and surgery, and the relation between cold drawing of fibers and textile performance.

Staff

The Department is pleased to have as additions to its faculty Associate Professor Alan N. Stroh, who has spent the year with us as a Sloan Postdoctoral Fellow from Sheffield University; and Assistant Professor Ali Argon, both in the field of materials. Great benefits have accrued from visits with us of Professor David S. Wood of California Institute of Technology; Professor Udoguchi of Tokyo University; Dr. Mihajlo Mesarovic, Sloan Postdoctoral Fellow from Yugoslavia; Dr. Henryk J. Leskiewicz and Dr. Bogumit E. Staniszewski, both Visiting Research Associates from Poland; and Dr. Jacques R. Goethals, whose prize for a technical paper in Belgium was to spend six months in America.

Professor Rona has requested leave of absence for the coming year. Professor Freddie D. Ezekiel has been on leave of absence during the year to do important professional work in industry. The Department regrets that Professor Reswick has resigned to take a position at Case Institute of Technology, and that Professor Robert

R. Archer has resigned to take a position in a department of mathematics in another university.

A great loss was suffered by the Institute and the Department in the death on May 25 of Professor Alvin Sloane, after 30 years of service. His skill as a teacher, his solicitude for the welfare of students, and his service as an officer of the faculty will make his loss deeply felt. A similar loss is the death on August 17 of Arthur L. Townsend, Associate Professor Emeritus and Director of the Lowell Institute School; he had been a member of the department since 1919, teaching subjects in machine design, applied mechanics, and patent relations, and he had served for many years as the department placement officer.

The staff of the Department has been heavily drawn upon for studies of engineering education as a whole and for other Institute concerns. Professor Shapiro conducted a summer study of undergraduate instruction in engineering science. Professor Norman C. Dahl has been appointed Chairman of the Committee on Undergraduate Policy; and Professor Shank, Chairman of an *ad hoc* committee of the Committee on Undergraduate Policy to consider a proposed major revision of the entire undergraduate program of the Institute.

Professor Shaw has been elected Vice President of the College International pour L'Etude Scientifique des Techniques de Production Mecanique, whose headquarters are in Paris.

Professor Toong went abroad in January on a Guggenheim Fellowship to study basic principles of combustion and to visit institutions in Europe where combustion research is in progress.

JOSEPH H. KEENAN

DEPARTMENT OF METALLURGY

On the basis of discussions with its visiting committee, the Department has taken steps to broaden its interests in the field of materials engineering. An interdepartmental committee under the chairmanship of Professor Morris Cohen recommended a graduate program leading to the degrees of Materials Engineer and Doctor of Science in Materials Engineering. Students enrolled in one of several cooperating departments as candidates for these new degrees will have substantial fractions of their programs in this Department in metallurgy and in ceramics. The Department expects to enroll a number of candidates for advanced degrees in materials engineering next year. There is an acute need for graduate fellowships in support of this program.

A parallel broadening is taking place in the undergraduate curriculum. The basic principles underlying the field of metallurgy are the same as those on which other materials sciences must be built. In the basic metallurgy subjects it is, therefore, a simple matter to introduce examples from other fields such as ceramics and organic substances. With the broadened range of electives introduced into the curriculum several years ago, it is quite feasible for an undergraduate in metallurgy to include organic chemistry and plastics in his curriculum as well as a newly devised subject, the Principles of the Structure and Properties of Ceramics. The undergraduate curriculum has thus become an excellent introduction to the whole field of materials engineering and a basis for graduate study in any specialized branch of this field.

Conferences and Meetings

The year was marked by two eminently successful scientific conferences, in both of which members of the metallurgy staff played a prominent part. Professor Benjamin L. Averbach was chairman of the International Conference on Fracture which took place in Swampscott during April under the auspices of the National Academy of Sciences — National Research Council, sponsored by the National Science Foundation, the Office of Naval Research, the Air Force Office of Scientific Research, and the Ship Structure Committee. The sessions dealt with the atomic mechanisms of cleavage, fatigue, and ductile fracture in metals, ceramics, and polymers. Professors Cohen, Nicholas J. Grant, Walter A. Backofen, and Dr. George T. Hahn also took a prominent part in this conference, and many other staff members and graduate students attended. Professor David A. Thomas will edit the forthcoming proceedings.

The International Conference on the Physical Chemistry of Process Metallurgy in Pittsburgh in April was outstandingly successful in bringing together ferrous and nonferrous metallurgists from all parts of the world. Professor John F. Elliott, as program chairman, played a leading part in the organization and conduct of this symposium. Others participating were Professors John Chipman and Thomas B. King and a number of graduate students.

Metallurgy Research

A number of research accomplishments came to fruition during the year, including the following. Professor Robert E. Ogilvie has completed the construction of an electron probe microanalyzer. This instrument, based on a recent French invention, focuses a beam of electrons on a microscopically small area of a metal surface and analyzes the metal in the area by means of the resultant X-ray. The M.I.T. version is a home-made affair constructed from the parts of an old electron microscope. One of its interesting results has been a joint study by Professors Ogilvie and Herbert H. Uhlig of the nickel content of several metallic meteorites. Variation of nickel content near crystalline boundaries has yielded a great deal of information on the probable metallurgical and thermal history of the meteorite.

A project of Professor Antoine M. Gaudin, sponsored by the Chemical Corps, has succeeded in applying methods developed for mineral flotation to the separation of microbiological organisms. Large-scale separation of spores and vegetative cells may be made.

Professor Grant has developed further the method of strengthening metals by means of an ultra-fine dispersion of oxide particles. This technique, originally applied to aluminum, has recently been used to produce copper strengthened with 3.5 volume per cent aluminum oxide having a creep resistance and rupture strength greater than that of stainless steel at temperatures of 600° to 800° C. It is anticipated that this kind of structure can be developed in other classes of metals and that it will lead to some important applications.

Alfred Duca, well-known sculptor, has been working with Professor Howard F. Taylor to develop a simple art-casting technique applicable to bronze, iron, aluminum, or other metals.

Professional Activities

Members of the staff continue to participate in professional activities on a national and an international scale. Professor Grant is a member of the Materials Advisory Committee of the National Aeronautics and Space Administration. Professor Gaudin made a trip to Russia at the invitation of the Academy of Sciences of the U.S.S.R. and gave six lectures in Leningrad and Moscow. This was followed by a visit to Finland as a guest of the Finnish Academy of Sciences, where he also gave an address. Similarly, Professor Elliott participated in a conference in Moscow and visited a number of Russian steel plants.

Professor Elliott served as chairman, and Professor James H. Brown as secretary, of the Boston Section of the American Institute of Mining, Metallurgical, and Petroleum Engineers. Professor Philip L. de Bruyn was chairman of the Basic Science Committee of the Society of Mining Engineers. Professor Gaudin has been a member of the Board of Directors of the Engineering Foundation. Professors Merton C. Flemings, Jr., and Taylor gave an invited paper at the International Foundry Conference held in Belgium. Professor Chipman served as president of The Metallurgical Society of A.I.M.E., Professor Elliott as its program chairman, and Professor King as chairman of one of its publications committees. Professor Cohen gave invited lectures at the University of Washington and at the Pittsburgh and Philadelphia chapters of the American Society for Metals. He served as an expert at the 1958 meeting of the International Institute of Welding, in Vienna. Professor John T. Norton was on leave of absence during the second term, attending the Powder Metallurgy Conference in London and lecturing at Innsbruck and other Austrian universities.

Enrollment

Enrollment has been substantially constant during the past four years. Graduate enrollment in particular is limited by available laboratory space and cannot be expanded until more space becomes available.

A recent survey of the teaching of metallurgy in the United States and abroad has disclosed the fact that no less than 104 professors and instructors are from M.I.T. There are 42 accredited departments of metallurgy in the United States; the heads of 8 of these departments are from M.I.T.

JOHN CHIPMAN

DEPARTMENT OF NAVAL ARCHITECTURE AND MARINE ENGINEERING

Although the future holds exciting technical developments and expanding activity, the number of students enrolled in this Department cannot meet by far the great demand for our graduates at all degree levels. A principal difficulty of this problem is that one of the two other schools in the country offering degrees in naval architecture is an all-scholarship school and the other is a relatively low-tuition state university.

During the year, 8 Bachelor's, 33 Master's, and 26 Engineer degrees were granted. (It should be noted that 23 naval officers received the Master's and Engineer degrees simultaneously, and one the Master's degree.) Of the 9 civilian students who were recipients of advanced degrees, only 2 are United States citizens. Seven recipients of the Bachelor's degree are United States citizens and one is in the process of acquiring citizenship.

The Department continues its important role in the training of naval officers. The class of 1962 in Naval Construction and Engineering (Course XIII-A) is composed of 14 U.S. Navy officers, 3 U.S. Coast Guard officers, and 7 foreign naval officers, making a total of 24 new students. Following the policy initiated last year, 4 Brazilian naval officers will join the class of 1961 in Course XIII-A, bringing its total to 28.

The U.S. Department of the Navy is initiating a plan to continue one of its naval engineering students in each group for an additional year of study to obtain the doctoral degree. Present plans call for a member of the XIII-A class of 1960, and probably a member of the class of 1961, to continue for the doctorate.

Personnel Changes

Professors George C. Manning and Evers Burtner, who retired from the Institute at the end of the academic year 1957–58, will serve as Lecturers, part-time.

Captain Jack A. Obermeyer, U.S.N., was relieved of his duties at the Institute by the Department of the Navy at the end of the academic year 1957–58 and was succeeded by Captain Edward S. Arentzen, U.S.N. Commander Joe W. Thornbury, U.S.N., will be relieved, after three years of duty, at the end of the academic year 1958–59 by Lieutenant Commander John R. Baylis, U.S.N.

Professor Kemal Kafali of the University of Istanbul, Turkey, who has been a Guest of the Institute since October, 1957, will return to his country at the end of this academic year. Dr. Shosuke Inoue, Professor of Naval Architecture at Kyushu University, Japan, and a Guest of the Institute for the second term of 1958–59, has been working in the Department.

Educational Program

Studies of the undergraduate curriculum by a departmental committee continued and will result in further adaptation of the curriculum to present-day science and engineering developments.

In the Francis Russell Hart Nautical Museum, various exhibits of ship models and plans were arranged. A short-term loan of whaling prints and Benjamin Russell paintings was again made to the Old Dartmouth and Whaling Museum, New Bedford. Emeritus Professor George Owen, who died during the year, willed his yacht and commercial ship models, plans, and pictures to the Department. Some of these are on display in Building 5.

Research and Technical Activities

The Propeller Tunnel, in addition to extensive use as a teaching and research tool in undergraduate and graduate instruction, has produced significant and unexpected results in the investigation of hydrodynamic vibratory effects. Professor Kafali has continued his work concerning propulsive and steering effects of propeller-rudder configuration. A substantial grant-in-aid has been received from an industrial firm to permit extension of work on controllable pitch propellers.

Use of the Ship Model Towing Tank as an effective research and instructional facility continued through the year. Research work was conducted in the tank in the areas of antipitching devices and the behavior of unconventional ship forms in waves. Physical model check was made of mathematical model calculations in the area of pitch damping due to wave generation.

Funds for designing and building a towing carriage were donated by a group of firms and by the Institute. Research in important new areas of ship hydrodynamics will be possible when this additional facility is completed.

The tank will be represented at the Twelfth American Towing Tank Conference in September, 1959, at Berkeley, California. Of the five reporting committees, two are chaired by Professors Martin A. Abkowitz and Laurens Troost.

The polariscope in the Ship Structures Laboratory was used this year for turbulence stimulation flow studies by means of a newly constructed pilot model of a closed circuit flow channel which makes use of the streaming double refraction property of a colloidal suspension of hectorite. Of prime value in such studies is their bearing on the refinement of model testing techniques.

The extensive second phase of buckling experiments on wide flat plates, being conducted for the Society of Naval Architects and Marine Engineers, is about half complete. Two degrees of rotational restraint are being applied to the long, loaded edges. It is hoped that all testing will be completed during the summer of 1959.

Additional instrumentation secured for this program greatly increases the accuracy of results and efficiency of operation.

Among the sponsored research projects carried on by the staff are the investigation of the performance of very unconventional ship forms in rough water and studies of the performance of a very deep-diving oceanographic research submarine, particularly as it rises rapidly to the surface in an emergency ascent. These projects link the Department with some of the most exciting engineering projects undertaken in the shipbuilding field during the past year.

A two-week Special Summer Program on the Stability and Control of Ship Motion was offered during the summer of 1958.

The Department's brochure written to attract young people to the profession continues to find widespread interest. The Society of Naval Architects and Marine Engineers now is essentially using this brochure and is sponsoring several attractive scholarships at the Institute.

LAURENS TROOST

DEPARTMENT OF NUCLEAR ENGINEERING

With the increased use of nuclear reactions for the generation of power, the transmutation of elements, and the production of radiation, a new professional field, nuclear engineering, has developed. In 1952 M.I.T. instituted a program of instruction in nuclear engineering at the graduate level within the Chemical Engineering Department, and in 1958 a separate Department of Nuclear Engineering was formed in recognition of the maturity of this new field.

During the past year the Nuclear Engineering Department recommended forty-six students for the Master's degree and seven for the Doctor's degree. These men have been in demand by prospective employers and have accepted responsible positions in industry, government laboratories, and teaching. Student interest in nuclear engineering is high, and the number of men from the United States and abroad seeking admission to the Institute's graduate program in nuclear engineering substantially exceeds the number for which we have places. These and other indications of the emergence of nuclear engineering as a recognized field of professional endeavor are evidence of the timeliness of the establishment of nuclear engineering as an independent department at M.I.T.

Educational Program

All instruction is at the graduate level. The teaching staff consists of ten professors, each of whom has had professional experience in physics, chemistry, chemical engineering, mechanical engineering, or electrical engineering. These are the principal fields of undergraduate training represented by the Department's students. There are two course options: the fission technology option has been available for several years, and the thermonuclear process option has been developed during the past year by Professors David J. Rose and Melville Clark, Jr. The Department offers instruction in thirteen subjects, of which Nuclear Reactor Theory II, Nuclear Reactor Laboratory, and Introduction to Thermonuclear Processes were taught for the first time during the past year.

In a field evolving as rapidly as nuclear engineering, the curriculum and subjects of instruction must be revised frequently. The Department's teaching staff is making every effort to keep instruction in nuclear engineering up-to-date, complete, and authoritative.

Research Program

Participation in research is an essential element in the training of graduate students in nuclear engineering. Members of the Department teaching staff are engaged in a variety of sponsored research projects which provide valuable experience for their students. The most comprehensive research project is a fundamental experimental study of reactor lattices, directed by Professors Theos J. Thompson and Irving Kaplan, under sponsorship of the U. S. Atomic Energy Commission. This project uses the thermal column of the M.I.T. reactor as a neutron source for subcritical reactor lattices.

Professor Edward A. Mason will study the decomposition of hydrocarbons in a loop within the M.I.T. reactor to determine the behavior of these materials as coolants in a type of power reactor being developed by Atomics International for the Atomic Energy Commission.

With support from the National Science Foundation, Professor Norman C. Rasmussen is determining nuclear energy levels with high precision by measuring the spectrum of gamma rays emitted by radioactive isotopes produced in the M.I.T. reactor.

Preliminary to use of the M.I.T. reactor in experimental cancer therapy, Professor Gordon L. Brownell is measuring the intensity and energy distribution of neutrons in the beam from the reactor into the medical therapy room, under a grant from the Rockefeller Foundation.

Professor Thompson is measuring the attenuation of radiation from the reactor in shielding materials supplied by the Bethlehem Steel Corporation. All of the above projects make use of the M.I.T. reactor, the Department's principal research facility.

Research is also being carried out in other areas, some of which are mentioned below. Professor Rose is participating in M.I.T.'s interdepartmental research program in plasma dynamics, which is being supported by substantial grants from the National Science Foundation, the Department of Defense, and the Atomic Energy Commission. Professor Alan H. Stenning is engaged in engineering studies of nuclear propelled rockets, supported by Pratt and Whitney Aircraft. Professor Elias P. Gyftopoulos is analyzing the dynamic behavior of the cooling system of the Enrico Fermi Nuclear Power Station for the Power Reactor Development Corporation. With support from Oak Ridge National Laboratory, Professor Mason is determining the solvent-extraction behavior of liquid ion-exchangers, a new class of materials for separating uranium from its ores or decontaminating irradiated nuclear fuels.

The M.I.T. Reactor

The M.I.T. reactor "went critical" on July 21, 1958. An extensive series of test measurements on the reactor were then carried out, first at low power and later at the design power of 1,000 kilowatts. The reactor behaved admirably in all of these tests. Participation in these tests was an experience of unique educational value for those students fortunate enough to be in residence during the start-up period of the reactor. The reactor is now in regular operation at 1,000 kw.; it makes possible many research projects for this and other M.I.T. departments, for medical research teams, and for industrial concerns renting reactor space.

The reactor has proved to be a useful and versatile research instrument and has attracted thousands of visitors from the United States and abroad. Its successful completion and operation are due to the untiring efforts of Professor Thompson and the reactor staff.

A.E.C. Support

The Nuclear Engineering Department has received substantial financial assistance from the U. S. Atomic Energy Commission. During the past year, thirty-four of the ninety-six regular students registered in the Department held Atomic Energy Commission Fellowships in Nuclear Science and Engineering. M.I.T. has been the recipient of grants from the Atomic Energy Commission totaling $210,000 for the purchase of equipment to be used in laboratory instruction in nuclear engineering and radiochemistry. The Atomic Energy Commission has lent M.I.T. the heavy water and uranium 235 used in the M.I.T. reactor and has defrayed the cost of fabricating the reactor fuel elements. Finally, the Atomic Energy Commission sponsors much of the research carried out by the Department. We are grateful for this generous financial assistance. At the same time, we are conscious of the risk involved in having so large a fraction of the Department's financial support come from a single source. Development of other sources of financial assistance, particularly from private industry, is one of the most important problems facing the Department.

MANSON BENEDICT

RESEARCH LABORATORY OF ELECTRONICS

During the past year, activities in the Research Laboratory of Electronics have included projects of direct interest to members of the faculty and students from eight academic departments. The doctoral and Master's theses evolving from such research projects always have been of high caliber. This year produced, in addition, a greater number than usual of first-rate Bachelor's theses. This situation merely reflects the growing tendency for undergraduate participation in the work of the various research groups in the laboratory. Such participation is encouraged to the limit of available space, equipment, and budget.

The TX-O computer provided by Lincoln Laboratory was installed during the summer of 1958. Almost immediately, this extremely versatile machine became an important asset to many research projects. Ease of programming is the basis for its special appeal. Any user of the machine can learn to do his own programming in a very short time, and as a result large numbers of the research staff and students have used the computer. The TX-O serves a different purpose than other computing facilities available at M.I.T. Though perhaps not as good as the I.B.M. 704 for producing detailed numerical results, the TX-O is very helpful during the formulation and preliminary stages of problem solution and for problems that require a pictorial presentation of data. Both the TX-O and the I.B.M. 704 were used heavily throughout the year.

Excellent examples of undergraduate use of these machines can be seen in the work of Lawrence G. Roberts and Robert W. Grass. The former programmed a problem in pattern recognition on the TX-O, and the latter used the 704 to compute a table of values to be used in a special-purpose target tracking system.

The Communication Sciences Center, established at M.I.T. somewhat more than a year ago, embraces a large segment of the research activity of the laboratory. The Center provides the mechanism for consolidating and extending the research pertaining to human communication systems. These include such diverse yet closely related subjects as information theory and coding, artificial intelligence, biophysics, linguistics, and psychology. Each of these must be further detailed to clarify the pattern of the interplay between the various disciplines. Even during this period of growth and organization, with many of the activities incompletely staffed, the research in progress has already received considerable stimulus. A number of outstanding visitors, such as Professor Nathaniel Rochester, on leave from I.B.M., have contributed to the work in progress during the past year. Other visitors have been invited for the coming year, for periods ranging from a few days to the entire year.

Professors William P. Allis and Sanborn C. Brown for many years have had active groups working in the field of microwave gas discharges, supported in large part by the Atomic Energy Commission. Recently attention has become more concentrated on high density plasmas. Since a number of persons in several departments are interested also in these and related problems under the general field of plasma dynamics, the question of more active collaboration has been under discussion for some time. As a result this collaboration has become more formalized, and the plasma dynamics group is now an active division in the Research Laboratory of Electronics. Support for this activity has been secured from the National Science Foundation, and this will permit the construction and operation of some large and more expensive devices, notably a high-current d-c arc.

The plan to use Technology Press monographs as a means of obtaining wider distribution of research reports was put into effect during the past year. The first publication was a series of lectures given by Professor Norbert Wiener and transcribed by Professor Yuk-Wing Lee and his group. The second was a monograph on noise theory by Professors Hermann A. Haus and Richard B. Adler. Other monographs are well along in the production schedule.

During the summer of 1958 the Research Laboratory of Electronics, jointly with Lincoln Laboratory, conducted a special study of Army communication problems for the Signal Corps. Participants from other laboratories and companies contributed to the study.

A detailed list of individual accomplishments is too lengthy for inclusion here. A few will be mentioned to indicate the scope of the research activities. Professor David A. Huffman added significant contributions to sequential switching theory; Professor Campbell L. Searle and his students contributed to the theory of variable-reactance amplifiers and frequency multipliers; Professor Jerrold R. Zacharias and his group conducted a study outlining a method of gravitational red-shift measurement using an earth satellite as a vehicle for carrying a precise frequency standard; Professors Malcom W. P. Strandberg and Robert L. Kyhl have made further progress on maser amplifier development; Dr. Jerome Y. Lettvin and others in the neurophysiology group contributed to the understanding of the mechanism of vision; Dr. Manuel V. Cerrillo, working on information processing and pattern recognition, independently postulated a mathematical model that agreed in general with Lettvin's results. Professor Louis D. Smullin and his associates completed the development of the theory of the gain-band performance of stagger tuned klystrons, and construction of experimental tubes based upon this analysis has begun.

Dr. Ronald G. Newburgh, working in Professor George G. Harvey's group on soft X-ray spectroscopy, has just completed a thesis on the experimental determination of the energy width of the conduction band of electrons in copper and nickel. He was able to show that this width is considerably greater than earlier measurements would indicate. The present result is considerably more reliable due to improved technique and cleaner surfaces.

Using the techniques of electrical engineering as well as those of neurophysiology and psychophysics, Professor Walter A. Rosenblith is continuing his research on the physiology of hearing. Professor Rosenblith is co-director of a new and unique laboratory which was established during the year by M.I.T. and the Massachusetts Eye and Ear Infirmary. Doctors, neurophysiologists, and electrical engineers will work together in this new laboratory in a program of research, treatment, and education which, it is hoped, will contribute to the understanding of the basic phenomena of hearing and help solve some of the problems of deafness.

During the past year, fifteen doctoral theses, five Engineer theses, twenty-nine Master's theses, and fifty-seven Bachelor's theses were sponsored by the Research Laboratory of Electronics. In addition, numerous smaller academic research projects were carried out by full-time graduate students, most of whom held fellowships.

The research staff included fifty-nine professors, eight instructors, three research associates, ninety-one research assistants, and eleven teaching assistants. These academic appointees represented the Departments of Physics, Electrical Engineering, Mathematics, Biology, Modern Languages, Chemistry, Chemical Engineering, and Nuclear Engineering. Total personnel, including non-staff and hourly employees, numbered about five hundred during the year.

JEROME B. WIESNER

School of Humanities and Social Science

IT IS DIFFICULT TO SELECT a single outstanding event to head a report on the activities of the School of Humanities and Social Science over the past year. Instead, I must call attention to a variety of highlights.

The successful completion of the first year in our unique graduate program in political science leading to the Ph.D. degree represents a major step forward in the development of the social sciences at M.I.T. Our social science program was further strengthened during the year by two grants from the Ford Foundation: one providing $50,000 per year for five years in support of our graduate program in economics, especially at the level of dissertation writing; and a second in the amount of $850,000 to assist us in stabilizing the program in international and foreign studies at the Institute. The latter grant will enable us to appoint two distinguished and mature scholars to permanent posts as professors and will help in other ways that will be elaborated later in this report.

Professor Roy Lamson assumed direct responsibility for Course XXI, our undergraduate major in Humanities and Engineering or Humanities and Science, and made significant improvements on several fronts. The Department of Humanities gave increased attention to the problems of composition and technical writing. The Special Summer Program in editing technical reports and instruction in technical writing in collaboration with the engineering departments both continued on an expanded basis, and a new remedial workshop on composition was established for work with selected undergraduates.

After several years of planning and experimenting, a Language Laboratory has been installed to provide modern teaching facilities for foreign languages.

The Choral Society, under the direction of Professor Klaus Liepmann, again distinguished itself during a year which included another successful European tour.

After a year's review by a special committee chaired by Professor E. Cary Brown, the Economics Department decided to revise its undergraduate program. In particular it added a new field for concentration in Course XIV, quantitative economics and methods, which will emphasize statistics, econometrics, and "operations research."

This last reflects a general trend in both the teaching and research programs in the social sciences, languages, and humanities to take the greatest possible advantage of the environment of our particular institution. Evidence of this trend is apparent, also, in some of the new subjects being offered in the political science graduate program, in certain research projects going forward at the Center for International Studies, in the theses of Course XXI, and in other areas. This is as it should be — not only because it represents M.I.T.'s comparative advantage among American universities but, more importantly, because the problems of the modern world, which were largely created by our developing technology, are susceptible to solution only through the combined efforts of both natural and social scientists. The social, political, and economic implications of scientific and technological change and the increased applicability of quantitative techniques of analysis to social science problems have served, to some extent, to break down traditional disciplinary boundaries and to show the need for teaching and research organized around central problems rather than separate intellectual disciplines.

The problem of integration among the disciplines is formidable at best. The humanists and the social scientists of the world do not really have many profitable exchanges; the relation of either to the natural scientists is at once more tense and more productive. The artists and architects who place more faith in intuition than in intellect may not have done as much damage to the house of the intellect as Jacques Barzun has suggested, but they do not ride in easy harness with those who use and value the intellect. Nonetheless, despite all the stutterings and the false starts, every effort must continue to be made or else the men of the separate disciplines will more and more come to deal only with partial problems, while whole problems will be left to men of no discipline at all in a world in which goodwill and "common sense" are obviously no longer sufficient.

At M.I.T. we do have a particular advantage and therefore a particular responsibility. The members of our faculty, regardless of their field, do not fear science, do not wish to undervalue it, do hope to understand it. The men of science here do not scorn the work of their colleagues in the humanities and social sciences as "soft." We have no time to spend in scoring brilliant verbal victories over each other or in polemical defenses of private bastions which have already crumbled. We can find a considerable number of terribly important problems about which talent and knowledge need to be pooled. And we have set about trying to make some of the necessary integrations not as a matter of theory or of paper organization but in specific contexts. This is all as it should be in a university polarized around science and technology and in a faculty which believes in change, if not necessarily in progress, and is determined to help to make our present-day world work on present-day terms. We do not believe in a retreat to village life or Greek urban life which, however admirable they may seem in retrospect, were quite as troublesome to those who lived the lives as the different life we now have is to us. Our advance is slow; the finish line seems far away — but we are not lying dead in the water.

Upperclass Electives

Each M.I.T. junior and senior is required to elect a group of subjects in the humanities or social sciences, normally four in all, and usually in a single field. The distribution of these elections changes slightly from year to year. The table on the next page offers comparisons for the years 1957–58 and 1958–59.

Last year I noted an increase in all the upperclass electives studied amounting to 366. This year, despite a very small increase in the number of upperclassmen (1 per cent), we note a decrease of 198. Ups and downs of this order are probably not significant unless a trend is revealed. Last year many more subjects were taken than programs barely meeting the minimum requirements would have accounted for; so it was again this year, and by 17 per cent.

It is, however, useful to examine the rank order of the choices and any substantial changes in them. Economics continues to enjoy the most selections; but the built-in requirement made by most of the engineering departments accounts for enough of the registration so that it is fair to say that, on a free choice basis, literature remains the most popular, and with no serious competition. The modest increases in registration in history and philosophy are interesting and encouraging, especially as one might expect many students to

Elective Choices in the Humanities

	1957–58	*1958–59*	*Change (in per cent)*
Total number of juniors	854	849	
Total number of seniors	883	907	
Total upperclassmen	1,737	1,756	
Required upperclass registration	3,474	3,512	+1%
Actual registrations:			
Economics	1,206	1,080	—10
Literature	703	638	— 9
Psychology	519	487	— 6
History	389	410	+ 5
Philosophy	366	391	+ 7
Political science	378	348	— 8
Music	292	291	None
Fine arts	149	201	+35
Industrial relations	242	171	—30
Foreign literature and linguistics	112	141	+25
Total	**4,356**	**4,158**	**—5%**
Registrations above requirement	882	646	—26%
Per cent of registrations above requirement	22%	17%	

avoid them as a "flight from the core," which is so heavily historical and philosophical. The increases are surely in some measure a testimony to the improved quality of the faculties in these fields. On the other hand, comparable improvements in the faculties of the social sciences have not been met with increases in registration but rather with small percentage declines. With one exception I cannot look on these changes as being very significant. The modest declines in economics, psychology, and political science may quite easily shift the other way in another year.

On the other hand, the decline in the registration in industrial relations is major; and it is moreover the continuation, even the acceleration, of a trend. Professor Robert L. Bishop, Head of the Department of Economics and Social Science, notes that the same trend can be observed in a decline of applications for graduate study in that area. In his view this is "attributable to an increasing public disapproval of labor unions and a decline of sympathetic public concern for the economic status of the working man after a long period of prosperity and creeping inflation, in notable contrast to attitudes that were prevalent during and after the 1930's. To some extent, indeed, the popularity of economics itself with students is 'counter-cyclical' — rising in depression and falling in prosperity — although this tendency is less strong for economics as a whole than for a special field like industrial relations."

This may be true for graduate work, but I find it hard to believe that it is the entire explanation for the undergraduate figures. The electives in industrial relations to satisfy the general education requirements were installed to meet a need for a particular kind of social psychology at a time when the M.I.T. undergraduate had few alternatives in this area. Now strong programs in political science and psychology certainly compete for some of this student interest. We have not expanded the work or the faculty in industrial relations as we have done in political science and psychology, and the undergraduate demands of the School of Industrial Management in this field as taught in the Department of Economics have also diminished. It would be a mistake, I believe, to regard the trend as one that is likely to be reversed; and we should no doubt re-examine the content of these subjects and their relation to the whole general education program at M.I.T., although it must be emphasized that it is the trend which is of concern and not the present absolute numbers.

On the other hand, the favorable trend in studies of foreign literature and linguistics continues. Now one can also see the beginning of a rise in the election of fine arts, which this year shows by far the largest percentage increase (35 per cent). This justifies the opinion of the committee which recommended the new program some years ago and warrants appreciation to the School of Architecture, which supervises the program, and especially to Associate Professor Albert Bush-Brown and Assistant Professor Robert O. Preusser, who are directly responsible.

Other Undergraduate Subjects

Little need be said of the other undergraduate subjects this year. The Department of Economics and Social Science has a continuing concern for the effectiveness of the first subject in economics, 14.01, in which 637 students were registered this year. The Department is aware of the difficulty created by the fact that the great majority of the sections are taught by teaching assistants. During the year, Professor E. Cary Brown questioned the students taking 14.01, seeking student evaluation of the subject and the quality of instruction. On the whole this was reassuring, though some weak spots were brought to light. In the second term, a special effort was made to include more members of the senior staff, and Professors Brown, Evsey D. Domar and Robert M. Solow each took a section. Further improvement will be possible when some gaps are filled at or near the assistant-professor level. This has begun with the appointments of Assistant Professor Robert Evans, Jr. and Visiting Associate

Professor Murray C. Kemp. However, we may as well face the fact that the staff structure in economics will remain a problem because of the relative shortage of experienced junior men in contrast to a wealth of full professors, most of whom are inevitably committed to graduate and advanced undergraduate subjects and to various programs in the School of Industrial Management. The problem might readily be solved if this faculty were content, as most university faculties are, to handle the "baby" subjects through lectures by one or a few of the senior men; but the Department, and indeed the faculty of the School, has consistently regarded this solution as unacceptable.

The core curriculum subjects have remained substantially the same, and newcomers to the staff have adjusted rapidly and successfully to the unusual demands, largely because of the time and effort spent by Assistant Professors Charles R. Niehaus, Bruce Mazlish, and Rowland L. Mitchell, Jr. in explaining the objectives of the Course and in preparing detailed memoranda suggesting ways of handling the readings.

Nonetheless the time has probably come to revise the core substantially. It is not that the subject matter is shopworn or obsolete, for it can never be. But it is not the only possible subject matter, and cores of this kind are at their best when they are taught by innovators with enthusiasm and not when they are frozen in any mass mold. A core should reflect the interests and enthusiasms of those teaching it more than the legacy of others who have gone on to other pursuits. Therefore substantial revision has been discussed in a series of staff meetings in the Department of Humanities. As a result, Professor Niehaus is expected to spend the summer of 1959 in preparing a new plan for autumn discussion.

Enrollments in Russian continued to spearhead the growth of registration in the Department of Modern Languages, which was up 50 per cent over the previous year. This year, for the first time, we have more students enrolled in Elementary Russian than in Elementary German by a small margin: 305 in two terms of Elementary Russian, 300 in German. We still offer more subjects in German than in Russian, so the total enrollment in German subjects is larger than that in Russian subjects: 720 vs. 471.

The rise in Russian enrollments did not take place at the expense of other language subjects, and this may require an explanation. Another inflationary factor was at work; namely, the substitution in the fall of electives for the previous military science requirement. The growing awareness in the country of the importance of foreign languages for Americans — as exemplified by the National Defense Education Act of 1958 and by the statements from the office of the President of the United States and from Dr. Killian's Science Advisory Committee, which put foreign languages on a par with science and mathematics as areas which need special attention — certainly contributed to the students' selection of electives in foreign languages rather than in other fields.

After years of planning, a laboratory for teaching languages has been installed. The general idea involves facilities for students to listen to recorded selections, to record their imitation or some other response, and to play back both the original and the response for comparison. Such programs are now widespread. There may be as many as five hundred language laboratories in the United States plus several dozen others at overseas establishments of the Armed Forces and the International Cooperation Administration. The value of such teaching facilities has been indisputably demonstrated. At M.I.T. we have delayed because we felt the available equipment was not really satisfactory. Over the past two years Professor William N. Locke has worked with Thomas F. Jones, Jr., formerly associate professor in the Department of Electrical Engineering and now Head of the School of Electrical Engineering of Purdue University, to design really satisfactory remote-control recording and playback equipment. At the end of last year specifications were submitted to several companies, one of which, General Electronic Laboratories, Inc., of Cambridge, agreed to go into design and production on a thirty-position laboratory for the Institute. The price was to be competitive with that of installations with conventional equipment.

Six months of intensive work by the company, a gift of $5,000 from an alumnus who has asked that his name not be used, and a grant of $16,114 from the Educational Facilities Laboratories, Inc., of New York made it possible to start installing fourteen positions in January. Small groups of students started using the equipment in March, and by the first of May the room was being scheduled for twenty-seven hours a week. During the summer the number of positions will be increased to thirty, and next fall the language laboratory is expected to be scheduled for forty or more hours a week, so that instructors will take each elementary and intermediate class to the laboratory for oral work at least once a week.

Undergraduate Majors

The biggest problem confronting the undergraduate major programs in the School of Humanities and Social Science is that they are not well enough known or understood outside the Institute. Briefly, they are designed so that a student may combine a program of serious study in the social sciences (Course XIV, economics or politics) or in the humanities (Course XXI, philosophy or history or literature) with an equally serious program in some branch of science or engineering and thus earn a Bachelor's degree. On attainment of this first degree he will admittedly not be prepared for professional performance in either area of his "double major." What he is prepared for is graduate work in either of the majors, or in professional schools of law, medicine, or industrial management, or to take his place in the world with other young men whose formal education is terminated with a baccalaureate degree. We hope and expect that many, even most, of the graduates will do graduate work in a specialty to which the breadth and depth of their undergraduate experience will forcefully contribute; and we think that those who stop with the first degree will bring a special and currently unusual competence to the world of affairs, in that they will know much more about science and technology than most holders of Bachelors' degrees in a world where science and technology are prime movers, to be ignored or misunderstood at the citizen's peril.

It must be emphasized that these courses of study are difficult and that men cannot succeed in them who are unable or unwilling to do strong work in subjects of science and technology which are taught with no change of content or demand for performance from that applied to M.I.T. students who carry a single major in science or technology. The four-year program naturally includes fewer subjects in these areas, but there is no abatement of rigor.

Several kinds of students might be attracted to this program. There are some who enter M.I.T. with hopes and expectations that are not met by their programs of study, who find themselves unable to carry on the rigorous scientific or technological subjects, and who may even lose interest in them. Sometimes, but not very often, such students reveal greater talents in the social sciences or humanities, and they may look on Course XIV or XXI as a refuge from what they have come to reject. Although such students can enter these Courses as long as they are in good academic standing, we do not encourage them to do so. If their talents and interests in the humanities are real and substantial, and if this is coupled with a positive block in matters of science and technology, it would be better for them to transfer to an institution which places less emphasis on these latter subjects and is less demanding of good performance in them. Courses XIV and XXI would serve no serious purpose if they were dominated by students with such a disposition.

Inside M.I.T. there are others who want to and can perform well in both the areas that any of our School curricula require, who wish to defer ultimate choice, who understand the advantage of having a good comprehension of both areas (even if their intention toward a specialty is clear), and who are willing to defer a little (for the Ph.D. perhaps no delay) the achievement of the competence provided by their formal education in favor of greater breadth and maturity. These are the men we do want.

There must be many more such young men who never seriously consider M.I.T. at all and who, if they understood the present and quite new opportunity, would seek to come here explicitly for these programs. We must find better ways to bring this understanding to more good students and their advisers in the secondary schools.

Course XIV, although now substantially modified, has existed for many years. Course XXI is quite new, having graduated its first class of 11 last year, and that a "rump" class. The new opportunities are bringing a quiet but encouraging increase in numbers, and even in those who elect the program as freshmen. (In the past the enrollees have swelled by transfers from other Courses at the sophomore or even the junior year.) Last year we had 13 seniors in XXI and 11 in XIV; this year there were 25 in XXI and 18 in XIV. A year ago there were a total of 111 undergraduates registered in these Courses, this year 129. Of the latter number, 49 were in Course XIV and 80 in Course XXI, so the growth is satisfactory. It is hard to name an optimum size for this program, but probably a group of 25 or so in each class in each department would be reasonably efficient. This would mean something like two hundred students altogether.

But the registration statistics are not sufficiently discriminating. What we need is a high product of quality times quantity. At present we have a top group who are not surpassed in academic performance by any undergraduates in the Institute and a bottom group who may not be up to the average performance of all the M.I.T. students. We want to encourage more of the former and fewer of the latter and must do this without the imposition of quotas, which are permitted neither by institutional policy nor by our own desires.

An example of what we like is given by this year's sophomore class in Course XXI. There were 27 of them. One-third were in the first quarter of their whole M.I.T. class; one-half in the first half; 85 per cent were in the upper three-quarters. Since at this stage of their careers most of their academic record was based on their performance in science, this is convincing enough and essentially satisfactory. Of the 27, five held National Merit Scholarships, one an Alfred P. Sloan Scholarship, one an Armco Scholarship, and two had General Motors National Scholarships; so that about one-third had scholarships of the most competitive national types. About one-half had some form of scholarship aid.

But we must peg our ambitions and our standards still higher. And to succeed in this we must, I am confident, rely principally on having these programs better understood among potential students who perhaps do not even consider what is stereotyped in their own minds (or those of their advisers) as a typical M.I.T. program. There is no such thing any more, even in the professional areas — a fact which is not yet understood. This is a task on which all members of this School's staff must work.

The undergraduate program in Course XIV was given a substantial going-over last summer by a committee consisting of Professor E. C. Brown as chairman, Professor Harold A. Freeman, Associate Professor Abraham J. Siegel, and Assistant Professor Francis M. Bator. In January the committee submitted an excellent 22-page report to the departmental policy committee, primarily on the economics side of the department's undergraduate teaching. Following a careful historical review, a number of suggestions were made as to desirable changes in certain subjects and in the structure of the economics option of Course XIV. Specifically, it was suggested that a greater degree of elective freedom be allowed our majors, especially as between the social sciences and the engineering or science components of their programs, and also as to the type of economics that they might wish to emphasize. Under the latter heading, we propose to give our economics students in Course XIV a choice among (a) general economics (essentially as a liberal arts supplement to their technical work), (b) industrial and labor economics (with somewhat more professional significance), and (c) quantitative economics and methods (a new option, with heavy emphasis on statistics, econometrics, and possibly "operations research," which would have a distinctly professional orientation). These changes, along with several additional subjects, were approved.

Course XXI gained enormously when, in September, Professor

Lamson assumed direct administrative responsibility for the Course. He has approached the task of familiarizing himself with the students, the registration officers, and the curriculum with great enthusiasm, skill, and tact.

The humanities seminar and the thesis received much of his attention. He arranged meetings of the seminar at which members of the staff discussed subjects, standards, and approaches to the thesis and the ways by which it could be related to the experience of the student in both his professional field and his humanistic studies. At other meetings students had an opportunity to discuss their thesis topics with specialists in history, literature, philosophy, and the history and philosophy of science. The main purpose of these meetings was to improve the quality of the theses by encouraging and assisting the seniors to get started early in the year under expert guidance. From now on this orientation work will begin still earlier.

In the spring term other meetings were held to discuss bibliography and research methods in the humanities; toward the latter part of the term the seniors reported orally on their theses at a meeting of their supervisors and other members of the staff. From this meeting the students gained a sense of the standards we are striving for and a feeling that the staff was interested in each individual's project.

The problem of placement needed study for the first time because of the diverse and frequently vague plans the students had about their futures. Professor Lamson arranged two meetings to discuss this problem. At the first Thomas W. Harrington, Jr., Placement Officer at M.I.T., explained the placement system to more than half of the students in Course XXI and answered many specific questions which they raised. As a result of this meeting came an agreement that each Course XXI man, in order to have equal opportunity for job interviews with men in the science and engineering Courses, would be listed in the Placement Office both under Course XXI and under the Course in which he was doing his technical major.

Since a substantial number of the seniors (and also the juniors) in Course XXI have tentative plans for a nonscientific academic professional career, the second meeting was devoted to a discussion of graduate school study in nonscientific fields and particularly to the problems facing an M.I.T. student because of his less conventional undergraduate studies in the humanities. The diverse backgrounds of our staff enabled them to inform the students of admission requirements, language requirements, and programs of study in several disciplines in specific graduate schools.

The number of students planning to go on to graduate work in some field of the humanities has raised some difficult questions in regard to the curriculum in Course XXI. As a first step toward providing adequate undergraduate training in one of several disciplines, the program has been made more flexible by eliminating 21.81, Science and Philosophy from Antiquity to Copernicus, and 21.82, Science and Philosophy from Copernicus to the Present, as requirements for all Course XXI students. These subjects are now required only for those who plan to concentrate in the philospohy and history of science. Other correspondingly basic subjects are provided for students who choose to concentrate in literature, history, or philosophy. By moving these subjects from the third to the second year we have increased the opportunity for students to plan effective junior and senior programs in fields of their choice.

Graduate Program

All of our graduate work continues to be concentrated in the Department of Economics and Social Science, but it now has two prongs, one in economics and the other in political science. As a result of increasing demand for the political science program, the Graduate School quota for the School of Humanities and Social Science has been increased. About 25 will be in residence next year in political science, 78 in economics.

The graduate economics program was studied last summer by a departmental committee consisting of Professor Solow as chairman, and Professors Domar, Charles P. Kindleberger, and Charles A. Myers. Certain changes of content and procedure were then recommended and adopted. As the most important of these, the required field of economic analysis was broadened to include the more modern "macroeconomic" approach (the analysis of the economic system's performance in terms of certain rather broadly aggregative components of "national income") in addition to the more traditional "microeconomic" approach (at the level of the price-and-quantity decisions of particular firms and households).

The department profits from a grant recently made by the Ford Foundation of $50,000 per year for five years. The money will be used for second-year fellowships for students undertaking thesis research projects of unusual scope or difficulty, summer fellowships to prepare theses for publication, the subsidized publication of meritorious theses, library materials needed and expenses incurred in connection with thesis research, and subsidies for research seminars to be conducted either by members of our own staff or by visiting professors.

This grant is distinct from the one made two years ago by The Ford Foundation in the amount of $15,000 per year for five years for the support of miscellaneous research projects in economics by members of the faculty. This "fluid research fund," it may be said, is proving extremely useful, especially for projects that are not ambitious enough to justify individual applications to foundations.

The principal event of the year for the Political Science Section was the inauguration of the Ph.D. degree. While it is still too much in the formative stage to be evaluated, the program has already contributed a broader sense of purpose and direction to the efforts of our faculty and students.

An initial class of thirteen candidates for the Ph.D. was admitted in September, 1958. These students were drawn from twelve colleges or universities, and nationals of three foreign countries were included. Seven members of this group had completed at least one year of graduate study before coming to the Institute; one had held a Rhodes Scholarship at Oxford, one had been a Fulbright Scholar in Ceylon, one was a graduate of the Interpreters' School at Geneva, and one held a doctorate in law from a Latin American university. Five of the students had already had some professional experience in advanced research activities; one had been a radio station announcer; one had been program director of a world affairs council and assistant to a United States Senator in a senatorial campaign; one had been an interpreter and translator for a European Foreign Office; one had experience as a college teacher; another had fifteen years of experience in business. Two of the group were graduates in science from M.I.T.

With such a wide range of backgrounds and experience, the Section was able to begin its program with a corps of unusually mature students who were well fitted, on the whole, to take advantage of the special facilities offered by the Institute.

Three of the most advanced students were permitted to stand for the general qualifying examination, held in May for the first time.

It is too early to say when the first candidates will complete the requirements for the doctorate. Probably it will not be before the end of 1960.

We are as desirous as any of seeing students complete the doctorate without undue prolongation of time. We think that as a general principle sufficient training should normally be acquired in three years of full-time graduate work or its equivalent, and that a thesis should represent about one year of intensive research and writing during this period. It should be borne in mind, however, that in many of the fields of political and social science which we are stressing at M.I.T. it is particularly desirable that candidates do a substantial portion of their thesis research through field activity here or abroad; this may well extend the time required for completion of the thesis.

As we stated in our petition for the Ph.D. program a year ago, we intend to emphasize the dynamic aspects of political behavior, communications, public policy, comparative politics, and international affairs, rather than the historical and the static. Understanding of the past is essential to general knowledge, but we believe it is vital that our students have, as a key part of their training, personal experience in guided research on some question relating to forces or institutions or attitudes in operation in the contemporary political scene. Learning how to design and to carry to completion a research project in these realms is likely to be more time-consuming than thesis preparation based upon the use of archival or documentary materials found in libraries. At the same time we believe it will make a more valuable contribution to the students in terms of the type of work they are likely to go into upon finishing their graduate work here.

We believe that the purpose of the program will be better served if we can ensure that adequate time is taken in preparing a few unusually well-equipped, creative scholars, rather than merely turning out more Ph.D.'s to fill more routine posts. We believe that it is the duty of a graduate faculty at M.I.T. to resist pressures for the awarding of more degrees, whether from colleges and universities or from government offices and research organizations, until they are satisfied that graduates are adequately prepared to do original and constructive rather than routine work.

Great strength has been supplied to the graduate program in political science by the existence of the Center for International Studies. As time has gone on, the liaison between "departmental" staff members and Center staff members has steadily strengthened. Further and substantial strength is afforded by the $850,000 grant from The Ford Foundation, reported above, to help to stabilize the Center. This grant funds the tenure appointment of two senior professors and one "rotating" one; provides for a small support of research management, publication, travel, and pilot research; and finances a number of graduate fellowships, over a ten-year period, in fields of economic development, international communication, and international politics. For all this as well as the earlier support of two chairs in international communications we are indebted to the generosity and what we believe to be the wisdom of The Ford Foundation.

So the new program in political science is off to a good start, but many problems remain. We must have a substantial increase in funds to support graduate study; and since the interim help the Institute has provided cannot be relied on any longer, we must be more successful than we have been in finding funds for this purpose. After the Ford fellowships and the four fellowships awarded by the United States Commissioner of Education under the National Defense Education Act of 1958 are counted, and after general institutional funds have been stretched as far as they will go, the Section must have something on the order of at least $12,000 per year of new money for graduate fellowships and scholarship funds in order to function according to M.I.T.'s standards of excellence. We have not been as successful in this solicitation as we must be, and there is no more pressing problem bearing on the graduate program in political science; it is a problem involving even its long-term survival. The difficulties in funding first-class programs of this kind offer convincing evidence that it remains much harder to find support for advanced study in the social sciences than it is in the natural sciences.

The intellectual problems are not less difficult but are naturally less pressing. We must find a long-term and first-class appointee in the field of political theory; we must arrive at a further decision on what more can and should be done in the fields of government and science and of defense policy, both of which are logical concerns at M.I.T. We should make provision for a limited number of subject offerings touching on political developments in Africa, the Soviet Union, and the Middle East — and in these directions the current interests of the Center will be very helpful. Finally, and it is not of trivial consequence (though the amount involved is), the library appropriation for political science is grossly inadequate. It needs to be at least doubled, and at once.

I cannot close this account of political science without expression of our appreciation to Professor Norman J. Padelford, who as Chairman of the Section during the first three years of its life has done a devoted and outstanding job of development to bring us to the point we have reached. In accordance with our policy of rotating this chairmanship, he will turn it over in July to an able successor, Professor Ithiel D. Pool. I must quote the final paragraph of Professor Padelford's report:

"I think that it can be fairly said that the political science program has passed beyond its beginning stages, both within the Institute and the profession. The task immediately ahead, then, is two-fold: first, to continue to develop the quantity and quality of dynamic knowledge and research techniques in political science available to the student, whether graduate, undergraduate, or within the community; and secondly, to move boldly into exploration of the new and vastly important area of interaction between science and public policy, which has become so important to the security of the nation and the advancement of human well-being throughout the world."

One problem of graduate study will require attention in the near future. A very considerable amount of exciting and important work is going on in linguistics at M.I.T., substantially focused around various relations of electronics to linguistics. More and more men are being drawn here to do postgraduate work in this area, and it is no longer true that they are dominated by people whose basic interest is in science or technology. Cooperation between the Department of Modern Languages and the Department of Electrical Engineering has been excellent. But in the end it may not be enough. This year the first doctoral candidate to do a thesis on problems of machine translation received his degree. Dr. Robert B. Lees, who earned this degree, was admitted to graduate work in the Department of Electrical Engineering for the express purpose of doing a linguistics thesis, but this expedient may not appeal to all the linguists who might wish to study here and might deserve to have the privilege; nor might it seem appropriate to the Department of Electrical Engineering if there were a substantial number of cases. The other solution, of having our graduate students in this growing field present their dissertations to other universities, is no more attractive. It is probable that before long we shall have to have a graduate degree program in the Department of Modern Languages, despite the fact that there seems no early occasion for an undergraduate degree program. I must say that there is substantial precedent for this in the history of the growth of some other fields at M.I.T., nor have all of these fields been in the humanities and social sciences.

Cooperative Program in Technical Writing

The program in technical writing, one of the important efforts within the School, has no immediate relation to our undergraduate teaching of general education; but it serves a sufficiently valued purpose so that the Departments of Mechanical Engineering, Electrical Engineering, Metallurgy, Civil Engineering, and Building Engineering solicit our aid and pay for it by supplying the credit hours from their own professional curricular time. These departments continue to cooperate with enthusiasm in our effort to give instruction in report writing in the technical courses where it belongs. This year Associate Professor Robert R. Rathbone and James B. Stone have discussed the preparation and presentation of reports at class meetings or in individual conferences with more than 600 students, meeting five different groups. I have described this procedure in earlier reports and need not explain it again here.

Whether students in other departments do their technical writing well without this further training, or whether they do not need to write well, we of course do not know. This teaching is available to any department which asks for it, but it is not part of any generally required curriculum. The cooperation has to start in the professional department.

I think it is safe to say, however, that there are undergraduates at M.I.T. who may be graduated without the minimum competence in writing and speaking the American language that ought to be expected of an educated man. And unfortunately we are not unique in this. We have all met products of institutions with far loftier literary aspirations than ours who show the same defect.

There is no reason why this should be permitted. Semiliterates will not have to be admitted to higher-level institutions during the "bulge." On arrival, even the literates need to be made to write as decently as they know how, which is often well enough. We do this effectively for the two years of our underclass humanities requirement, but there is certainly no consistent follow-up in the professional courses — and perhaps, alas, not even in some of our own upperclass subjects.

The time has come when we must find out whether all of the men to whom we award baccalaureate degrees have developed their competence in writing to the minimum standard that ought to be expected of every degree holder. This is not a very high standard. It does not call for elegance or wit or persuasiveness. It asks merely that the graduate be able to make a clear decision as to what he wants to say, to organize it in some sort of useful order, and then to express it simply and clearly, never violating the manners or current conventions of writing save deliberately and for a conscious purpose. Even before we make such a study I am confident that as many as a quarter of the seniors do not meet the standard. This is not because we have erred in seeking to teach students to write without the gonfalon of a specific course in composition. The problem is not unique to engineering schools or to M.I.T. Jacques Barzun has stated it recently in a chapter which seems to be dealing with students in traditional institutions:

> . . .In good hands general education courses at least teach a youth how to read.
> But no way has yet been found to teach him how to write. The sole magic that could make freshman composition succeed would be the belief on the part of both student and teacher that writing mattered, that the instructor was bored by dullness, offended by barbarisms, and outraged by nonsense. Then the student might begin to feel, through his written work, a moral responsibility for his intellectual acts. As things are, he writes in order to gain three credits, work off a degree requirement, and "satisfy" the English department, which has been delegated by the rest of the faculty to demand payment of this debt of honor. Members of the other departments can apparently do without clear prose, though some ask for it, grumbling at its permanent scarcity. More often, they rely on powers of divination to glimpse historical or literary or scientific truth through the mists of adolescent incoherence, which they themselves would find it grievous and perplexing to correct.[1]

We can safely apply Barzun's stricture to ourselves. Something might be accomplished by declining to admit any subliterates, but I suspect that no practical jacking-up of the admissions standards and procedures would improve things much. We can do more than we now do to identify the students whose ineptitude is really intolerable and perhaps find ways to force them to correct their erroneous habits. But in the end not too much can be expected unless, as Barzun suggests, the whole faculty cooperates. This is not a problem for the Department of Humanities alone, though it is reasonable to expect that department to initiate proposals for improved procedures.

Professor Rathbone and Mr. Stone have surveyed the need for remedial instruction in composition with the instructors in the core course. They estimate that 5 to 10 per cent of the nonforeign freshmen need such instruction for at least two terms. Another 5 to 10 per cent are less seriously deficient and can be helped in one term. Both these estimates are on the low side, Professor Howard R.

[1] Jacques Barzun, *The House of Intellect*, Harper and Brothers, New York, 1959, p. 116.

Bartlett feels, if our standards are set as they should be. During the spring term Mr. Stone experimented with a five-week workshop at which attendance was voluntary. About 25 students took advantage of the opportunity, and the results were sufficiently promising to suggest that much can be done by expanding this workshop program. To do so, however, will require an additional full-time member of the staff experienced in remedial instruction.

But it will require more than that. It will require an effort to admit as few verbally incompetent students as possible. (The number of quantitative geniuses who are verbally pitiful is undoubtedly very small; it is the men with mediocre quantitative ability who give the most trouble in matters of writing.) After we have admitted them, we must inform the deficient ones of their deficiency. We must enlist the support of the professional schools to the point at least where they penalize the student for work that is incompetently written up; and we probably need a still more stringent ultimate requirement. I expect to put some concrete proposals on this subject before the faculty during the coming year.

Research and Publication

It is no longer physically possible to do any sort of justice to the amount and diversity of the research which goes on in this School. Those interested can only wait until the work has progressed to the point where publication begins and can be listed. It is invidious, moreover, to try to select some projects for mention, and it would be quite impossible to pick out the "most important." All that is possible is to name a few that have special interest either because of their newness or some other factor of the current situation. Among these I would include Associate Professor Robert C. Wood's field study program in political education sponsored by the Maurice and Laura Falk Foundation; the work that the Department of Modern Languages is doing to study the effect of frequency response of equipment on language learning under a grant from the Educational Facilities Laboratories; continuation of the work of Assistant Professors John A. Swets and David M. Green on experimental tests of a mathematical model for perception based on decision theory; Associate Professor Lucian W. Pye's study in Burma on the basic attitudes of important groups toward the political process; Professor Pool's study of educational television under a grant from the Department of Health, Education and Welfare; Professor Kindleberger's work on rates of economic growth in Great Britain and France; and Assistant Professor Bator's work on government spending. Major team research programs in the Center for International Studies include completion of the first year of field work under a four-year Ford Foundation grant to cover research on Indian economic development in cooperation with research and planning institutions in India; a new program arising from a contract with the Foreign Relations Committee of the United States Senate to study the implications for United States foreign policy of economic, social, and political conditions in the underdeveloped areas; and the preparation for a two-year field program of research in Africa, south of the Sahara, on the problem of economic growth per se and the relationships between economic development and political evolution. This research, supported by a Carnegie Corporation grant of $200,000, will concentrate in Nigeria, the Belgian Congo, French West Africa, and the Federation of Rhodesia and Nyasaland; it is directed by Arnold Rivkin. Many special studies outside the team projects relate to this work; included are Professor Pool's work on India, and Harold R. Isaacs' on Africa. The Center's more general work on economic and political development, international communication, American society and foreign policy, and the Communist Bloc continue; but for elaboration of all these I can only refer to the separate annual report of the Center for International Studies.

The same dilemma arises in attempting to do justice to the publications of our faculty in any short account. It cannot be done, and I must rely on the appended list of publications.

Staff Activities

The same problem of discrimination arises when one attempts to list the extracurricular activities of the staff, and again I must refer readers to the appended list of Honors and Awards to our faculty.

During the year I had the privilege of being a member of the Panel on Science and Engineering Education of the President's Science Advisory Committee under the chairmanship of Dr. Lee A. DuBridge, which produced the report issued by the White House in May entitled "Education for the Age of Science."

Practically every one of us gave learned papers, participated in panel discussions and two-day conferences, lectured in universities or before women's clubs, or inspired a graduating class somewhere with one or another oration. We did this in a great many states and a great many lands; there were significant statements and insignificant ones, I am sure. To add them up, to list them, would be simultaneously encouraging and appalling. I do not ask the reader to have either experience. But I may say that the time will surely have to come when most of us in the American academic world will do less talking and more thinking; and I hope that the spontaneous panel discussion and the two-day conference will soon be discovered to be what they usually are — at most a momentary exhilaration for the participants and an occasional listener; at the least, a desperate desecration of the scholarly process and a poor substitute for thoughtful writing and reading; some American professors are becoming professional conferees; of deans, naturally, no more is to be expected.

Comings and Goings

Even a partial list of the travels of our staff — which follows — demonstrates the effect of the jet age on a modern-minded faculty. But on any given day a call of the roll would have shown most of the faculty to be on campus, and the good effects of these experiences on their teaching is noticeable.

To Africa — Professor Millikan for eight weeks under the auspices of the Council on Foreign Relations to talk with African and colonial officials in many of the areas where the Council will do field work.

Around the World — Professor Myers in a seminar trip under the auspices of The Ford Foundation in company with several other industrial relations experts; Professor Huston Smith to study religion, a year's venture to accomplish which his appointment as Professor at M.I.T. was delayed one year.

To Belgium — Assistant Professor Theodore D. Lockwood on a CRB fellowship from the Belgian-American Foundation to carry on research on the Belgian Labor Party prior to 1914.

To Bombay — Dr. George Rosen as part of the Center for International Studies Indian Research Team.

To Cambridge, England — Professor Walt W. Rostow and Assistant Professor Elspeth D. Rostow on a year's leave of absence.

To Corfu — Professors Domar, Samuelson, and Solow to give invited papers at meetings of the International Economics Association. Professor Samuelson has been on leave as Ford Faculty Research Fellow.

To Denmark, Norway, Sweden, and Finland — Professor Padelford to interview 50 leaders of political parties on attitudes toward United States policy in the U. N.

To England — Assistant Professor Laurence W. Martin on leave for study in Europe on a Rockefeller Advanced Research Fellowship.

To Europe — Assistant Professor Richard F. Koch to study methods of teaching modern languages in France, Switzerland, and Spain; The Choral Society, under the direction of Professor Liepmann, had its second enthusiastically received European tour, singing at Paris, Brussels, Munich, Hamburg, and a number of other German cities. In Munich they recorded Haydn's *Theresa Mass*, in commemoration of the eight hundredth anniversary of the city.

To France — Professor Lerner to plan and carry out a new series of interviews for his study of attitudes toward European integration.

To Moscow — Professor Rostow to deliver a lecture, "The States of Economic Growth and the Problems of Peaceful Coexistence," before the Institute of World Economy and International Relations.

To New Delhi — Professor Trevor Swan (Australian National University) and Professor I. M. D. Little (Nuffield College, Oxford) as part of the Center for International Studies Indian Research Team.

To Paris — Associate Professor Morris Halle, Dr. Victor H. Yngve, and Dr. G. Hubert Mathews to give papers at a UNESCO Conference on Information Processing.

To Paris and Geneva — Associate Professor William F. Bottiglia for work on the propaganda pamphlets of Voltaire.

To Princeton — Associate Professor Noam A. Chomsky on leave at the Institute for Advanced Study.

To Rangoon — Associate Professor Pye for study of the political process in transitional society.

To Rome — Professor Paul N. Rosenstein-Rodan to give a two months' lecture course at the Center for Development Studies and to direct research projects there.

To Rotterdam — Professor Rosenstein-Rodan to deliver the De Vries Foundation lectures.

To Saudi Arabia — Professor Everett E. Hagen to give a series of talks to the management and staff of the Arabian American Oil Company.

Visitors and Guests

We can no longer report the quick visits paid us by distinguished scholars, educators, and political leaders from all over the world. M.I.T. has become one of the meccas, and the School of Humanities and Social Science is one of the much-visited mosques. On a longer basis and as part of our steady program, we have been fortunate to have with us Robert H. Strotz of Northwestern University, Visiting Professor of Economics; Erik H. Erikson, Psychiatrist, Austen Riggs Center, Visiting Professor of Communications; Benjamin C. Roberts, London School of Economics, Visiting Lecturer in Industrial Relations; Wolfgang Stopler, Professor of Economics at the University of Michigan, to work with the Center's Africa project; and Irving Singer, Assistant Professor of Philosophy at the University of Michigan, as Visiting Lecturer in Philosophy.

Meetings and Conferences

Of the many meetings generated on our campus this year, I might single out the Hayden Colloquium, the Endicott House Conference on Science and Public Policy, a conference on India and the United States held in Washington, and a highly successful political gaming exercise sponsored by the Center.

The India conference was sponsored jointly by the Center and the Committee for International Economic Growth; Professor Millikan and Professor Wilfred Malenbaum and Mr. Isaacs participated. The Endicott House meeting on Science and Public Policy, lasting two days, was financed by The Carnegie Corporation of New York. It involved some fifty invited guests, including almost all the men in the United States who have had most to do with the problems of science and public policy; it was a closed working conference designed to shed further light on the problems and to suggest which ones could be defined with sufficient clarity to permit definitive research and teaching. It was managed by Professors Lerner and Padelford; there will be no public report.

The Hayden Colloquium, managed by Professor Lerner, maintained the high standard of previous years. The Colloquium of 1957–58, on Evidence and Inference, was published in an issue of *Daedalus* last autumn and will appear in hard covers this summer. The one just completed was on the subject of Quantity and Quality. Papers were given and the discussions led by John G. Kemeny, Professor of Mathematics at Dartmouth College (mathematics); Harold G. Lasswell, Professor of Law and Political Science, Yale Law School (political analysis); Victor F. Weisskopf, Professor of Physics, M.I.T. (quantum physics); Donald G. Marquis, Professor of Industrial Management, M.I.T. (psychological analysis); and Wassily Leontief, Professor of Economics, Harvard University (economic analysis).

One other colloquium which may properly be mentioned was conducted for the students in Course XXI by Professor Lamson, on "Darwinism, 1859–1959." During the two days papers were given by Walter F. Cannon, Assistant Professor of History, M.I.T.; Henry Stuart Hughes, Professor of History at Harvard University; and Dr. W. Grey Walter of the Burden Neurological Institute, Bristol, England.

Extracurricular Activities

The School continues to play a leading role in the support of many student extracurricular activities. It is no longer possible for me to dwell on the successes of the Concert Band, the Symphony Orchestra, the Glee Club, the Choral Society, the Humanities Concert Series, the Dramashop, and the Debating Society, or on the exhibitions in the New Gallery, all of which are part of our regular fare. The exhibits continued to be directed imaginatively by Professor Herbert L. Beckwith and included a notable exhibit of the American contenders at the time of the America's Cup Races, the most comprehensive show of Charles Sheeler's work ever to be held in this area, and a distinguished exhibit of pictorial weavings by Anni Albers; this was immediately requested by several other museums and will be on tour this autumn.

The Choral Society, in addition to its successful European tour, gave five performances at M.I.T., including the complete Mass in B-minor by Bach and, especially, a sensitive, delightful, and highly appreciated presentation of *The Fairy Queen*, in recognition of the tercentenary of the birth of Henry Purcell. It is the penalty of Professor Liepmann's consistently high standards of performance that they now come to be taken for granted.

I must, however, now say more about the important niche Joseph D. Everingham and his assistant, Mrs. Helen Bottomly, have carved at M.I.T. When Mr. Everingham came here, student theatrical production (except for an occasional Tech Show) was at a very low ebb. Since then everything has markedly improved. This year was the most successful ever, beginning with a booth at the Freshman Midway where two hundred freshmen signed up for Dramashop as an extracurricular activity.

Following the procedure established in previous years, four one-act workshop evenings were an important part of the organization's activities. These events are conducted wholly by students. Students direct, design, build, act, costume, and produce the plays on a very small budget and with a limit of nine days' rehearsal time. After each performance Mr. Everingham moderates an on-stage critique in which the entire company participates with the audience. This year's program included: *The Lesson*, by

Ionesco; *The Apollo of Bellac*, by Giraudoux; *On the High Road* and *The Boor*, by Chekov; *Bedtime Story*, by O'Casey; and *The Strangest Kind of Romance*, by Williams.

For the last evening the plays were written by M.I.T. students: "No Grass to Walk On" by Irv Rinard, a graduate student; and "Men Above, Men Beyond" by Jean Pierre Frankenhuis, a sophomore.

At all the workshop performances people had to be turned away for lack of room in the Little Theatre.

The two major productions of the Dramashop were Ben Jonson's *The Alchemist*, in November, and Richard Brinsley Sheridan's *The Rivals*, in April. Mr. Everingham directed both these plays, with Mrs. Bottomly assisting him in the costuming and other production details.

In January the Dramashop had the unique experience of presenting as part of its Celebrity Series the Poets' Theatre of Cambridge in a world premiere of *The Doctor and the Devils*, by Dylan Thomas. Mr. Everingham wrote the movie scenario and from this adapted the play for the stage. After opening to a preview audience and the Boston press, the group played to capacity audiences nightly for two weeks. The result was a widespread interest among theatrical and newspaper circles, with favorable notices in the *New York Times* as well as the Boston papers. In addition, requests came to Mr. Everingham from several noted New York producers for permission to produce the play.

Staff Changes

A full list of changes is provided in the President's Report, but I should note a few highly welcome additions to our staff. Dr. Paul N. Rosenstein-Rodan and Dr. Everett E. Hagen, who have been playing important roles as Visiting Professors in the Center for International Studies, have, with the funding aid of the Ford Foundation grant, been appointed permanent full Professors of Economics. They are men of great distinction and add still further weight to our already distinguished faculty of economics. Dean John P. Roche of Brandeis University will serve as Visiting Professor of Political Science (part-time). Lincoln P. Bloomfield, who has been an important member of the staff of the Center for International Studies, has been appointed Associate Professor of Political Science. Dr. Irving Singer, who has been Visiting Lecturer in Philosophy, has been promoted to Associate Professor. Dr. Murray C. Kemp has been appointed Visiting Associate Professor of Economics. New appointments at the assistant professor level include Dr. Walter R. Davis in literature, Dr. Robert Evans, Jr. in economics, and Dr. Ronald Melzack and Dr. Michael A. Wallach in psychology.

Promotions within the ranks include Dr. Morris A. Adelman to Professor of Economics; Dr. Paul Pigors to Professor of Industrial Relations; Dr. Abraham J. Siegel to Associate Professor of Industrial Relations; Gregory Tucker to Associate Professor of Music; Dr. Robert C. Wood to Associate Professor of Political Science; and Robert S. Woodbury to Associate Professor of History of Technology.

On the administrative side, and as has been noted earlier, Professor Pool assumes the chairmanship of the Political Science Section at the end of Professor Padelford's term, and Professor Lamson has been put in charge of Course XXI. In recognition of the brilliant success he has scored here, Mr. Everingham becomes Director of Drama. After four years of extremely effective service as Administrative Officer of the Center for International Studies, Arthur L. Singer, Jr. will assume the new post of Assistant Dean in this School as of July 1, 1959. Mr. Singer will assist me in a wide variety of policy and administrative matters in the School, with special emphasis on those relating to the social sciences. He will also continue for the present some of his chief responsibilities for the Center.

Life in university faculties always unhappily includes the *vales* as well as the *aves*. After many years of effective and loyal service to the Institute both as teacher and as scholar, Associate Professor John B. Rae has resigned to accept a position as Professor of History at Harvey Mudd College. No faculty could wish for a more thoughtful, unselfish, and friendly colleague, and we wish him everything of the best in his new life. Visiting Professors Benjamin H. Higgins and Wilfred Malenbaum have served us with distinction, primarily in research work in the Center for International Studies, but also in some of the graduate teaching process. We regret their resignations and at the same time congratulate them on their new posts; Professor Malenbaum goes to the University of Pennsylvania as Professor of Economics, and Professor Higgins to the University of Texas as Professor and Chairman of the Economics Department. Dr. George Leuca, Jr. resigned as Visiting Lecturer in Modern Languages on January 1, and Dr. Henry C. Hornik as Assistant Professor of Modern Languages on June 30.

Two leaves of absence were granted for nonacademic purposes: to Associate Professor Walter F. Urbach, because of serious family illness, and to Assistant Professor Martin Lichterman so that he may serve as Director of Research on the staff of the Governor of the Commonwealth of Massachusetts.

The entire Institute and particularly this School suffered a great loss when Professor W. Rupert Maclaurin died this summer. Over the twenty-three years that Professor Maclaurin was a member of our faculty he played a major role in many aspects of the life of the Institute. As expressed in a special resolution adopted by the faculty pursuant to his death:

> "He established the Industrial Relations Section in the Economics Department and served as its first director from 1937 to 1945. Under his leadership, this group was a pioneering one in its field. He was the Chairman of the Human Resources Panel at the Mid-Century Convocation. He was the Chairman of the Committee on Faculty Environment which recommended many of the constructive changes that have taken place in the last decade in the physical surroundings and academic atmosphere of the Institute.
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> "He also made major contributions of a less formal character. Many of the men who have served M.I.T. with distinction in several different departments were brought here by his interest and enterprise. His greatest effect, naturally, was within his own department. It was largely through his vision and industry that the doctoral program in economics was established — the first at the Institute in a field other than science or engineering. Throughout the subsequent years of the department's growth, he continued to exert an always gracious and constructive influence.
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> "During Rupert Maclaurin's entire career at M.I.T., he always acted from the deepest feelings of loyalty to his colleagues and the Institute. In turn, he will always be remembered with affection and respect."

Quandaries

My job would lose its savor if there were no troubles. At the lesser of these I have hinted from time to time through the report. We must find substantial funding for the support of graduate students in political science; the stabilization and consolidation of the Center for International Studies has been only partly accomplished, though we have a good start; we must grapple with the question of how we shall deal with the field of science and public policy; we need to add a first-class political theorist; as I reported last year, it is abundantly clear that sooner or later we are going to be hurt by the teacher shortage and must study every possible way of teaching more efficiently. We must have another look at the writing (and perhaps speaking) competence of our men who are about to graduate. But all such problems are, I think, easily within our grasp; they are, I think, all solvable with only normal effort, and so they will be solved when the occasion presses hard enough.

These are two problems, however, which remain more sticky; and I close with some discussion of them.

I have no doubt that the most serious problem in the school is the perennial one about which I never seem able to report progress; to wit, the state of psychology at M.I.T. It has been a problem for at least fifteen years. How big the problem is may depend upon the point of view. We are actually doing very well if one is content with the ambition that M.I.T.'s contribution to psychological knowledge shall be limited to studies that come naturally, almost spontaneously, in connection with and as a part of other research work at M.I.T. that has itself developed naturally. Then one does not worry because there is not a department, because the psychologists are scattered, or even because no single person really knows what is being done here in the name of psychology. There is much that is attractive in that view. If one feels that good general education for undergraduates at a technological institution must include electives in psychology, then again we may say that the young psychologists of our faculty have done well by their students and that the courses are improving. Here, though, the situation is cloudier because some of the conventional implications of continuity for the staff are not clear. The opportunities for promotion, for tenure, for salary increases, or for support in the way of library tools, space, and the like are not in fact diminished in any material way; but it is possible that the relations between research and teaching are not and cannot be made sufficiently explicit under the present incomplete arrangement. And of course if one dreams of an undergraduate major in psychology, a graduate teaching program, an independent department, and if the stuff of these dreams provides the measure of our state, then the state is dire. These are the conventional accoutrements of a successful venture in any field in a university; they may or may not be indispensable, but convention says they are and I am prepared to accept the convention as also the truth, at least in this case. I also have no doubt that it is the destiny of M.I.T. and of psychology to be joined at all these levels. But since there is still so much concern both among the psychologists inside the Institute and those outside, it is perhaps desirable to make the administrative position clear.

It is not easy to say how to bring about the desired juncture. The interests in psychology run an enormous gamut from architecture to science, with many applications in engineering, in industrial management, even in the study of literature and philosophy. That these interests are reconcilable, that catching up all the needed psychologists into something called a department would have anything more than administrative significance, if that, is by no means certain. Perhaps the chief significance would be symbolic, but that is not necessarily unimportant.

To this end and during the year we authorized the Department of Economics and Social Science to seek a suitable candidate for a newly created substantial post to help the Psychology Section to the growth its own members desire. Possible prospects have been discussed both within the department and with others interested in psychology elsewhere in the Institute. Some outside psychologists have also joined these discussions. However, no prospective candidate has been approached with a specific offer, because the preliminary explorations have revealed some serious conflicts as to the type of man desired and as to the more fundamental issue of future directions that psychology should take. Furthermore, since the future development of psychology at M.I.T. also depends on a fruitful collaboration among the various centers of psychology that already exist here, the decisions are complicated by the desire to make them fit into an all-Institute framework. It will be necessary over the next several months to try to settle some of the fundamental questions that now stand in the way of immediate action. In this, as in many other matters, Professor Millikan's all-Institute Committee on the Social Sciences should be helpful.

A similar problem of destiny lurks in the situation in the history and philosophy of science. Here we are doing good undergraduate teaching and enough of it so that there is no substantial problem of augmenting the effort in that direction. The individual professors we have, needing less equipment than their colleagues in psychology, can pursue their individual researches effectively, and have done so. It can perfectly readily be stated that there is therefore no problem. But there is a problem if one hypothesizes that M.I.T. is of all institutions the one in which advances should be made in the knowledge of the history and philosophy of science. This hypothesis may not in fact be defensible, but it is superficially, at least, highly convincing; and it can probably be said that if any field of the humanities were to be carried to the level of graduate work at M.I.T., it should be this one.

The issue is therefore somewhat simpler than that of psychology. Should we or should we not have much more advanced scholarship in these fields than we now do? How shall this be arranged? What lines shall the scholarship follow, since it can hardly do everything? The history of science (and technology) can include detailed monograph investigations of ancient or modern calculations, of designs of gears or boilers, of how a particular innovation did or did not get adopted, or the relation of technology to industry or even to capitalism, of the social climate in which science or technology thrives, generalizations about the history of culture, including science, or the history of ideas which includes the philosophy of science. The monographs are a necessary part of the stuff of scholarship and probably have to precede the great generalizations, although that may not be so.

We must not fall too easily into the conclusion that the history of science is interesting to most people *per se* or even that it ought to be. Scientists who love science may not easily understand why lots of people do not find the history of its details or even its protagonists of any great importance; but they can understand this better if they remember how rightfully they themselves ignore works in other fields, such as Vasari's *Lives of the Artists.* Political actions have so dominated the writing of the best general history for centuries that many important activities of man have not had their just due in most histories we read, and this has spawned efforts to be popular about the history of art or architecture, of literature or economics or science. What is really needed is the virtuous historian, the super-Burckhardt, who understands the significance of art and economics and science and puts it all into his chronicle of a time, not as a catalogue of events, not as a disconnected set of episodes, but in harmony and mutually related. This is a prodigiously difficult accomplishment, not of course achieved by Toynbee or Spengler or Pareto, although each was encyclopaedically informed. More modest goals are certainly justified for any further effort at M.I.T. There is a great deal yet to be known about the details of scientific achievement and scientific thought. There are very few men in the whole world who are well practiced in the methods of history and who also know enough about science to write an intelligent history of it. The scientist who does not understand the methods of the historian is trapped into grave error or is unduly credulous about reports he meets; the historian who does not know science will not know what he is talking about. Moreover it has been easier to obtain an adequate understanding of what science was before Galileo than after, and it becomes more and more complicated and difficult as one moves into the nineteenth and twentieth centuries. So I have no hesitation in saying that there are not more than a handful of really competent historians of science in the whole world and that of these very few indeed have a wide cultural view and are capable of bringing the history of science into focus with the history of other ideas, much less with the whole of cultural history. Yet this is the thing that most needs doing if the world of generally intelligent people is to profit from the product.

Given the lack of enough first-rate men, the dearth of competence in the most interesting centuries (which are not those of Pythagoras nor of Galileo nor even Dalton, but rather those of Avogadro and Cannizzaro and Planck and Einstein and Fermi and Heisenberg, and their opposite numbers in the life sciences), it is not obvious what ought to be done. There are a number of institutions already offering small programs of graduate study leading to degrees in the history of science; they probably are adequate in quantity to educate all those who presently want to study in this field, though the demand that each campus shall have at least one historian of science is growing; the problem of whether what they are doing is enough, whether the whole area would gain from further centers, and specifically one at M.I.T., remains, despite the ideology, uncertain. We have nonetheless accepted the general premise that we ought to expand our work in the field, and we have available at least minimal pilot funds to make the start. The agreement seems general now that the start should be in the direction of extending the scholarship rather than enlarging the undergraduate program. Beyond that the decisions remain to be made, save for the conclusion we have already reached that the last thing we want is an enormous project directed by an academic entrepreneur. Despite the high quality of the work done by Professors Giorgio de Santillana, Associate Professors Woodbury and Chandler, and Assistant Professor William D. Stahlman, — and by Professor Elting E. Morison and Associate Professor William L. Letwin of the School of Industrial Management — each on quite different terrains, it is clear that we must make some important additions to our staff. The unresolved questions remain as to the concentration of interest and, perhaps even more cogently, as to who are the first-class men we should seek. Here we must be vitally concerned with the quality of the men rather than with the part of the field that concerns them individually, for integration or the creation of a department is by no means the most important immediate concern.

For the past two years I have ended my report with the words, "It has been a good year." Even if it looks as though we were fossilizing into a tradition, I cannot end differently this time.

JOHN E. BURCHARD

School of Industrial Management

IN THE YEAR JUST CLOSED, the School of Industrial Management made further headway in developing its programs of education for management. To describe this progress in terms of classifications of data on student enrollment and staff changes, publications, and promotions — so useful in some contexts — is not adequate in a report such as this. It must be described in terms that capture the essential dynamics of the educational process. This kind of progress is embodied in the further definition of our goals and methods toward education for management, and it can best be seen in either of the twin functions of a university — its teaching program and its research output. Both functions complement each other, of course. Both must depend on the quality, vigor, and creativity of the faculty. Last year in my report I discussed the developments of the School of Industrial Management in terms of the first function, our curriculum, the rationale that holds together the educational process of faculty and students. This year I want to describe our progress in terms of the second — our research effort — and appraise in this way the rate and intensity of our forward motion in the School.

The research activity of an institution cannot be measured fully within a given twelve months' span. The flow of imagination, the spurts and flashes of real breakthroughs, the steady, sometimes monotonous analysis of data are best seen in longer prospect. But it is good to take stock of the emphases now clearly seen, the results achieved, and the possibilities on the horizon. Schools of management too seldom have emphasized the need for research in business as an important ingredient to the educational process for management. My review of research here reflects the serious commitment of our faculty to the need for, and the process of, research in management problems.

Research in a school seldom originates in a plan; it grows out of aspirations for new knowledge, the curiosity, the spirit of discovery existing in individual faculty members. Without this, there is no research. With it, the environment can encourage and the opportunity can be provided. In short, it is at this point that the question of support becomes vital. Fortunately, the School of Industrial Management has been in a position to encourage research. In the early years of the School's development we have been able to provide our faculty with more time for inquiry into problems than is often possible in similar institutions. The Alfred P. Sloan Foundation, Inc., has been generous and wise in making assistance possible when that seemed necessary for the support of individual faculty research. This has stimulated assistance from other sources both to the School and to individuals for their specific needs. I will describe the directions of the current emphasis of our research in the sections that follow.

Education for Management

First, however, a word must be said in summary about the process which I have called education for management. The expression "education for management" makes clear the distinction between management training and the deeper, more significant growth in understanding necessary to prepare men for management responsibilities in a rapidly changing industrial world. On most points there is evidence of progress in our teaching efforts.

Our two executive programs, for men already in positions of policy authority, continue to attract attention and produce well-regarded results at a time when companies are taking a critical second look at executive education. Our Sloan Fellowship Program graduated the largest class in its history in June and immediately prepared for a new record by enrolling for the first time three groups instead of two groups of Sloan Fellows at the end of the current year. This expansion is made possible by the continued encouragement of Alfred P. Sloan, Jr., and the expanded grant of the Sloan Foundation. The Program for Senior Executives continues to be a most sought-after educational experience on the part of many highly regarded companies for their best executives.

Our graduate program, now enrolling 140 men, continues to attract a satisfactory number of high-calibre students who consistently surpass our high expectations upon leaving us. Only the undergraduate program, always a backbone of the M.I.T. graduating class, shows some signs of losing some of its attraction for the incoming freshman and the maturing sophomore. But all four groups of students, unique in the country within a single institution, continue to produce, in interaction with our faculty, a most reassuring intellectual ferment and an atmosphere of action within our School. It is this ferment and atmosphere that is so dependent on the quality and the appropriateness of our research activity.

RESEARCH EFFORT in the context of our School can be best gauged in the scholarly output of the faculty member, and it is this inquiry for inquiry's sake that tends to characterize most academic endeavor. As the hard problems of organization yield their answers, however, we see other important feedbacks from the research effort. First, we see an immediate strengthening of our teaching programs; and indeed, as I shall remark later, some research in the School is aimed directly at making the learning process more effective. Second, we see the application of some research approaches to the practical problems of industry, and it is here that consulting can provide for a cross-feed of ideas between industry and the university. Third, we see the upgrading of student research, best exemplified by their thesis efforts. It strikes us that the depth of student effort at the thesis level is a direct reflection of the seriousness of the faculty research effort. Some examples of each of these three feedbacks will be apparent in the pages which follow.

The research interests of faculty members of the School can be grouped under four general headings.

The Quantitative Analyses

The School reflects its Institute environment in having substantial research emphasis in the mathematical approaches to the solution of business problems. To the extent that these management-science approaches have been fruitful in dealing with problems not amenable to other solutions, the art of management increasingly becomes more predictable or describable — hence, more scientific. It is impossible to imagine that the management practitioner of tomorrow can be effective without a solid quantitative base for understanding the problems facing him. But these understandings will broaden only as the researcher makes his forays into the unknown.

The range of investigation in which the quantitative methods are paramount in the School is a wide one. The work of Professor Jay W. Forrester and his associates on the dynamic interactions operating within systems at the company, industry, and national economy levels, now in its third year, is an example of the new and stimulating investigations underway in the School. Up to now this work has largely been confined to research, but it is beginning to enter the teaching programs of the School. In our marketing group another example of dynamic simulation using the marketing framework is in its second year. The work of Professor Sidney S. Alexander in evaluating techniques of forecasting levels of business activity must also be mentioned here. Professors David Durand and Myron J. Gordon have been constant contributors to the knowledge about the cost of capital and its productivity.

Professor Edwin Kuh's interest in econometrics is now entering a productive period in both research output and teaching applications. The work of Professor Thomson M. Whitin, back from a two-year stay with the Atomic Energy Commission, continues to be productive in the operations analysis of inventory problems. In the field of production, it is fair to say that Professor Edward H. Bowman, with his former School colleague, Robert Fetter, revised the standard approaches to the teaching of production by his quantitative investigations of production problems. A striking thing about management research using the quantitative tools is that the younger men on the faculty are perhaps best positioned to make important contributions.

In all of this, the availability of large-capacity, high-speed computers stretches the scope of the researcher's ability, and the computers will play an increasingly large part in our research effort in the future.

Research in Organization: The Social Sciences

The old complex of problems relating to man and his behavior in organizations designed to achieve his goals has yielded but slowly to investigations of the researcher. The social scientist seeks to explain the actions of the individual in the group in several ways: the economic, the social, and the political. The difficulty of achieving an adequate synthesis of all these levels and directions of inquiry is complicated by the changing nature of man's motivations as his economy changes. We have emphasized these ways of describing the managerial problem fully as much as the quantitative approaches.

Professor Douglas McGregor's work in the social psychology field has been notable and has been reinforced by the work of Professors Howard W. Johnson and Edgar H. Schein. Professor Leo B. Moore over the years has made important contributions to the description of organizations under the prod of change. With the addition of Professors Donald G. Marquis and Warren G. Bennis, this work will be amplified. Closely related to this research has been that of Professor Albert H. Rubenstein, whose interest in the ecology of research organizations has been noted repeatedly in the last two years and whose departure from us will be felt.

The area of economics has particular significance for the field of management, and the strength of the School has always been magnified by our faculty's close working arrangements with M.I.T.'s distinguished Department of Economics and Social Science. The collaboration is not only in the design of the teaching programs, where members of that Department contribute substantially to our programs, but also in the close personal research relationships which exist between members of the two groups.

Noteworthy is Professor Eli Shapiro's work in the source of capital funds; this interest is currently being expanded by his important assignment as Deputy Research Director of the National Commission on Money and Credit of the Committee for Economic Development. We have a lively interest in all of the ramifications of national fiscal policy, and Professor Daniel M. Holland's current work on corporate taxation has been highly regarded.

The social science viewpoint also has characterized the public policy inquiries of Professor Douglass V. Brown, and his visiting research appointment to the University of Chicago for the coming year undoubtedly will further his inquiry into the labor-management-public matrix.

No account of research in organization would be complete without citing the work of the historians, Professors Elting E. Morison and William L. Letwin, whose concern with the long-view appraisal of actions and reactions in an industrial society enriches the understanding of the framework within which managerial decisions are made. The current year was especially productive for both of these men, some of which shows in the standard report on publications.

Research in Teaching Methodology

Not surprisingly, the spark of originality often turns to the improvement in teaching efficiency. This must be increasingly the case in the management field, where the problem of theory and principle on the one hand, and practice and method on the other, is only unsatisfactorily resolved. I wish to cite only a few cases where this year marked the beginning of new experiments in teaching.

One development which holds much promise is the interest being taken by the New England Chapter of the Young Presidents' Organization in organizing, in cooperation with the School, an internship for our graduate students in the summer between their first and second years. Selected students are placed in companies headed by the enterprising young leaders and are given opportunity to observe and, where possible, to participate in the decision-making process at top levels. These graduate students will report on their experiences at the end of the summer, and this experiment may well prove to be significant for these beginners in management.

Another example of teaching originality of real potential is the work of Stanley M. Jacks, so long associated with us as a lecturer, and now as Visiting Associate Professor, in developing tape recordings of complex social and economic events which utilize the voices of the characters originally associated with the problem. This dramatic placement of the total problem seems to make more efficient our students' comprehension of the issues and times discussed in class.

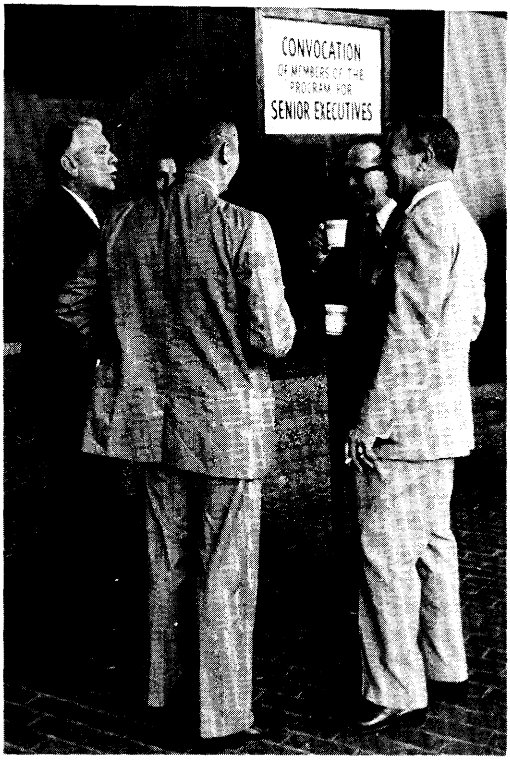
Finally, I also wish to cite the example of the continued experiment in education for Boston-area executives in which the School is informally participating. Cognizant of our role and responsibilities in the community, we have aided in developing a seminar program running one day each week for fifteen weeks for middle management from local companies. This experiment, unique in the country, deserves to be continued on the basis of the reaction of both the men and their companies thus far.

The Student and the Research Process

Two avenues for placing the student in the vortex of the research process are available in the university world. One is the research assistantship, and the second is the actual writing of the required dissertation. While both of these roles can be more form than substance for the student, we have tried to make them vivid experiences.

Last year, 36 students in our School held part-time or full-time research assistantships on our staff and either aided in research or undertook work of their own under faculty guidance.

The thesis topics chosen by student candidates for both the Bachelor's and Master's degrees reflect the environment of discovery in the School. We had a remarkably satisfying experience with the first year of competition for the best Master's and the best Bachelor's theses, with a prize award provided by donor-friends of M.I.T. The quality of the theses reviewed by the prize committees was excellent in both classes. In the Master's class, Simon Goldstein's prize-winning thesis, "Synthesis of the Theory of Inventory Control," represented a well-conceived research task that, in the opinion of the committee, constitutes a strong contribution to the field.



Convocations of present and former members of our Executive Development Programs brought nearly 250 Sloan Fellows and members of Programs for Senior Executives to the campus for lectures and seminars on "Management in an Era of Dynamic Technology" in the spring of 1959. One of the contributions of an executive development program should be to encourage the habit of continuous learning about the whole managerial process. Our convocations gave evidence of the vitality and freshness of this habit in the men attending.

The convocations included addresses by distinguished leaders in management and a series of seminars (*top*) with members of the faculty of the School of Industrial Management. A highlight of the Sloan Fellows' convocation was the ovation for Alfred P. Sloan, Jr. (*left, bottom picture*) upon his receiving honorary membership in the Society of Sloan Fellows.

I TURN NOW TO MORE STANDARD topical headings for reviewing the School's progress during the year.

Enrollment

The enrollment data of the School reveal the regular growth that has characterized the School from the beginning in those areas where facilities and faculty permit. During the year 89 undergraduates, 6 more than last year, received Bachelor of Science degrees in Course XV. However, the total enrollment in this undergraduate Course declined about 12 per cent from the previous year's total.

In the graduate division, 91 men received Master's degrees in industrial management during the year. The total enrollment of graduate students, including Sloan Fellows, was 177, with about the same increase as in the previous year. Once again, we showed a substantial but somewhat unpredictable out-of-Course load in both undergraduate and graduate subjects.

The enrollment in both our Sloan Fellowship Program and our Program for Senior Executives continued at peak levels. The problem of having to turn away well-qualified men from our Sloan Program was partially solved this summer by the addition of a third group to that program. In both programs, we continue to devote much time and care to the selection of high-quality participants, and this reputation for standards serves us well in attracting a higher-grade field of candidates.

Finally, we initiated the Sloan Internship Program, designed to develop young academicians more effectively for the business teaching role. With a grant from the Sloan Foundation, we selected three men to undergo a year's internship experience in teaching and research at all levels of the School's program. These men, about the same age as the Sloan Fellows, will be teamed with the Sloans in much of their activity. The resultant interaction should enrich the lives of both the young teacher and the young executive.

Special Events

The last few years have seen some important convocations in connection with the School's activities. But it would be difficult to surpass in impact, both on the School and on the participants, the convocations held in the spring of 1959 for the Society of Sloan Fellows and the former members of the Program for Senior Executives. Both convocations were organized by the Director of these programs, John M. Wynne, and his associates. The interest and enthusiasm of these men who were returning to rekindle some of the intellectual excitement that had been theirs at M.I.T. was a great source of satisfaction to us.

The Convocation of Sloan Fellows was attended by approximately 180 of the 333 men who have been in the Program during the twenty-eight years of its existence. The Convocation was addressed by a group of distinguished men including Mr. Sloan; James R. Killian, Jr., then Assistant to the President of the United States for Science and Technology; Theodore V. Houser, the former Chairman of the Board of Sears, Roebuck and Company; Alfred C. Neal, President of the Committee for Economic Development; and General James M. Gavin, Executive Vice President of Arthur D. Little, Inc. Professors Robert L. Bishop and Elting E. Morison delivered major papers to the Convocation, and a number of other members of our faculty contributed significantly by conducting seminars in their fields for the returning Sloan Fellows.

Mr. Sloan's concluding remarks to the Sloan Fellows and their wives at the Convocation banquet merit quotation in this report because they bring our work in executive development into sharp focus.

> The revolution in United States industrial management has been characterized by the rise of an executive group, increasingly professional in background and method; by growing stress on human relationships at all levels of industry; and by a wave of new techniques. Thus it seems to me the significant lesson we learn from the original concept of Dr. Compton is the recognition in the cause of increased efficiency of a more intimate relationship, as I have expressed it, between working industry and working education. In accepting that concept, the management of American enterprise is recognizing, in an accelerating degree and in its own self-interest, the demand for a truly scientific approach to the problems of industrial management.

The Convocation for members of the Program for Senior Executives was attended by 65 of the 132 who have completed the Program. Among the distinguished men from business and education who addressed the group were Robert C. Sprague, Chairman of the Board of Sprague Electric Company; Dexter M. Keezer, Vice President of the McGraw-Hill Publishing Company; and Peter F. Drucker, author and consultant. President Julius A. Stratton spoke to all the members of the Program for Senior Executives and their wives at the Convocation banquet. Professors Elting E. Morison and Donald G. Marquis gave major papers, and other members of the faculty contributed by leading seminars on new frontiers in their own fields.

Both Convocations served greatly to strengthen the bonds between the School and alumni of its Executive Development Programs, who are assuming increasing responsibilities in the management of their companies.

Executive Development in India

One event which looks to the future instead of reporting the past concerns a possible School of Industrial Management Program for Indian Executives to take place in India beginning in the summer of 1960. At the invitation of The Ford Foundation, Associate Dean Howard W. Johnson, on behalf of the School, visited several industrial centers in India in the spring and sought out the views of business leaders, management association executives, and government and university heads. As a result, the School has under discussion with the Foundation and appropriate key Indian executives a plan under which the School would take responsibility for organizing and conducting a Senior Executive Seminar in India for each of three summers, beginning in 1960. The implications of such a program could be far-reaching. In one sense, it is a logical extension of work already being done in Cambridge with the dozens of teams of foreign businessmen and teachers who have been guests of the School over the past several years.

Staff Activities and Awards

The range of activities apart from the priority of teaching and research in a faculty such as ours is a notably wide one. These activities extend from various kinds of government and advisory commission work, to consulting with corporations and businesses, to teaching in other university environments. All represent experiences which should add depth to the understandings and competence of our staff members as well as representing a service that has come to be expected of the Institute as part of its larger community role. Some examples follow.

In connection with the government of the United States:

Professors Alexander and Kuh served as consultants to the Tax Analysis Section of the United States Treasury.

Professor Billy E. Goetz was engaged in a study to determine postal rates in the United States Postal Service.

Professors Richard B. Maffei and Bowman were guest lecturers at the Air Force Institute of Technology.

Professor Rubenstein was consultant to the Director of the United States Army Ballistic Laboratory.

Professor Johnson was consultant to the Internal Revenue Service of the United States Treasury.

In connection with other teaching:

Professor Alexander appeared in the lecture series of the Brookings Institution on the general subject, "Economics in Action."

Professor Goetz taught production in Chile in the summer of 1958 in the ICARE-Chilean Management Society's executive program.

Professor Bowman spent the spring semester in Europe, under European Productivity Agency auspices, centering in England, Sweden, and the Netherlands.

Professor Chadwick J. Haberstroh spent the spring semester lecturing in statistics at the University of Cuenca, Ecuador, under a Fulbright Award.

Several members of the faculty received awards and other kinds of recognition that go beyond the ordinary achievement in academic life.

Professor Shapiro was appointed Deputy Director of Research for the National Commission on Money and Credit, which necessitated his half-time leave beginning in February, 1959.

Professor Zenon Zannetos was awarded a Ford Foundation Faculty Fellowship for study in mathematics and statistics.

Professors Thomas M. Hill and Holland were named Fellows in the Ford Foundation's Institute of Basic Mathematics for Applications to Business.

Dean E. P. Brooks was named a Fellow of the American Academy of Arts and Sciences and received the honorary degree of Doctor of Science in Commerce from Drexel Institute of Technology.

Professor Letwin was awarded a Social Science Research Council grant for research in Great Britain on the relation of economic ideas and economic policy during the 18th century.

Professor Edgar H. Schein was awarded a Social Science Research Council research grant.

Professor Rubenstein was awarded a grant by the McKinsey Foundation for his work in the organization of research and development in decentralized companies.

Professor Whitin was named a Fellow in the Econometric Society.

Professor Moore was named a Fellow in the Standards Engineering Society.

Staff Changes

It is a pleasure to record the faculty promotions which took place during the year: Howard W. Johnson has been named to the rank of Professor. Edwin Kuh and Edward H. Bowman have been promoted to the rank of Associate Professor.

Professor Douglass Brown has been appointed Ford Foundation Visiting Research Professor at the University of Chicago and will be on leave of absence during the coming year. Professors Hill, Zannetos, Letwin, and Holland, as indicated above, will also be absent for the coming year.

Professors Wroe Alderson and David L. Marples were visitors on the faculty during 1958–59.

The following new appointments for 1959–60 were made at the close of the current year:

Donald G. Marquis, Professor of Industrial Management
Carl T. Devine, Visiting Professor of Industrial Management
Donald J. White, Visiting Professor of Industrial Management
George E. Lent, Visiting Professor of Finance
Warren G. Bennis, Associate Professor of Industrial Management
Stanley M. Jacks, Visiting Associate Professor of Industrial Management
Paul H. Cootner, Assistant Professor of Industrial Management
James C. Emery, Assistant Professor of Industrial Management

I record, with warm recognition of their contribution to the School, the resignations of:

Marvin E. Shaw, Associate Professor of Industrial Management
Robert H. Gregory, Assistant Professor of Industrial Management
Gregory C. Chow, Assistant Professor of Industrial Management
Albert H. Rubenstein, Assistant Professor of Industrial Management

Alumni Relations

The M.I.T. Alumni Association provides an important continuing link between the graduates of Course xv and the Institute. Over the years, many graduates of this Course have served the Institute well in many capacities. It is of interest to me that nine of the past fifteen presidents of the M.I.T. Alumni Association were Course xv undergraduates.

Most of our graduate students come to M.I.T. with undergraduate affiliations of their own; therefore, they do not feel the same tie with the Alumni Association in a continuing relationship. Each year our departing graduate students have urged the formation of an alumni group of their own as a special link to the School of Industrial Management. Such an organization came into being this year, and we hope for it a life of usefulness both to the former students and to the School.

The Society of Sloan Fellows, which combined its meetings with our Convocation in the spring, seems well launched. While its program is yet visionary, its promise, in the hands of men like the Sloans, is great.

A Summing Up and a Look Ahead

Long years become short in retrospect. Progress, in the grand sense by which I mean to measure it, is discernible in the long run; whereas the short run sometimes obscures it.

In the first seven years since its founding, the School of Industrial Management has made progress toward the goals set for it; and as we pick up the growing momentum of a faculty now in place, we shall continue to make progress and at a faster pace.

The special purpose of the School's program of education for management in the Institute's environment of technology recognizes the simple fact that in the world of action management and technology go hand in hand. We are prepared to meet the responsibility implied by this full partnership. In this sense, the vigor and thrust of our research program will always be a key to the effectiveness of our performance. And our research program, like our teaching program, will depend on the quality and resolution of our faculty. From the present point of vantage I see our past progress matching up to our expectations. I see new developments in both teaching and research gathering strength to give further impetus to our forward motion.

This is my concluding report as the first Dean of the School of Industrial Management. Professor Johnson, my Associate Dean for the past year and previously the Director of our Executive Development Programs, has been named to succeed me and will assume his new duties on November 1. I can best express my satisfaction at this appointment by saying that I have never been more confident that the School will live up to its calling.

In concluding this report, I would be remiss if I did not record my grateful recognition and thanks for the hearty support which I have had during these beginning years — and the School is still only beginning. This support has been generous from the administration and faculty of M.I.T., from the Sloan Foundation, and particularly from Mr. Sloan, from industry, from our growing alumni, and from the enlarging faculty of the School itself. I like to think of this as approval in some degree of our aims and progress.

EDWARD PENNELL BROOKS

School of Science

THE TWO LARGEST DEPARTMENTS of this school, physics and chemistry, continue their active roles in the production of professional scientists and in undertaking two of the principal service roles of the Institute in teaching undergraduates. Particularly in physics a marked growth in undergraduate enrollment continues; this year this curriculum was selected as a major subject by more new students than any other, with electrical engineering a close second. This department is the largest physics department in the country and now leads the nation's universities in the production, over a five-year period, of professional physicists having doctor's degrees; together with the University of California at Berkeley, that at Los Angeles, Harvard University, and Yale University, it produces more than one-fourth of the doctorates in physics in the country. The department is being maintained as closely as possible at its present size, yet its undergraduate enrollment continues to grow.

An even more rapid proportional growth is taking place in the Mathematics Department. Although its absolute size is somewhat smaller than that of physics, its service load of teaching courses taken by students from other departments is the largest in the Institute and continues to grow. Extensive additions to the mathematics staff and in the allocation of space to this department have been made necessary by steadily increasing demands for its subjects. Two out of three members of the entire Institute student body, undergraduate and graduate, are now enrolled in mathematics in any given term. The rapidly mounting load on this department, which shows no signs of diminishing in its rate of climb, has made necessary special expansion; this will ensure adequate handling of the teaching load next year and provide for future growth.

Steps taken this year include the appointment of two new professors, Dr. Richard D. Schafer and Dr. Gerald B. Whitham; four new assistant professors; and nine additional instructors. Professor Schafer has been appointed deputy head of the department to relieve the department head of some of his heavy administrative load. To accommodate this staff, five classrooms have been converted to offices, and the building which houses the Mathematics Department is being considerably altered and redecorated. Of particular importance is the establishment of a Mathematics Reading Room adjacent to the existing Mathematics Lounge. These changes should provide an atmosphere helpful in the teaching and research work of the department. Long-range plans now under study involve a further increase in the professorial ranks of the department, the provision of additional office space, and changes in the handling of the mathematics collection in the Science Library.

Special attention has been given to building strengthened faculties and curricula in the earth sciences and in the life sciences, and important steps forward have been taken in both these fields in the past year. An outstanding event is the gift by Dr. and Mrs. Cecil H. Green of Dallas, Texas, of more than $2,500,000 in support of the earth sciences. This will take the form of a major building on the M.I.T. campus for the newly formed Center for Earth Sciences. This building will house the teaching and research facilities to be used in geology and geophysics, meteorology, and oceanography, and in their joint programs. It is to be located just east of the Dorrance Building, extending almost to Ames Street, and will be a major addition to the "Science Court" which is at present shaping up in front of the Eastman and Dorrance Laboratories.

Plans for this building, together with closer and greatly extended collaboration with the Woods Hole Oceanographic Institution, are bringing into being a Center for Earth Sciences on a scale which we have been hoping for years might be achieved.

Of particular importance in the life sciences program is the appointment of Dr. Salvador E. Luria as Professor of Microbiology. The fourth floor of the Dorrance Building is undergoing modification to become a center for this important branch of biology. Additional extensive changes are being made in this building, particularly on the eighth floor, where new laboratories will replace the greenhouse and utilize all of the space on the roof, thus accommodating the new developments in biology, biochemistry, and biophysics.

The Department of Food Technology continues to be one of the most active departments in this field in the country. Its work is increasingly moving its emphasis into the graduate field, and the interaction of science and technology necessary for the proper carrying out of programs in food sterilization, preservation, and the like is undergoing continued strengthening.

During the past year steps have been taken to help in establishing closer communication and collaborative efforts between the Physics Department and that part of the Lincoln Laboratory involved in fundamental research, mostly on solid state physics. Particularly noteworthy were joint efforts in low-temperature physics spearheaded by Visiting Associate Professor Emanuel Maxwell, who was on leave from the Lincoln Laboratory last year to work on the M.I.T. campus; joint colloquia which brought M.I.T. students and staff to the Lincoln Laboratory on several occasions; and the collaboration of Dr. Benjamin Lax and his group, particularly those concerned with magnet design, with Professor Bitter in planning for extended magnet facilities.

Relations Between Teaching and Research

The growth of the School of Science is bringing into focus a problem which has recently come to the fore in the science departments of many American universities and colleges. Traditionally, a professor has been both a teacher and a creative scholar. During the last decade increasing numbers of large research projects have been undertaken by university groups, and specialists have been employed to help with various phases of the investigations. Often these scientists are well trained and highly qualified for academic rank. Academic rating would give them certain desirable privileges — as well as responsibilities — which nonacademic staff members are frequently denied, but it would also frequently involve a lowering of salary scale. At the same time, the teaching load in some academic fields has reached a point at which many of the faculty members are overburdened with somewhat routine duties; they have little time left for planning the course changes required by the rapid evolution of scientific ideas and by the increasing numbers of students. Both of these factors make it important that we reconsider the ever-recurring theme of the role of specialized research workers and of specialized teachers in a university environment.

Dr. Peter T. Demos of the Laboratory for Nuclear Science has been making an extensive study of the nature of problems of this kind at various institutions and the ways they are being solved. From these studies is emerging a realization of the very general nature of the problem and of the wide variety of steps — none yet completely satisfactory — that have been taken toward its solution. It seems clear that insofar as the School of Science is concerned, our traditional policy has much to recommend it. In order to be a true professor it is desirable for a man to combine and practice actively both of the traditional skills: the transmission of knowledge to students on the one hand, and the pursuit of scholarly investigations on the other. A new tradition endowing the more specialized assignments with dignity and stature should be established as rapidly as possible, however. It may well be that collaborative efforts on an informal basis with other institutions having similar problems may prove valuable.

GEORGE R. HARRISON, FRANCIS BITTER

DEPARTMENT OF BIOLOGY

During the past year, a new subject in general microbiology was organized by Professor Salvador E. Luria. Although this is an introductory subject, it will be taught at a fairly advanced level because all of the students will be required to take General Biochemistry as a prerequisite.

Under the direction of Professors Patrick D. Wall and Jerome Y. Lettvin, the subject in General Physiology Laboratory is being completely revised; new instrumentation is being set up for experimental work, particularly in the fields of neurophysiology and electrophysiology.

The number of sophomores enrolled in Course VII has doubled in the past year, and there has been some increase in the number of students enrolled in various subjects of the department. Most of these students come from either the School of Humanities and Social Science or the School of Science, so that now almost half of the students enrolled in these subjects are not biologists.

For some years the department has offered a special graduate training program for young medical doctors who are interested in research. Some of these have enrolled as regular graduate students, while others have joined one of the research laboratories and have taken only a few graduate subjects. In addition to this medical training program, a new cooperative arrangement has just been worked out with the New England Medical Center. Under this program, residents at the Hospital will spend one postgraduate year in the department taking a special curriculum of graduate subjects.

These medical doctors will be enrolled as special graduate students and will in every way meet the requirements of the M.I.T. Graduate School.

As a result of an appreciable increase in research and teaching personnel, an extensive reorganization of space in the department has become necessary. The fourth floor of the Dorrance Laboratory is undergoing modification to become a center for microbiology. New research laboratories for biochemistry have been constructed on the fifth floor. New laboratories on the eighth floor will be primarily devoted to the study of mammalian cells in tissue culture. This will make possible the investigation of certain problems of growth and development as well as a study of animal viruses, with special reference to heredity and to their role in infectious disease and cancer. Teaching and research laboratories for instrumentation are being built in Building 20.

During the winter the Biology Department, in collaboration with the Center for Communication Sciences, presented an Industrial Liaison Symposium entitled "Information Processing and Coding in Biological Systems," under the chairmanship of Professor Wall. This symposium brought together industrial and academic people of widely different interests. It became apparent from the work presented that the department shares many common interests in the fields of neurophysiology and biophysics with members of the Communications Center.

During the summer of 1958 many of our biophysicists, as well as other scientists from M.I.T., participated in a four-week Symposium on Biophysics at the University of Colorado. This meeting, which was largely organized by Professors Francis O. Schmitt (Biology) and Richard H. Bolt (Electrical Engineering), was most successful in outlining the field of modern biophysics. It brought together physicists as well as biologists, biochemists, and biophysicists and offered an opportunity for the exchange of ideas among this heterogeneous group. Approximately 10 per cent of the papers, which were presented by people from all over the world, came from M.I.T.

Personnel

Dr. Luria, Visiting Professor from the University of Illinois, is to continue here as Professor of Microbiology. Dr. Vernon M. Ingram, who has been with us as Visiting Associate Professor of Biochemistry from Cambridge University, will join us as Associate Professor of Biochemistry. Professor Boris Magasanik, now at the

Pasteur Institute on leave from Harvard Medical School, will become Professor of Microbiology about January 1, 1960. Dr. Phillips W. Robbins, Assistant Professor at the Rockefeller Institute, will come to M.I.T. on February 1, 1960, as Assistant Professor of Biochemistry.

During the spring term of 1959 Professor John Z. Young, Head of the Department of Anatomy at University College, London, spent a month at M.I.T. as Visiting Professor of Biology. During this time he presented an exciting series of lectures on problems of learning and behavior in the octopus. Many informal seminars were held in conjunction with these lectures.

Professor Howard P. Jenerick has left the department to accept a position as Executive Secretary at the National Institutes of Health. Dr. Standish C. Hartman, Jr., will leave this summer to accept a teaching post at the Harvard Medical School.

During the fall term Professor Eugene Bell will be on leave of absence to work with Professor G. Pontecorvo at the University of Glasgow in the field of tissue culture as applied to problems of growth and development. Dr. Lettvin will spend a year in the department, starting July 1, 1959, as Visiting Associate Professor of Physiology.

Research

Major progress was made in research in the Biology Department during the past year. Professor Bell used ultrasound as a tool to investigate the role of the epidermis in the development of limbs and collaborated with research workers at the Massachusetts General Hospital on the effects of ultrasound on nerve tissue. In genetics, the following studies were made: the genetic control of enzymes in drosophila, by Professor Herman W. Lewis; the biochemical nature of genetic blood disorders, by Professor Ingram; the relation of genetic mutation to virus infection by Professor Luria; bacteriophage genetics, by Dr. Alan Garen, Dr. Irwin Tessman, and Professor Cyrus Levinthal; and the interaction of environment and heredity on bacterial enzyme synthesis, by Professor Levinthal. On the nature and duplication of large molecules, contributions were made by Professors Schmitt, Levinthal, David F. Waugh, Alexander Rich, Cecil E. Hall, and Bernard S. Gould, and Dr. Howard M. Dintzis. Special attention has been devoted to the problem of the nature of genetic orders, the method of transmitting these orders, and the synthesis and structure of the large biological macromolecules. Professor John M. Buchanan and his associates continue their investigations on the key points of intermediary metabolism, particularly as related to protein synthesis. At a higher level of organization of matter, Professor Sizer and his colleagues have purified certain vitamin-enzyme systems concerned with amino acid oxidations; Professor Schmitt has investigated the relationship of nerve fibers to their surrounding cells; and John R. Segal and Marcus C. Goodall have studied the relations of nerve and muscle physiology to certain model systems. Professors Wall and Lettvin have elucidated some of the principles by which information is transmitted along the visual and skin sensory pathways in the central nervous system.

IRWIN W. SIZER

DEPARTMENT OF CHEMISTRY

During the past academic year, juniors majoring in chemistry completed the third year of the revised undergraduate curriculum in chemistry. They were registered for Physical Chemistry and Physical Chemistry Laboratory as in previous years. In the first semester, juniors also registered for Principles of Inorganic Chemistry, a lecture course taught by Professor F. Albert Cotton. In this new subject, the theoretical principles of chemical bonding and molecular structure and their application were presented in a survey of the chemistry of all of the elements of the periodic system. Many students not majoring in chemistry also registered for this subject. A new laboratory subject, Qualitative Organic Analysis, was offered to chemistry majors during the first semester of the junior year. This material formerly was covered as part of the laboratory course in General Organic Chemistry when that subject was taught in the junior year. With the transfer of General Organic Chemistry to the sophomore year, part of the laboratory work was separated and placed in the junior year as a new subject covering the identification of organic compounds, including current research techniques used for the determination of the structure of organic compounds. The subject matter was reorganized and taught by Professor Herbert O. House.

In the second semester, the first half of the required year of Analytical Chemistry was offered as a lecture and laboratory subject. The subject is based on general, organic, and physical chemistry; accordingly, it was possible to design the subject matter as an advanced course illustrating a realistic approach to both inorganic and organic analytical chemistry as it is practiced today.

Another new subject offered during the year for the first time was a sophomore subject in Structural Chemistry, given by Professor David P. Shoemaker at the request of the Electrical Engineering Department. The subject was taught for the first time to a selected group of sophomores in Course VI-B, Electrical Science and Engineering. It was concerned with the structure and bonding present in molecules and crystals. The subject provided an introduction to crystallography and to the nature of ionic, covalent, and metallic bonds. The methods of determining molecular and crystalline structure were described, as was the relationship of structure to chemical, mechanical, electrical, and magnetic properties. This subject will be offered again next year as an elective for students in physics, electrical engineering, and mechanical engineering, at the request of those departments.

A new senior elective subject in Advanced Inorganic Chemistry was offered by Professor Cotton during the second semester. Among the topics discussed in this subject were complex ion chemistry, compounds of the nonmetals, organometallic compounds, solid state problems, and radiochemistry. The subject emphasized structural, kinetic, and quantum mechanical principles.

Personnel

Professor Frederick S. Dainton of The University, Leeds, England, served as the seventh Arthur D. Little Visiting Professor of Chemistry during the spring term of 1959. He delivered a series of twenty lectures on "Some Topics in Reaction Kinetics." Professor Dainton's lectures were attended by many M.I.T. students and faculty members and by others from the Boston area.

Professor John C. Sheehan received the third American Chemical Society Award for Creative Work in Synthetic Organic Chemistry, sponsored by the Synthetic Organic Chemical Manufacturers Association.

Professor Cope received the Charles Frederick Chandler Medal awarded annually by Columbia University in recognition of achievements in pure or applied chemistry.

Professor John W. Irvine, Jr., returned to M.I.T. in September from a year's leave of absence during which he served as scientific liaison officer with the Office of Naval Research in London.

Professor Stephen G. Simpson retired from full-time service on the faculty at the end of the 1958–1959 academic year. Professor Simpson will continue teaching in the field of analytical chemistry next year as Lecturer.

Research

Research in the Chemistry Department is conducted primarily by members of the faculty in collaboration with doctoral candidates, postdoctoral fellows, and research associates (the latter two groups now total approximately sixty persons), senior thesis students, and guests. The presence of a relatively large number of postdoctoral appointees — who usually are located in research laboratories with graduate students and in many instances seniors — adds greatly to the advanced character of the experimental research being done currently. The postdoctoral men also aid greatly in teaching the methods of chemical research to students with less experience. Many of the postdoctoral men go on to teaching positions in various universities after added research experience through their M.I.T. appointments. During the past year there were twelve guests present in the department, mostly faculty members of other institutions. They spent all or a part of the year here in advanced study, writing, or research.

The following summaries outline some of the recent outstanding accomplishments in research in the department:

Professor Isadore Amdur has completed the calculation of transport and equilibrium properties of the rare gases, nitrogen, and their mixtures in the temperature range 1000° to 10,000° K. The calculations are based on interaction potentials derived from experiments on the scattering of high-energy molecular beams. Similar experiments on the scattering of helium by methane and its fluorine derivatives have led to interesting correlations on the effect of substitution on the intermolecular potential.

Work on the structures and syntheses of natural products was continued by Professor George H. Büchi. Since the first half of the nineteenth century, chemists have been investigating the highly toxic principles of the genera aconitum (monkshood) and delphinium (larkspur). In collaboration with a group at the University of New Brunswick, it has been possible to arrive at the chemical structure of aconitine, the most complicated member of this group of alkaloids. The structure of ulein, which was recently determined in this laboratory, revealed a novel biogenetic pattern in the field of indole alkaloids. A stereospecific total synthesis of maaliol, a tricyclic sesquiterpene, confirmed the previously postulated constitution. The antibiotic nocardamine was shown to be an eleven-membered monocyclic hydroxamic acid.

Professor Cotton and his research group are engaged in the preparation of new types of complexes of transition elements and the study of these along with others already known by various physical and theoretical means, in order to elucidate some of the basic features of the bonding between the metal atoms and the ligands. Complexes being studied include strictly inorganic ones as well as various kinds with organic ligands, the latter being related to catalysts and reaction intermediates in a variety of important chemical processes.

Professor Frederick D. Greene's investigations of photochemical reactions in the authracene series have led to the preparation of organic compounds possessing the structural feature of small rings of unusual stability. The discovery of systems in which variation in wavelength of irradiation has led to marked changes in product composition may be of general use in the problem of selectivity in photochemical organic reactions.

Photochemical and related research on solar energy conversion has continued under the supervision of Professor Lawrence J. Heidt. The quantum yield for the production of hydrogen gas from water has been increased from about 0.1 per cent in the cerium-water system to about 30 per cent in the iron-water system. Differences in the electronic spectra of benzene derivatives in a variety of liquid solvents have been interpreted in terms of simple linear relationships regarding changes in the term values of the energy levels. Significant advancement has been made in the elucidation of the ligand field light absorption spectra of ions of the transition elements in fields of cubic symmetry.

Professor Nicholas A. Milas and Dr. Charles P. Priesing have succeeded in synthesizing a homolog of vitamin D which was found to have essentially the same antirachitic activity as the crystalline vitamin D_2 when tested on rachitic rats. Working with several postdoctoral research associates, Professor Milas also made significant contributions toward the total synthesis of homovitamin D_3 and vitamin D_3 itself. A new chromatographic method capable of detecting and separating organic peroxides in quantities as small as 0.2–0.5 γ was developed by Professor Milas in collaboration with Dr. Igor Belič and Mr. Aleksandar Golubović.

Professor Lockhart B. Rogers and his students have studied electrochemical reductions of certain organic halides and aromatic nitro compounds. This research has shown that ions adsorbed on the electrode surface can alter appreciably the voltages at which reduction starts by forming ion-pairs with the intermediates. In addition, anomalies in the expected relationship between potential and reduction current have been traced to the formation of relatively stable charged intermediates. These results extend the range of information about mechanisms and intermediates beyond that obtained from chemical reactions alone and, at the same time, provide a basis for the development of more reliable analytical procedures.

Professor David P. Shoemaker, Dr. Clara B. Shoemaker, and Dr. Yukitomo Komura have been engaged in x-ray studies of the crystal structures of complex transition-group intermetallic compounds. Structural relationships found in a family of complex alloys have suggested the application of crystal-field concepts to metallic binding. X-ray studies of organic compounds and organo-metallic complexes have also been made.

Professor Walter R. Thorson has been studying a problem in phenomenological molecular dynamics, the "quasi-linear" molecule. Analysis leads to the prediction of unusual features in the spectra. These features occur in the spectrum of disiloxane $(SiH_3)_2O$. Another problem currently under investigation is a theoretical study of the simplest chemical reaction, the transfer of electronic excitation in an atom to translational kinetic energy by collision with a second atom.

ARTHUR C. COPE

DEPARTMENT OF FOOD TECHNOLOGY

During the past year significant increases in the research activities of the department have taken place.

A new research area was opened under a grant from the United States Atomic Energy Commission, for an investigation of new uses for isotopes and nuclear techniques in food toxicology. This subject has become of extreme importance because of the recent amendment to the Food and Drug Law passed by Congress in September, 1958. This project was undertaken by Dr. John H. Rust, a retired colonel from the United States Surgeon General's Office, an outstanding pharmacologist, who joined the staff of the department in December, and who will be with us as a Lecturer next year.

An unusual Special Summer Program was held in June on "Food Protection Factors in Modern Food Technology," sponsored jointly by the department and the United States Food and Drug Administration. More than fifty senior-echelon representatives of the food industry were present, and some twenty other representatives from the food industry participated as guest lecturers.

New research areas investigating the microbiological fundamentals of the *Salmonella* groups of organisms were opened with grants from the National Institutes of Health.

A program investigating the nutritive value of Maine sardines has been completed. Further studies relating to this product are now underway in cooperation with the sardine industry under sponsorship of the Maine Sardine Council.

During the year, a grant-in-aid from the Sugar Research Foundation initiated fundamental studies on the rheological properties of confectionery products.

Enrollment

The graduate student enrollment of the department has been increasing steadily over the past five years. During the last academic year, some fifty-six students from twenty-four countries were in residence.

Personnel

Professor John T. R. Nickerson spent the summer of 1958 at the Swedish Institute for Food Preservation Research in Göteborg as a consultant in food research to the Swedish government.

The third edition of the highly successful text, *Industrial Microbiology*, by Samuel C. Prescott and Cecil G. Dunn, revised by Professor Dunn, appeared in May.

Several visiting scientists were in residence for a year in the department. These included Dr. Tei Yamanishi from the Ochanomizu University, Tokyo, Japan, who has had an integral part in the flavor chemistry research program of the department; Eric G. Davis of the Commonwealth Scientific and Industrial Research Organization of Australia, who has been active in our packaging research program; and Alexander A. Taylor, who came as a Fellow from the British Ministry of Agriculture, Fisheries, and Food.

Professors Proctor and Samuel A. Goldblith have been active in the affairs of the Institute of Food Technologists, for which Professor Proctor has served as Liaison Representative to the Food and Nutrition Board of the National Research Council and as a member of the Food Protection Committee. Professor Goldblith has continued as a member of the National Research Council Committee on High Level Dosimetry.

BERNARD E. PROCTOR

DEPARTMENT OF GEOLOGY AND GEOPHYSICS

During the year steady progress was made on the plan to develop an integrated and unified instructional and research program in the earth sciences. This plan envisions bringing the geosciences (geology, geochemistry, and geophysics), the atmospheric sciences, and the sciences of the ocean closer together in a common educational effort.

Great impetus was given to this program by the gift of Dr. and Mrs. Cecil H. Green, mentioned earlier.

Another step forward in this effort was taken by appointing five senior scientists of the Woods Hole Oceanographic Institution to part-time positions at M.I.T. and by making arrangements which permit M.I.T. staff members and students to take full advantage of the facilities at Woods Hole. Thus a cooperative arrangement that has long existed between M.I.T.'s Department of Meteorology and Woods Hole was expanded to include the Department of Geology and Geophysics. As a consequence, eight of our students carried on oceanographic research at Woods Hole during the summer of 1958, and ten plan to work there during the summer of 1959.

The instructional and research program of this new Center for Earth Sciences will be conducted by staff members of M.I.T.'s present Departments of Geology and Geophysics and of Meteorology, joined by faculty members from other M.I.T. departments and scientists from the Woods Hole Oceanographic Institution. The five Woods Hole scientists who now hold M.I.T. appointments to teach in Cambridge and supervise student research work at Woods Hole are Dr. Columbus O'D. Iselin, Dr. Willem V. R. Malkus,[1] Henry M. Stommel,[1] and Dr. William S. von Arx, all Professors (part-time) of Oceanography, and Dr. J. Brackett Hersey, Associate Professor (part-time) of Oceanography.

Departmental Activities

The eleventh Summer School of Geology was held at the Nova Scotia Centre for the Geological Sciences, with Professor Arthur J. Boucot as Director, Professor Roland D. Parks as Assistant Director in charge of geological surveying, and Dr. Nathaniel McL. Sage (University of New Hampshire) as Lecturer in charge of field camps.

Thirty-three students received basic field instruction: fifteen from M.I.T., fourteen from ten other U.S. colleges and universities, and four from three Canadian universities. In addition, four students from M.I.T., one from Yale, and one from Bates carried on field research for theses.

[1]Department of Meteorology.

For the eighth summer, we participated in the Student Cooperative Plan of Geophysical Service, Inc., of Dallas, Texas. This is a cooperative plan for training exploration geophysicists, started eight years ago as a joint venture by M.I.T. and G.S.I. and now grown to a nationwide effort. One Course XII junior and sixteen students from as many other colleges worked as field assistants on seismic and gravity crews. The seventeen participants were chosen from a list of more than six hundred applicants. A notable feature of this carefully planned program, which is arranged annually by Dr. Cecil H. Green, Honorary Chairman of the Company, is a series of forty short lectures delivered to the student group by professional geologists and geophysicists; these are given during the orientation week at Dallas before the students go to their field assignments. Professors Gordon S. Brown, Truman S. Gray, and Robert R. Shrock were guests of G.S.I. during the orientation program.

The growing interest in the earth sciences was greatly stimulated by a weekly colloquium and numerous less formal lectures, seminars, and discussion groups that brought many distinguished earth scientists to M.I.T.

Course XII continues to provide some of our best candidates for graduate work, but more and more Bachelor's students from other M.I.T. departments are applying for graduate work; we encourage such students if they are interested in any of the earth sciences.

Research

The department carried on a vigorous and diversified program of research, largely supported by agencies of the federal government, consisting chiefly of quantitative and theoretical investigations of the physical nature, chemical composition, and geological age of the earth's crust.

Professor Martin J. Buerger, besides directing the School for Advanced Study, continued with his students to investigate the theory of image-seeking functions and its application in crystal-structure analysis. His laboratory, from which have come three important x-ray instruments and several superior methods of crystal-structure analysis, continues to attract students and visitors from all over the world. Professor Buerger also published his fourth book in the field of crystallography, *Vector Space*, early in 1959.

In the Mass Spectrometry Laboratory research was continued on the variations in radiogenic isotope abundances as a means of determining the age of minerals and rocks from many parts of the earth. An expanding and world-wide 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 their graduate students and field geologists in a dozen foreign countries.

Professor Fairbairn and several graduate students investigated thermal equilibrium in certain metamorphic rocks by photometric analyses of the constituent minerals.

In the Cabot Spectrographic Laboratory, Professors William H. Dennen and Ely Mencher devoted their principal efforts to developing new analytical techniques and to the determination of the ratio and distribution of the major and minor elements in sediments and sedimentary rocks.

Professor William F. Brace investigated indentation hardness of quartz as an indicator of plastic behavior of single crystals, rock fracturing as a function of bonding strength, and deformed fossils as indices of directions of stress and extent of strain in deformed rocks.

Professor Richard R. Doell taught in the University of California (Berkeley) during the summer session, then resumed his studies of remanent magnetism in rocks, paying special attention to paleomagnetic interpretations as they bear on the problems of polar wandering and continental drift. Early in 1959 he was granted a leave of absence, and will continue this work with the United States Geological Survey in Menlo Park, California.

Professor Theodore R. Madden and his group of graduate students continued to modify and refine electrical prospecting methods developed in our Geophysical Laboratory for locating conductive mineral deposits utilizing frequency dependent effects resulting from localized polarization. Work was also started on a long-term study of magneto-telluric currents in the earth's crust.

Professor Boucot supervised thesis work of students in both Nova Scotia and Maine. During the school year he identified and described Silurian and Devonian brachiopod faunas from several widely scattered areas in North America and Europe, and he continued his investigations of the middle Paleozoic rocks of New England, the Maritime Provinces of Canada, and Western Europe.

Professor Harry Hughes, working largely in Harvard's Dunbar Laboratory of Geophysics, measured the electrical conductivity of minerals, under pressure and temperature conditions thought to exist in the earth's crust and mantle, for the purpose of determining temperatures possible in the earth's interior.

Professor John W. Winchester conducted radiochemical research, directed toward analysis of minerals and rocks, using neutron activation and other radiochemical methods, and chemical studies of geological processes. A study of radioactivity in rain water was also begun. Last summer Professor Winchester was a University Research Participant in the Oak Ridge Institute of Nuclear Studies; he plans to attend another ten-week session during the summer of 1959.

Personnel

Professor Buerger was twice honored during the year: first, as a recipient of the Roebling Medal of the Mineralogical Society of America, and second when he was made "Doctor honoris causa" by the University of Berne, Switzerland.

ROBERT R. SHROCK

DEPARTMENT OF MATHEMATICS

The year was marked by a number of changes in the Department of Mathematics. These related to faculty and staff, curriculum, plans for expanded use of the lecture and lecture-recitation system of instruction, and plans for renovation of existing offices and acquisition of additional office space and a Mathematics Reading Room.

Professor Norbert Wiener, distinguished member of the Department of Mathematics for the past forty years, was appointed to the academic post of Institute Professor for advanced teaching and research without departmental boundaries. Professor Wiener will continue to have a close relationship to the Department of Mathematics and at the same time will, as in the past, collaborate scientifically with others throughout the Institute.

Drs. George E. Backus, Arthur P. Mattuck, and Franklin P. Peterson joined the department this year as Assistant Professors. During the year Professors Nesmith C. Ankeny and George W. Whitehead were on leave, Professor Ankeny on a Guggenheim Fellowship at Cambridge University and Professor Whitehead as Visiting Professor of Mathematics at Princeton University. Professor Daniel B. Ray spent the spring semester on leave on an Alfred P. Sloan Fellowship at The Institute for Advanced Study, Princeton. Assistant Professor Barrett O'Neill of the University of

California, Los Angeles, continued as Visiting Assistant Professor in our department this year. Drs. Ronald J. Gribben and Azriel Levy spent the year with us as Sloan Foreign Postdoctoral Fellows in the School for Advanced Study.

The department was active in research in various fields of pure and applied mathematics. Members of the department spoke at colloquia and at meetings of mathematical and other scientific engineering societies in Cambridge and elsewhere during the year.

Enrollment

The number of undergraduate students electing to major in mathematics continued to show a substantial increase. Last fall 76 freshmen indicated that they intended to become mathematics majors. This compares with 45 freshmen in the fall of 1957, 28 in the fall of 1956, and 23 in the fall of 1952. The total number of undergraduate mathematics majors — that is, freshmen, sophomores, juniors, and seniors combined — was 217 last fall; this is an increase of 61 per cent since the preceding year and an increase of 244 per cent since the fall of 1952.

The number of graduate students who are degree candidates was 96 last fall, an increase of 30 per cent over the preceding year and 81 per cent since the fall of 1952. The number of freshmen who designated mathematics as a major last fall was the fourth largest group at M.I.T.; the total number of mathematics majors for all years — undergraduate and graduate degree candidates and special students — was the seventh largest in the Institute.

Again this year a peak in enrollment in mathematics subjects was reached. During the fall semester a total of 4,024 students enrolled in mathematics subjects in 139 sections. This compares with 3,585 students in 137 sections in the fall of 1957 and with 2,663 students in 89 sections in the fall of 1952. Since 1952 the enrollment in mathematics subjects has increased by 51 per cent. During the same period the total M.I.T. enrollment has increased by 23 per cent. Last fall, for the first time, less than half of the enrollment in mathematics subjects was in the four required subjects of the first two years, Calculus and Differential Equations (M11, M12, M21, and M22).

Curriculum Changes

During the year, the department gave a great deal of thought to the problem of handling effectively the large increase in the number of majors and the continuing large increase in the enrollment in mathematics subjects. In this consideration the department had the help of an ad hoc Committee on Mathematics and Physics under the chairmanship of Associate Dean Francis Bitter.

One important need was for new courses for the undergraduate majors. In this connection departmental committees recommended a number of new elective subjects for junior and senior majors. These were: an introductory subject in topology; a one-semester subject in Riemannian geometry, having the introductory topology as a prerequisite; a year's subject in modern algebra; an introductory subject in functions of a complex variable; a one-semester subject in vector analysis and calculus of variations, followed by a second-semester introductory subject in partial differential equations; and a one-semester subject in intermediate differential equations. All these new subjects will be given next year. They will add greatly to the range available to our undergraduate majors, and the department feels that they will give us an extremely strong undergraduate curriculum.

At the graduate level, several new subjects are also planned, including a one-semester subject on topics in conformal mapping, a year's subject in algebraic geometry, and a one-semester subject in advanced tensor calculus.

A substantial increase in the department's staff has been approved for next year, including the appointment of several new faculty members and a marked increase in the number of C.L.E. Moore and regular instructors. These increases in staff will enable the department to introduce the new subjects mentioned above for next year and will also enable us to devote more time to the majors and to research while still carrying our heavy load of courses for students in other departments.

A number of the existing mathematics offices are now being renovated and remodeled, and new mathematics offices and a Mathematics Reading Room have been approved. The new research reading room will be of great value to the department, and the renovated and new offices will furnish us with vastly improved quarters. In particular, there wlll be a considerable increase in the number of private offices, which the mathematician needs for his scientific work.

During the year the department requested and received authorization from the faculty to make the thesis requirement for the S.B. degree in mathematics optional for those students who expect to receive the Bachelor's degree during 1959. For students not offering a thesis, equivalent units of professional subjects are required. At the same time the department requested authorization to have the thesis for Bachelor's students in mathematics made optional for an indefinite period, and a committee of the faculty is now studying this request. This request was considered by the Departmental Visiting Committee at its meeting during the year, and the Committee recommended this step.

In last year's report it was mentioned that the department planned to offer, on an experimental basis, one large lecture section to approximately 175 students in Calculus (M11) during the fall semester of 1958–59, with Professor Eric Reissner giving the lectures two hours a week followed by recitation sections in small groups for one hour a week. This experiment was tried during the fall semester and was observed carefully by the department. All available information on the experiment indicated that it was successful, and it was continued during the spring semester. The department voted to use this method for the entire freshman class in Calculus (M11 and M12) next year, with the group divided into four subgroups for the lectures two hours a week and into 35 sections for the recitation once a week. Professors Reissner, Jürgen K. Moser, Hartley Rogers, Jr., and George B. Thomas, Jr., will give the lectures during the fall semester.

In a similar situation, the department experienced heavy and unexpected increases in its enrollment in Elementary Statistics during the spring semester and as a result decided to operate it on a lecture basis. Three members of the faculty handled two groups of students in the subject; two faculty members gave the lectures, while a third scheduled conference hours with individual students and assisted in the grading of the quizzes and examinations. The department felt that this method of instruction for Elementary Statistics proved highly satisfactory and plans to use this procedure next year in this and certain other subjects.

With the expanded staff for next year, and with these changes in method of instruction for several of the important subjects, the department will be able to handle its increase in students in an effective manner and to offer the new subjects which it has planned.

WILLIAM T. MARTIN

DEPARTMENT OF METEOROLOGY

The field of meteorology has received increased attention in both governmental and private circles during the year. In part this is due to the increasing impact of weather on our complex technological society. A more fundamental reason is that the scientific progress of the past decade, in which our department has played a leading role, has placed meteorology on a sound scientific basis which gives real promise of future important developments. Spurred on by the reports of the Committee on Meteorology of the National Academy of Sciences and the University Committee on Atmospheric Research, plans are being formulated for a major increase in the national research effort in the atmospheric sciences.

The enrollment in the department, which is all at the graduate level, was about 35 per cent larger than last year's. The demand for our graduates greatly exceeds the supply, and the shortage of meteorologists with advanced degrees is becoming acute.

A substantial revision of the subject matter in many of the subjects of instruction was instituted this year with very satisfactory results. A definite need has developed both within the department and from students in other departments for a subject covering the physics of the high atmosphere. Some effort will be made to satisfy this demand, but it is clear that a satisfactory solution will require the addition to the staff of an individual with a primary interest in problems of the high atmosphere.

Plans for further changes in the educational program and the research effort are being made in close collaboration with the Department of Geology and Geophysics and the Woods Hole Oceanographic Institution. The new Center for Earth Sciences which is discussed more fully elsewhere provides a unique opportunity to develop to its fullest the planned integration of our research and educational programs in the earth sciences. The Earth Sciences Colloquium and the Seminar on Planetary Convection have made important contributions to an integration of our research efforts during the year.

Research

Research represents the major activity of the department. Not only the staff but essentially all of the graduate students participate in our extensive research program. With minor exceptions the research is supported by agencies of the federal government, including the Air Force, Army, Navy, National Science Foundation, Weather Bureau, and Atomic Energy Commission. A total of fifteen research grants and contracts were in effect during the year. Some difficulties have been experienced in securing continuation of research support in certain areas, but for the most part these problems have been successfully resolved.

Professors Jule G. Charney and Norman A. Phillips have developed more realistic mathematical models of the atmosphere, and these have been tested at the Computation Center. This work offers the prospect of developing a model that will encompass the long-term changes of climate revealed by geological and other evidence. Knowledge of the causes of natural climatic changes may well offer clues to possible artificial control of climate. One of the factors governing climate is the radiation balance; Dr. Lewis D. Kaplan has been making notable strides in unraveling the complexities of the long-wave radiational flux in a nonhomogeneous atmosphere.

The large-scale circulation of the atmosphere transports heat and momentum on a global scale between low and high latitudes so as to maintain the necessary long-term balance. Studies of the transport of heat and momentum have been made for several years under the direction of Professor Victor P. Starr and have led to new concepts concerning the general circulation of the atmosphere. During the year this work has been extended into the stratosphere on the basis of data collected during the International Geophysical Year.

Solar radiation is the prime mover of the atmosphere, and it has long been suggested that variations in the solar output can bring about changes in the weather. It is now known that solar variability is confined largely to the short wavelengths and the corpuscular radiations, both of which are absorbed in the high reaches of the atmosphere. Professor Hurd C. Willett has been examining the indirect data on such solar variability in an effort to trace its effects on the large-scale atmospheric circulations.

For much the same reason that the properties of gases are treated statistically instead of in terms of the behavior of individual molecules, weather must also be considered as a statistical ensemble. Professor Edward N. Lorenz has been applying modern statistical techniques to both the specification and prediction of weather parameters. One probable result of this work will be an objective estimate of the inherent predictability of weather from data of the kind that are now available.

Many important weather phenomena are of too small a scale to be picked up by the rather coarse grid of regular observations.

Our radar group, under Dr. Pauline M. Austin, has been studying these meso-scale phenomena. At the same time Professor James M. Austin has been relating this radar evidence to the larger meteorological scene of which it is an integral part. In a closely related effort, Professor Frederick Sanders has worked on the dynamics of meso-scale systems, with particular reference to the field of vertical air motion.

Across the boundary between the earth or ocean and the atmosphere flows all of the water vapor and much of the heat required by the atmosphere. The downward flux of momentum to the surface is the brake that, in the mean, dissipates kinetic energy at the rate it is formed and maintains the over-all momentum balance of the earth-atmosphere system. An investigation of this important coupling between the earth and the atmosphere is being carried on at the Round Hill Field Station under the general supervision of Professor Henry G. Houghton.

Professor Delbar P. Keily has continued his work on the measurement of cloud drop size and number with a unique instrument. The data obtained so far show that there are many small drops present that were not previously observed. The implications of this finding are now being investigated.

Personnel

Members of the staff have participated in numerous outside professional activities. Professors Charney and Houghton were elected to the Council of the American Meteorological Society, and Professor Austin entered on the second year of his term as a member of that Council. Professor Charney served as a member of the Committee on Atmospheric Sciences of the National Academy of Sciences. Professor Houghton was elected Chairman of the Board of Trustees of the University Corporation for Atmospheric Research; he also served on a Review Committee of the Argonne National Laboratory and on the Committee on Meteorological Aspects of the Effects of Atomic Radiation of the National Academy of Sciences.

HENRY G. HOUGHTON

DEPARTMENT OF PHYSICS

The past year has brought with it a continuing growth in the number of students majoring in physics, along with increased activity and broadening horizons on the research front. In the fall of 1958, for the first time in the history of the Institute, more freshmen elected physics as their major field than any other professional Course. As of that date the number of physics majors, both undergraduate and graduate, totaled about 850. Essentially all the increase in the number of Course VIII students comes from the undergraduate body. For example, five years ago there were approximately 300 Course VIII undergraduates as compared to about 620 this past fall, so that our physics undergraduate population has more than doubled in this period. The total number of physics graduate students increased by about 10 per cent during this period. In addition to our growing obligations to physics majors, the service load of the department continues to increase, largely because of the third-year enrollment in physics subjects. These subjects now have become sufficiently large so that they must be handled in much the same way as our first- and second-year teaching.

Teaching Activities

In the freshman physics instruction, Professors William L. Kraushaar and K. Uno Ingard continue to improve their new version of the first-year subjects in Mechanics and Heat and Kinetic Theory (8.01 and 8.02). Their experience with this new venture over the past two years has culminated in the preparation of a textbook manuscript.

The activity and strengthening of the first-year laboratory continue unabated, and this is true of all our undergraduate laboratories. New and challenging experimental opportunities continue to evolve for these undergraduate laboratories, and experiments hardly thought possible a few years ago are now available as effective educational opportunities. As an example, a first-class experiment in molecular beams is now part of our standard freshman offering.

Our contributions to undergraduate laboratory teaching have achieved national recognition. Professor William M. Whitney and Robert Marcley were awarded first prize for the development of experimental equipment for undergraduate laboratory instruction at the annual meeting of the American Physical Society. The award winning invention stems from our first-year physics laboratory. In addition, the Apparatus Committee for Educational Institutions of the American Association of Physics Teachers has offered Mr. Marcley a position in the Apparatus Drawings Project sponsored by the National Science Foundation and the American Institute of Physics. Mr. Marcley has accepted this assignment and will devote himself to preparing detailed presentations of undergraduate laboratory experiments for national distribution.

In the second-year physics, Professor Hans Mueller has taken over the teaching of the subjects in Electricity and Magnetism and Optics and Atomic Physics (8.03 and 8.04), carrying on Professor Francis Bitter's earlier effort, and is strengthening this program considerably. The second-year laboratory, under Dr. William Bertozzi, is gaining stature continually.

In the third year, Professors Francis E. Low and Laszlo Tisza have contributed significantly to the improvement of the teaching of our quantum physics in Physics of Atoms, Molecules, and Nuclei I and II (8.05 and 8.06). The demand for modern physics for non-physics majors (Atomic and Nuclear Physics I and II, 8.051 and 8.052), has grown in breadth as well as size, so that an additional elective subject in nuclear physics (Introduction to Nuclear Physics, 8.053), taught by Professor Harald A. Enge, has come into being. Professor Malcom W. P. Strandberg will introduce a junior solid state elective to strengthen our offerings in this area at this level. The junior laboratory, under the direction of Professor Irwin A. Pless, is a beehive of activity; to accommodate all our students, we have had to add to it the space formerly occupied by our senior laboratory. In the fourth year, the new format of senior laboratory and thesis is paying rich dividends, and we are now able to match the educational opportunity of our large number of seniors quite well to the spectrum of their abilities. New laboratory space in Building 20 has been provided to replace the former senior laboratory space taken over by the third-year laboratory.

At graduate level, a new program of graduate offerings, evolved by a departmental committee under the chairmanship of Professor Herman Feshbach, has been put into effect. We now have, in addition to a number of specialized advanced subjects, a strong systematic core of graduate subjects to serve as the base for our graduate educational program. The graduate students have initiated their own colloquium, to which faculty are not admitted except by special invitation, and this has turned out to be exceedingly valuable. The rapid growth of fellowship support for graduate students in physics has brought with it a decrease in the supply of available students for teaching assistantships. This poses somewhat of a problem in staffing our laboratories properly.

Physical Science Study Committee

The work of the Physical Science Study Committee, aimed at creating a first-class high school program in physics, is reaching the later stages of its mission. The relatively large participation of the Physics Department in this effort should taper off during the next year. Professors Jerrold R. Zacharias, Francis L. Friedman, Bruno B. Rossi, Uri Haber-Schaim, Arthur K. Kerman, John G. King, and Nathaniel H. Frank will continue their work with this Committee next year. Professor Zacharias devotes the major part of his time to this effort, and Professor Friedman gives full time to it. Professor Friedman is principally responsible for the text, while Professor Haber-Schaim has been largely responsible for the laboratory manuals. A non-profit corporation, Educational Services, Inc., has been formed and is taking over most of the problems of getting the new materials into the high schools. Plans are under way to take the first steps next fall toward starting a Science Education Center at M.I.T. This is a natural sequel to the work of the Physical Science Study Committee, and it is planned to have this evolve into a full-scale research effort in science education at the college and university level.

Research

As in the past, the major part of the research done by members of the physics faculty has been carried out in the Research Laboratory of Electronics and the Laboratory for Nuclear Science. Such research is reported fully by these laboratories elsewhere in this book.

In the Radioactivity Center, Professor Robley D. Evans and Dr. Robert A. Dudley are continuing most effectively their studies of the biological effects of radiation. This Center continues to hold a most significant place nationally in this field.

In solid state theory, Professors John C. Slater and George F. Koster and their collaborators continue a productive and active program. The use of the new 704 Computer has been most helpful in furthering this work. During the past year Professor Slater has led a series of meetings of members of the M.I.T. faculty whose research lies in the field of chemical and solid state physics. Out of these meetings has evolved a proposal for the establishment of an interdisciplinary laboratory of chemical and solid state physics to be staffed principally by members of the Departments of Physics, Chemistry, and Metallurgy, in collaboration with members of the Department of Mechanical Engineering. A proposal is being made to obtain support for such a new laboratory, and it is hoped that this will provide the first step towards a large Materials Center at M.I.T.

Professor Bitter, working with Dr. Benjamin Lax of the Lincoln Laboratory, has generated a proposal for the construction of a new "magnet facility" to make possible experimental work with steady magnetic fields not hitherto available. It is planned that some of the Lincoln Laboratory solid state research will move into this new facility, thus strengthening the ties between the Lincoln research program and the departmental work. Professor George E. Valley, Jr., is actively assisting in obtaining the necessary support for this new facility from the Department of Defense.

Dr. Emanuel Maxwell of the Lincoln Laboratory staff, with the department this past year as Visiting Associate Professor, has been collaborating actively with Professors Whitney and John F. Cochran in strengthening the low-temperature experimental program. The x-ray diffraction group, under Professor Bertram E. Warren, continues its work in order-disorder, temperature diffuse scattering, and dislocations of crystals. Professor Shull's neutron diffraction program is actively under way, and experimental work using the reactor is in progress. Dr. Andrew Hutson of the Bell Telephone Laboratories spent the spring semester as Visiting Associate Professor of Physics. During this period Dr. Hutson offered a special subject in solid state physics in addition to his other activities. Plans for augmented activity in the field of plasma research and for the construction of new facilities are under way. The physics contribution to this general field, under the leadership of Professors William P. Allis and Sanborn C. Brown, looms as one of the major research areas in the foreseeable future.

In the Spectroscopy Laboratory, Professors George R. Harrison, Lee C. Bradley, III, and Bitter have continued their active program in high-resolution spectroscopy and the study of hyperfine structure.

During the spring, the Laboratory for Nuclear Science held a most impressive two-day research review meeting during which the laboratory's research program was presented to a distinguished group of guests. In addition to the areas of experimental solid state and chemical physics and that of plasma physics, the new program just getting under way in space physics, under the direction of Professor Rossi and his collaborators, promises to grow rapidly into one of the more important research efforts of the department. The program on "terrestrial" cosmic rays is rapidly giving way to a program of cosmological physics. Professors Kraushaar and George W. Clark have already carried out successful balloon experiments utilizing gamma ray telescopes. The high-energy physics research, especially in the Bubble Chamber Group, is turning its efforts in directions anticipating the completion of the new Cambridge Electron Accelerator. The construction of this accelerator is progressing satisfactorily.

It is evident that the physics research program is active and healthy and that the next several years will bring with them significant new enlarged research areas of vital importance.

Personnel

The Physics Department was host to the American Physical Society for its spring meeting at M.I.T. Professor Low held the post of Loeb Lecturer at Harvard University during the spring semester. Professors Louis S. Osborne and Ingard have received Guggenheim Awards for study abroad during next year. Professor Victor F. Weisskopf holds the position of vice president of the American Physical Society and will become its president next year. Professor Philip M. Morse is serving as Chairman of the Faculty in addition to his duties as Graduate Registration Officer of the department and Director of the Computation Center. Professor Rossi holds the Chairmanship of the Committee on Space Projects of the Space Science Board of the National Academy of Sciences. Professor Feshbach has been named to the Advisory Committee for Electronuclear Research and Physics at the Oak Ridge National Laboratory. Professor Bernard T. Feld has been named trustee of Associated Universities, Inc., replacing Professor Frank. Professor Wayne B. Nottingham's annual Conference on Physical Electronics was held again with its customary effectiveness.

Professor Valley returned to the department and is actively participating in its activities. Professor Robert W. Williams has been on leave from the department as Visiting Professor at McGill University. Professor John D. Linsley has resigned to devote his full time to the large cosmic ray shower experiments carried on in New Mexico.

A number of the physics staff have participated in international conferences, including visits to the U.S.S.R. Dr. Wolga represented the Physics Department on the Woodrow Wilson Fellowship Committee. Harry Anderson, who is in charge of our lecture demonstration equipment, has been invited to participate in the American Association of Physics Teachers Conference on Lecture

Demonstrations. During the year, in addition to numerous seminars in special fields, the Physics Department has been host to a number of distinguished guest speakers at its regular colloquia. These are:

Professor R. D. Lee	Columbia University
Professor Thomas Gold	Harvard University
Dr. Herbert B. Callen	University of Pennsylvania
Dr. Walter Baade	Harvard University
Dr. Bernd T. Matthias	Bell Telephone Laboratories
Dr. Lloyd P. Hunter	IBM, Poughkeepsie
Professor Walter Kohn	Carnegie Institute
Dr. Robert Jastrow	National Aeronautics and Space Administration
Dr. Harry J. Lipkin	University of Illinois
Dr. Charles Kittel	University of California
Dr. Edwin E. Salpeter	Cornell University
Dr. S. Chandrasekhar	University of Chicago

NATHANIEL H. FRANK

LABORATORY FOR NUCLEAR SCIENCE

All programs within the laboratory were extremely active during the past year. The main areas of research were: inorganic and organic nuclear chemistry, and chemistry of the fission elements (including Drs. Charles D. Coryell, Frederick D. Greene, II, David N. Hume, John W. Irvine, Jr., George Scatchard, Lockhart B. Rogers, James W. Ross, and C. Gardner Swain); cosmic ray research (Drs. Bruno B. Rossi, Herbert S. Bridge, George W. Clark, William L. Kraushaar, John D. Linsley, Stanislaw Olbert, Livio Scarsi, Frank Scherb, and Robert W. Williams); photomeson and photonuclear research with the laboratory's synchrotron and linear accelerator; and high-energy studies of the fundamental particles using nuclear emulsions, bubble chambers, and scintillation detectors (Drs. Bernard T. Feld, William Bertozzi, David O. Caldwell, Peter T. Demos, David H. Frisch, David A. Hill, Paul D. Luckey, Hans Mark, Louis S. Osborne, Irwin A. Pless, David M. Ritson, Lawrence Rosenson, Charles P. Sargent, Robert A. Schluter, Roy M. Weinstein, and Robert W. Williams); theoretical nuclear physics (Drs. Victor F. Weisskopf, Paul G. Federbush, Herman Feshbach, Marvin H. Friedman, Luis Gomez, Kerson Huang, Arthur K. Kerman, Kenneth A. Johnson, Francis E. Low, and Felix M. H.

Villars); nuclear energy level studies using the O.N.R. Van de Graaff generator (Drs. William W. Buechner, Harald A. Enge, Frederic J. Eppling, Joan Freeman, Anthony Sperduto, Robert J. Van de Graaff, and Robert E. White); studies with the Rockefeller Van de Graaff proton accelerator (Drs. Leon E. Beghian and Rolf P. Acharenberg); radioactivity research (Drs. Robley D. Evans, Monique Crut, Martin Deutsch, Lee Grodzins, and Andrcej Hrynkiewicz); and studies of nuclear structure using the Markle cyclotron (Dr. Nathan S. Wall).

Participants in the work of the laboratory during the past year totaled 293 persons, including 38 academic staff members and 86 graduate students of the Departments of Chemistry and Physics; 39 research associates and D.S.R. staff members; 85 full-time nonstaff employees; and 39 part-time nonstaff employees (mostly undergraduate students). Eleven physicists, including five temporary staff members, were from other universities and represented a total of seven countries in addition to the United States. Thirty Ph.D. degrees were completed in thesis research in the laboratory.

The efforts of the laboratory's High-Energy Accelerator Physics Group were centered about researches within the laboratory's electron synchrotron and other high-energy accelerators throughout the country. Of particular note was an experiment completed during the summer of 1958 at Berkeley which measured the interaction of very high energy K mesons with nucleons, using a new type of Cerenkov counter developed here. An incidental result from this experiment was the confirmation of the existence of clearly defined second and third excited states of the proton. A triggered spark counter and other apparatus are currently under development for a continuation of this experiment. Three quantitative experiments were carried out at the laboratory's synchrotron concerning the production and interactions of π mesons. Considerable theoretical analysis was done also toward interpreting previous related results on the scattering of high energy x-rays and the production of π mesons. Brief exposures of photographic emulsions were made at the Harvard cyclotron and the Brookhaven cosmotron for the study of polarization recoil protons from scattered π mesons. Stimulated in part by the reported existence of a mass 500 particle, some experiments were carried out, using cosmic rays and the Harvard cyclotron; these have set upper limits on the production of particles in the mass 30 to mass 900 range. In particular, the experiments add substantially to evidence for the unlikeliness of the existence of the mass 500 particle.

As was emphasized last year, there is a serious need in elementary particle physics for devices capable of recording in detail complex, many-particle events. Much effort is being concentrated within the laboratory on the development of large bubble chambers; the scintillation fiber technique; and on a coarser version of the latter, using plastic scintillating blocks. Work in bubble chamber research has continued to develop most vigorously. A 15″ methyl-iodide and propane-filled chamber, fitted with a large electromagnet, has been assembled at the Brookhaven cosmotron and will be used for the study of the neutral decay modes of strange particles. The cooperative effort in bubble chamber research among members of the laboratory and physicists from Harvard, Brandeis, and Brown Universities has continued. The group is now designing and fabricating parts of a large liquid hydrogen bubble chamber and associated electronics for use at the forthcoming Cambridge Electron Accelerator.

Commitment has been made for the purchase of a fast film-reading apparatus to render possible the analysis of the large number of bubble chamber events which will be recorded. Choice of the apparatus was made jointly with a number of other institutions engaged in bubble chamber research throughout the country.

The "scintillating fiber" detector under development permits the direct viewing of particle tracks in scintillating materials. The scintillations are very fast and, because the light amplifiers which view them may be counter controlled, the device possesses a unique combination of space and time resolution. Cosmic ray particles have already been viewed in a chamber, and preparations are being made to use this device at the Brookhaven cosmotron to measure the gyromagnetic ratio of the Λ_0 hyperon. A larger coarse-resolution hodoscope of plastic scintillators with separate transistorized circuits is being built for studies at Brookhaven of angular correlations of K-meson decay products, bearing on the interesting question of "time-reversal" in elementary processes.

Research in cosmic rays, as usual, has been extensive. The analysis of the data obtained in the air shower experiment performed at Harvard, Massachusetts, has been completed. The final analysis has confirmed the preliminary results, showing that the cosmic ray spectrum extends without sign of a break beyond 10^{18} ev., and that, even at the highest energies, the particles arrive with approximately equal frequency from all regions of the sky that can be explored from our latitude. The Harvard experiment has now been reassembled near La Paz, Bolivia, where it is being operated in collaboration with physicists from the University of La Paz. The first data have already come in and are in the process of being analyzed. The "giant" experiment at Volcano Ranch near Albuquerque, New Mexico, has also yielded its first preliminary data. It is expected that the Bolivian experiment and the Volcano Ranch experiment will improve and extend considerably our present knowledge of the high energy end of the cosmic ray spectrum, and supply information on the number of high energy particles arriving from the equatorial regions of the sky. The smaller air shower experiment at Kodiakanal, India, has been completed, and its data, including over 100,000 showers, have been fully analyzed.

Another major activity of the Cosmic Ray Group has been a research program directed to the study of gamma rays from extraterrestrial sources. The detection of such γ-rays would help solve problems of great cosmological significance. A preliminary balloon flight was carried out in the summer of 1958. Several other balloon flights are planned for the coming summer. In addition, a detector is under construction that will be installed on an earth satellite to be launched presumably in 1960. This part of the program is being carried out under contract from and in close collaboration with the National Aeronautics and Space Administration.

The polarization of cosmic ray μ-mesons, which was first demonstrated and measured in an experiment recently carried out in this laboratory, is now being investigated in greater detail with a new and greatly enlarged apparatus. The purpose is to measure the variation of the degree of polarization with depth underground and, thereby, to obtain information on the energy dependence of the relative production frequency of the π and K mesons which are the parents of the observed μ mesons. The work on strange particles using the multiplate cloud chamber has been completed; measurements have been made of the production cross-sections for π^- mesons and protons on iron; the lifetimes of the Λ^0, θ_1^0, θ_2^0, and θ^{-0}; the branching ratios for neutral decays of the Λ^0 and θ_1^0; the helicity of the proton in the parity non-conserving decay, $\Lambda^0 \rightarrow p + \pi^-$; and the mass difference of the θ_1^0 and θ_2^0 (an amazingly small 10^{-38} grams).

In the program of nuclear-reaction studies and high-resolution nuclear spectroscopy, using the O.N.R. accelerator and precision magnetic analyzers, a gas-target assembly has been successfully used for an investigation of the interactions of protons and deuterons with neon. This technique will make possible studies of the level schemes of a number of nuclei which have been inaccessible because of the difficulties in preparing suitable targets. The reaction energies of several of these nuclei are also of great importance for the establishment of an improved table of atomic masses. During the year, various improvements have led to increased voltage and higher current outputs from the accelerator and have permitted studies of nuclei in the rare-earth region. The work on stripping reactions has continued with particularly interesting results in the case of potassium 40. The new multiple-gap, broad-range spectrograph for studying the angular distributions of reaction products is being assembled, and research with it will soon be in progress. This instrument will be a major addition to the already outstanding equipment of the laboratory in the area of nuclear-binding energies.

Work at the Rockefeller generator was directed toward the conversion of the generator into a pulsed machine capable of delivering pulse beam of 2×10^{-9} sec. duration for the investigation of the properties of short-lived nuclear states as well as the interaction of fast neutrons with nuclei. The pulsing and detecting systems have been installed, and preliminary tests are proceeding. Further investigations have been made in the measurement of gyromagnetic ratios of short-lived nuclear states, and apparatus for producing fast neutral beams has been developed as an integral part of this program.

Cyclotron research activity over the last year has been directed primarily toward a detailed understanding of the interactions of alpha particles and deuterons with nuclei. The types of experiments performed involved elastic and inelastic scattering as well as transmutation reactions; they have led to a more critical examination of the various semi-classical approaches to the description of medium-energy nuclear phenomena.

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. Over fifty new cases have been measured during the past year.

The program of measuring magnetic moments of radioactive nuclei has begun to yield significant results. This program has at present two parts. On the one hand, the Rose-Gorter method is being used for aligning and polarizing nuclei of paramagnetic elements at low temperature. The moments are then determined by an observation of the anisotropy of the emitted gamma radiation and its circular polarization. This method is applicable to nuclear states with lifetimes of at least a few minutes, provided they are derived from radioactive parents with a lifetime of at least a few hours. A second method consists of observing the rotation, as a function of time, of an angular correlation pattern of gamma-gamma coincidences when the intermediate state has a lifetime sufficient to permit an appreciable precession of the nuclear spin direction in the time interval between the two gamma ray emissions. This method is applicable to states with lifetime in the range between 10^{-6} sec. and about 10^{-9} sec. A combination of the two methods — that is, an application of the Rose-Gorter technique to correlation experiments — may permit investigation of even shorter-lived states.

Two nuclear spectroscopy programs, each of wide scope, have been started. The first is an investigation of the coincident radiation emitted by short-lived radioactive isotopes and by compound nuclei formed by neutron capture. It is hoped to measure transition intensities over a range of 100:1 with no greater than 20 per cent uncertainty. The second program is a study of the lifetime of excited states of nuclei by the resonance scattering process. The first problem to be studied by this technique concerns phenomena associated with the details of the resonance process itself: i.e., investigations of the slowing-down time of recoiling nuclei in condensed material; the effective mass of the recoiling nucleus; and the effective microscopic temperature which determines the Doppler broadening of the nuclear level under study.

Time-of-flight measurements of photoneutron spectra are being continued at the linear accelerator. Recent work has concentrated on light elements and in particular on Be^9, which has the lowest photoneutron threshold among stable nuclei and provides a good opportunity for study of the photonuclear interaction at low energies. Work has also been done on the application of transistors to fast counting problems. A section of the accelerator has been successfully driven by an amplitron tube.

The work of the Theoretical Group can be conveniently broken up into four elements. In field theory and the theory of elementary particles there should be mentioned: the development of conditions on the solutions of field equations of quantum electro-dynamics which must be fulfilled if the theory is to be self-consistent; the development of a proof which demonstrates that elementary particles of odd half integral spin cannot have consistent quantization; and the demonstration that the two-photon mode of π_0 decay will contribute to the proton Compton effect with a unique angular distribution permitting the setting of the lower limit on the π_0 lifetime.

A second area of interest for the Theoretical Group has been the many-body problem. One notable development here has been the solution under rather restrictive assumptions of the problem of the interacting Einstein-Bose gas. The third region of interest has to do with the theory of deformed nuclei, in which considerable effort has been extended in obtaining expressions for the nuclear moments of inertia and magnetic moments. Finally, there has been the work on nuclear structure and reactions in which the connection between the Brueckner treatment of nuclear matter and the real nucleus is in process of delineation. The calculation of the imaginary part of the nuclear optical potential and other elements in nuclear reactions are being made.

No report is given here of researches performed by the laboratory's Nuclear Chemistry Group. These are described elsewhere in the President's Report in the section concerned with research efforts in the Department of Chemistry.

PETER T. DEMOS

SOLAR ENERGY PROGRAM

The Godfrey L. Cabot Solar Research program covers activities in the Schools of Science, Engineering, and Architecture.

The M.I.T. Solar House in Lexington, occupied by the family of a research associate on the project, has given a winter-heating performance which, while confirming some of the conclusions from design studies, indicates a need for flow-sheet simplification, now under way. Three symposia related to solar energy were held during the past year, indicating the growing interest in this field. Institute staff members participated in all: the Mont Louis Solar Symposium in France, the U. S. Army Quartermaster solar symposium and solar furnace dedication, and the New York meeting of the Association for Applied Solar Energy. Research continues under Professor Lawrence J. Heidt on photochemical production of hydrogen from water by light absorption in cerous or ferrous ions; with the latter, quantum yields as high as 30 per cent have been obtained. Cabot Solar Energy Fellowships this year are held by graduate students in chemistry and chemical engineering.

HOYT C. HOTTEL

SUMMER SESSION

Special Summer Programs planned by departments of the School of Science for the 1959 Summer Session are:

Chemistry
Infrared Spectroscopy: Technique
Infrared Spectroscopy: Applications

Food Technology
Food Protection Factors in Modern Food Technology.

***Mathematics* (Operations Research)**
Applications of Probability Theory to Operations Research.

Physics
Plasma Dynamics

FRANCIS BITTER

THE COMPUTATION CENTER

The Computation Center has completed its second year of activity using the IBM 704 computer provided and maintained by the International Business Machines Corporation. During the year some six hundred problems were active on the machine. These problems were representative of many fields of research such as physics, linguistics, and engineering. The problems were programmed and coded by graduate students and staff from M.I.T. and from the twenty-eight cooperating colleges and universities in New England.

Use of the machine has grown to the extent that nearly all of the available time on the computer is being taken. Because of this and because of intrinsic interest in machine utilization, several procedures have been developed by the center staff to make the operation of the machine more efficient. Primarily these steps have consisted of organizing computer operations so that most frequently used programs are read from magnetic tape and of eliminating manual intervention for noncritical thinking. Hence time wasted is minimized in running any given problem. Other improvements have been the development of various utility programs which have facilitated the use of the Fortran II programming system. The Fortran system, which is used to prepare about one-half of the problems for the machine, has definitely made such preparation easier.

Among other projects, the staff of the Programming Research Group at the center has actively assisted the R.L.E. language translation project in the development, programming, and coding of the COMIT compiler-interpreter which, in effect, defines a manipulating language for the purposes of linguistic study and machine translation. In addition, the center has lent support to other groups such as the artificial intelligence project which has made great strides in the development of the LISP programming language. The LISP language is designed to facilitate the processing of symbolic information, as opposed to numeric information. It will be applied to problems such as symbolic differentiation and integration and the manipulation of formal proofs in symbolic logic and related areas. At present, effort is being devoted to arrange for multi-program time-sharing operation of the computer. The latter feature should allow the development of new techniques of machine utilization which as yet are largely unexplored but which are becoming urgently desirable as faster machines are built. More extensive descriptions of these activities are given in the semiannual progress reports of the center.

The center also has participated in educational activities at M.I.T. and at other New England institutions. In addition to the special two-week programming course which is given in August for students and faculty, there have been many instances in which the center has been used as a laboratory for the testing of classroom coding exercises.

PHILIP M. MORSE

SPECTROSCOPY LABORATORY

Reconstruction and enlargement of the laboratory's facilities for high-resolution spectroscopy took place during the past year. The room formerly housing the 10-meter concave grating spectrograph has been altered to permit installation of a second 40-foot Ebert mounting using a 10-inch grating produced by the M.I.T. interferometrically controlled ruling engine, two large echelle spectrographs, two new source locations, and an additional darkroom.

Along with the new Bitter magnet, these facilities will give the laboratory's staff powerful instrumentation for the investigation of atomic spectra. Incorporation of another 10-inch grating, also from the M.I.T. ruling engine, in a high-resolution infrared spectrometer has given resolution superior to 0.1 $cm.^{-1}$ in the spectral region near 4 microns.

The ruling engine has continued to produce gratings of unprecedented size and quality, and the advantages of interferometric control of mechanical processes in the precision range of one-tenth to one-millionth of an inch have been amply demonstrated. Twelve-inch gratings are now being attempted. The performance of these gratings and the operation of the engine have been described by Professor George R. Harrison in a series of ten invited papers, including one before the Fifth International Congress of Optics in Stockholm.

Examination of the spectra of radioactive mercury has yielded new information about the sizes and shapes of nuclei, in both their normal and excited states. The analysis of Zeeman spectra for the purpose of discovering atomic energy levels in the rare-earth atoms has been continued with the aid of the IBM 704 computer. New SHARE programs have been developed. This work was carried out by Dr. Sumner P. Davis, who has recently been named Associate Professor of Physics at the University of California. His loss will be keenly felt by the laboratory. Atomic beams, light sources, and absorption cells are being developed to reduce Doppler width in spectral lines. Hollow cathodes requiring very few atoms ($\backsim 10^{14}$) have been made and are being improved. Interesting spectra of radioactive thallium have been photographed under the direction of Professor Francis Bitter.

Activity in molecular spectroscopy has included extension of the work with small grating spectrometers to approximately 600 microns, the strong water-vapor absorption at about 560 microns having been mapped at modest signal-to-noise ratio. Various far-infrared studies have been completed and published during the year, and invited papers on the laboratory's work in this field have been presented by Professor Richard C. Lord at the Tenth Symposium on Spectroscopy of the American Association of Spectrographers in Chicago and at the Conference of European Molecular Spectroscopists in Bologna, Italy. A high-resolution near-infrared spectrometer has been completed and is in use, and low-temperature infrared studies of hydrogen bonding in biologically important materials are in progress. Other investigations in molecular spectroscopy were carried out by Professors Lockhart B. Rogers, Carl W. Garland, and F. Albert Cotton and their students. Some of the above work has already been published, the titles being given elsewhere in this volume.

Among the visiting scientists working in the laboratory during the past year have been Professor A. R. H. Cole of the University of Western Australia and Dr. Ichiro Nakagawa of Tokyo University.

RICHARD C. LORD

Dean of Students

IN HIS INAUGURAL ADDRESS last June, President Stratton emphasized that M.I.T., as a great educational institution, must be concerned with things of the spirit as well as of the mind. We must strive, he said, "to impart to our students a better understanding of the professional estate and of the values it implies." Among other things, he added, "we must convey to them a respect for moral values" and "a sense of the duties of citizenship."

Certainly the establishment of high professional and ethical standards must be an active concern of the Institute. Yet the problem of attaining such standards is particularly difficult in institutions like M.I.T., which draws its student body from a wide cross-section not only of the United States but of the world. It is quite clear that unless the problem is attacked aggressively, the mores of the student body will not approach a level set by the institution but will in general reflect those with which the student body entered — namely, those of the young people of the country at large.

While M.I.T. itself must promote the moral standards and preferred patterns of living which it wishes its student body to believe in and maintain, I am convinced that high morale and pride in ethical standards cannot be legislated by the Institute nor taught to the students by the faculty. I believe rather that the single most powerful influence in the student's life, particularly the freshman's, is the "climate of opinion" of the student body as a whole — the unspoken intellectual and ethical atmosphere which surrounds him.

In short, the student must be immersed in a strong, socially compelling atmosphere from which no defection is acceptable to his peer group. The establishment of such an atmosphere is a particular concern of the Office of the Dean of Students. Moreover, we now have, as a residential university, the living conditions through which it can be appropriately provided.

I think that all educational experience has shown that high standards can be reached and maintained only through the establishment of strong traditions within the student living groups; these traditions capture the new student's loyalty, appeal to his pride, and weld him to the group. Such traditions must have some mechanism for permanence in the form of continuing and mature personnel who subscribe to and transmit standards, some visible symbols of belonging (the fraternity pin, for example) which persist through years, and a maximum of social communication so that infusion can take place.

The answer of the Institute to the problem of establishing such traditions is, of course, in large part the Housemaster Plan with houses of reasonable size. It cannot be said that we have much more than made a beginning, though that beginning is very encouraging. The crux of the problem is student acceptance and student realization that their lives have in fact been enriched and their horizons broadened by the system, but this is not done over night; any firmly fixed traditional atmosphere requires time and great patience.

The Housemaster and his staff, however, can supply academic aid, stimulating faculty visitors, a center for good conversation, and the base for social and intellectual communication at a high level; by so doing they can gradually infuse the house with a sense of the meaning and content of quality in ethical areas as well as intellectual ones and thus gradually aid the establishment and the perpetuation of the desired atmosphere. It is toward this that we are working.

In the spring, Dr. John B. Goodenough became Housemaster of the Senior House on East Campus. Dr. Goodenough will have a senior tutor and four tutors for the next academic year. He and Mrs. Goodenough had already helped begin many of the trends toward realization of the goals we have been discussing — notably in the area of faculty participation in dormitory life. Furthermore, the students in Burton House, under Professor and Mrs. Howard R. Bartlett, seem to me to display full acceptance of the system and enthusiasm for what it has meant to the House.

Decision to proceed with a dining room for Burton House and Connor Hall should greatly add to their unity. Architect's plans have been perfected, taking advantage of suggestions by students now in residence. The facilities should begin operation at the opening of the academic year 1960–61.

Fraternities

The Institute's continued growth toward being a complete cultural community has more and more centered the students' entire life on campus. This fact, coupled with the crowded living conditions of the Back Bay area and the aging of houses, has again caused the question of fraternities' moving onto campus to be carefully examined. The difficulties are great, but the philosophy we have discussed above would be greatly furthered if more fraternities do, in fact, find it possible to be on the campus. Several at least have strong desires to do so.

The fraternities this year established and put into effective operation a cooperative purchasing office.

Women Students

The need for increased woman power in this country in recent years has stimulated the feeling that women, while retaining their feminine roles as wife and mother, should be encouraged and guided to accept the multiple roles of wife, mother, home-maker, community member, and builder of a career, as they may play these roles at different times during their lives.

With these things in mind, the Faculty Committee on Student Environment discussed the whole question of women at M.I.T. As a result, a recommendation was forwarded to the administration that we make some preliminary studies and do some research in order ultimately to set up a program which more adequately meets the needs of women.

The freshman women's dormitory at 120 Bay State Road has completed its second year of operation. The year began with 14 entering freshmen, one transfer student, two upperclass counselors, and a new resident head, Mrs. Anna Korda. On the whole the year was quite successful, although there were two uncooperative and unhappy girls who asked and were granted permission to leave the house toward the end of the first term. Two others were disqualified.

The over-all academic average for freshman women for the second term was better than it has been for some time. The girls in the house for this term had more space; because of this they seemed to find studying easier with less trouble from noise. This experience emphasizes the fact that we should provide better facilities for quiet study as well as recreational and social facilities, both of which are very difficult in the present residence.

Bexley Hall continued as a living situation for upperclass and graduate women. It was filled to capacity both terms, and Professor and Mrs. William Bottiglia continued as faculty residents. Because there is no lounge, dining room, or adequate meeting room, the women are not able to entertain nor to achieve any coherence as a living group other than on a very small scale in individual apartments. After two years it seems quite clear that Bexley Hall as presently set up, however convenient and pleasant it may be as apartment living, can in no sense be considered a women's dormitory, for it offers none of the social and educational opportunities we are so eagerly attempting to establish in all our dormitories.

As we continue to examine the place of women students at M.I.T., our attention is constantly focused upon the inadequacy of the living situation. It becomes increasingly clear that we should be looking toward a complete residential unit with all that this implies and not a series of makeshift arrangements, as has been the case in the past.

Freshman Advisory Council

The Freshman Advisory Council, under Professor Charles N. Satterfield as Chairman, continued to make a real contribution to the life of the Institute. Professor Satterfield asked to be relieved of his responsibilities at the end of the academic year. Professor Roland B. Greeley of the Department of City Planning will succeed him.

The year opened with a dinner at the Faculty Club to which Faculty Advisers and Student Counselors were invited. Admiral Edward L. Cochrane represented the administration, giving a brief and interesting talk following the dinner. Professor Satterfield conducted the discussion which followed when both faculty and students exchanged questions and comments. The students, particularly, appreciate this opportunity to talk with faculty about plans for Freshman Weekend as well as more inclusive plans for the freshman year. The spring luncheon of the Council, which had worked so well the previous year, was repeated, giving new members (constituting one-third of the Council) an opportunity to ask questions and become better acquainted with the Council's operation.

Professor Peter Eagleson, as Executive Officer of the Council, took responsibility for the Course Orientation Program. The pattern of the program was substantially the same as in previous years. At the Convocation which opened the Course Orientation Program, the Deans of the various schools spoke briefly on the philosophy of their schools. The program as presently constituted has been in effect a number of years. We propose to review it carefully this year, hoping to increase its appeal to the freshmen.

In addition to the regular Course Orientation Program, Professor Eagleson developed a list of research projects sponsored by different faculty members who were willing to invite the participation of interested freshmen. There was an enthusiastic response by the entire student body. Seventy faculty volunteers and sixty-eight students actually took part. There were, of course, some students who dropped out, but the majority who continued wanted to continue next year. No effort to bring student and faculty together has seemed more promising to — nor created more good will among — the students. The program will be continued next year.

At the end of both terms, the members of the Freshman Advisory Council who had students in academic difficulty met in a preliminary session to discuss each individual case before making recommendations to the Committee on Academic Performance. This was extremely helpful both to the student and to the faculty as it gave more time for discussing each case and permitted the Council to make recommendations as a group rather than to give only a few facts at the committee meeting and come to a hurried decision.

Freshman Weekend

Freshman Weekend was an excellent event from the point of view of introducing freshmen to student affairs, but after a few years' experience with the academic introduction it seems quite clear that the mass of advice is quickly forgotten, and detailed information concerning operational procedures could as well be printed. The end result has been an impressed but bewildered freshman.

It was consequently decided that a new approach was desirable, calculated to maintain and stimulate the freshman's initial enthusiasm for science, engineering, and research by focusing on ultimate goals rather than specific information. A committee under Professors Harold E. Edgerton and Frederick J. McGarry has arranged programs on which distinguished and well-known Institute faculty will stimulate the freshmen by talking about their own research careers during this September's Weekend. The experiment will be watched with great interest.

Student Counseling

Student counseling is a part of the Institute's program that gives rise to mixed feelings and considerable variety of opinion among members of the faculty and administration about its nature, purpose, and importance. In the broadest meaning of the phrase, it is accepted as one of the Institute's general responsibilities. In practice, it is the responsibility of approximately 180 members of the faculty who serve as Registration Officers or Freshman Advisers. What it should be, in particular for sophomores, will become a practical matter for faculty attention if the recent proposal of the Committee on Undergraduate Policy is adopted, deferring until the junior year a student's choice of major.

There is a notion that Registration Officers or advisers are concerned only with marginal or failing students. This is strengthened by the fact that they meet together officially as a group only at the end of each term when, with the Committee on Academic Performance, almost all of their time is spent on the art of applying probation or disqualification to the small fraction of their students who are doing poorly. Individually, advisers are often concerned with all their students, but organized public concern is focused regularly only on those who are marginal.

Does this suggest that we are better able to identify and deal with academic "vice," so to speak, than we are to define and stimulate academic "virtue"? Is counseling provided, in fact, only to deal with the academically disagreeable when it occurs, or has it a more positive part to play in the Institute's aims?

The answer to this cannot be reached by concern only with the organization and machinery of counseling; we must also deal with the ambivalence that underlies the larger question of how educational aims can be translated into practice. Is the collective effect of a student's various courses sufficient for his best growth, and can the stimulus of a close relationship between student and faculty be left to chance? Or is this stimulus something which the student cannot supply for himself, and which will come, therefore, only as a result of wider faculty initiative?

In the non-academic area of the student houses there is a parallel to this issue. Until recently the general tone and atmosphere of a house was a product of student "autonomy," in which there was no faculty influence except indirectly, through administrative supervision. With the introduction, first, of faculty residents and more recently of housemasters, the Institute has given effect to the conviction that student autonomy is not incompatible with direct faculty interest in quality of living. Counseling represents in an academic form the same issue of reconciling the student's need to understand that "he must be his own teacher" with the Institute's function of affording him "the incalculable benefit of intimate association with first-class minds."

Kresge Auditorium

Each year since the dedication of the Auditorium in 1955 there has been an increasing number of events scheduled in Kresge. The year's reservations for use of all sorts totaled:

Auditorium	421
Little Theater	530
Rehearsal rooms	547
Total	**1,498**

This represents an increase of 448 or 43 per cent in the past year; the outlook for 1959–60 is that for the first time the physical capacity of the building will have been reached for evening and weekend events. This is especially true of the Little Theater, which is already solidly booked evenings and weekends from October through the middle of May, and it is nearly the case with the large auditorium. This circumstance is a splendid tribute to the imagination, creativity, and vigor of the Institute family, and is occasioned by expanding programs of the Choral Society, Baton Society, Dramashop, Celebrity Series, Community Players, and Musical Clubs, and the fact that next year we shall have two series of Karl Taylor Compton Lectures, one each in the fall and spring. In almost every respect, Kresge is increasingly becoming the center of the cultural life of the Institute. The pressure of these additional events upon the Kresge facilities suggests the increasing necessity for groups sponsoring programs to plan farther ahead than is now the case.

Mr. James Murphy, Auditorium Manager, reports that the flow of visitors to the Auditorium and Chapel continues unabated, while the frequency of complimentary letters received from visitors and sponsors of Auditorium events attests to the superb spirit and interest of Mr. Murphy and the Auditorium staff.

Chapel, Religious Counselors, 317 Memorial Drive

The religious counselors continue to extend their quiet influence through channels previously established for worship, instruction, and counseling. All have high praise for the new facilities at 317, and they report increasing counseling contacts with students.

The full-time addition of the Reverend Myron Bloy, Episcopalian, has been most welcomed. Next year, the Reverend Donald Idhe will spend nearly full-time as the Baptist representative, while the Unitarians have appointed the Reverend Peter Baldwin to a part-time assignment. It is my understanding also that Rabbi

Herman Pollack will have the part-time assistance of a colleague. Professor Huston Smith has been extremely helpful to the student religious groups and to the individual counselors.

The wonderful spirit of cooperation that has been present among the counselors has extended itself to the student groups, mainly, I believe, because of the frequency of contact occasioned by the new house. Next year, for the first time, the student groups will cooperatively publish a brochure describing their several activities.

In order to keep pace with the increasing religious program, we need urgently to refurbish the basement of 317 in order to accommodate larger groups than are now possible in the seminar room on the second floor.

The Chapel during the year scheduled 618 religious services, 46 weddings, and 10 organ recitals; there were 188 reservations for other purposes.

Walker Memorial

Walker is increasingly becoming a center for student activities. With the Athletic Association and the Non-Resident Students' Association moving to new quarters, several activities either formerly without office space or located in dormitories or in Building 20 have petitioned for space allocations in Walker. In most cases, these groups can be accommodated. However, the major policy question is whether the expense of structural changes is justified, in light of the imminent construction of a new student center.

W1MX, the amateur radio station which was forced to move from its quarters in Westgate, has been assigned space on the third floor rear. Other pending major moves to Walker include WTBS from Senior House and the IFC Purchasing Office from Building 20. WTBS has been incorporated and is applying for a 250-watt broadcasting license.

Non-Resident Students' Association

The merger last August of the Commuters' Association with the 5:15 Club to form the Non-Resident Students' Association was an important forward step in the further development of the concept of the non-residents as an undergraduate living group. This thoughtful action has made it possible to proceed with confidence toward establishment of the non-residents' house at 318 Memorial Drive.

When the NRSA House is opened this September, it is anticipated that it will provide our non-resident undergraduates with a greater sense of identity with the Institute and also offer some of the educational advantages now enjoyed by residents in the dormitory housemaster system. A graduate-tutor will reside in the House.

It is also anticipated that the new House will strengthen the goals of the NRSA, where the expectation is to:

a. Stimulate the interest of non-residents in undergraduate activities.
b. Promote such activities as will provide for the furtherance of social contact among the non-resident students.
c. Promote a spirit of cooperation between the non-residents and the resident students.
d. Acclimate new non-resident students to the M.I.T. community.
e. Foster friendly student-faculty relations.

A Dean of Students' committee was formed and met twice during the winter for the purpose of inquiring into the long-range needs of the non-resident students. In order to inform the committee more fully of the nature of the non-resident situation, personal interviews were conducted with nearly two hundred non-resident undergraduates. This material is now in the process of being formulated for committee purposes.

Student Center Committee

The undergraduate Student Center Committee, a special committee of the Institute Committee under the chairmanship of John Beynon '59, has met frequently throughout the year. Delegates were sent to the New England Regional Conference of the Association of Student Unions at the University of New Hampshire and to the annual conference of the Association at the University of Miami. Alan Shalleck '60 and Sherman Grossman '60 are presently co-chairmen of this committee.

The Dean of Students' Student Center Committee met during the fall to hear Malcolm Rivkin, Planning Officer, discuss possible site locations for the Center with President Stratton. Student enthusiasm remains high for this proposed building.

Student Activities

Student interest in undergraduate activities of a nonathletic nature appears to have increased and matured during the year. The Musical Clubs, under superb student leadership, experienced their finest season. The joint Glee Club Concert with Mount Holyoke in Kresge was a joyous occasion; the joint concert of the M.I.T. and Harvard Bands was an impressive performance; and the Symphony Orchestra concerts were enjoyed by increasingly large audiences. The Baton Society, which sponsored the "All Tech Sing," drew so many contesting student musical groups that the program was over-long. The Society is investigating the possibility of two performances next year.

Dramashop also has increased both its audiences and its student participation. The enthusiastic response of undergraduates to the four sets of student-directed and -produced one-acts and the two major productions are eloquent indication of the extent to which drama and theater have become an integral part of student life.

The Outing Club increased its accommodations for ski enthusiasts by erecting two of the Westgate units on land which it purchased in Bartlett, New Hampshire.

The Sports Car Club informs me that it has won most of the contests held in New England this year and that its superiority is generally conceded by its collegiate rivals.

Lecture Series Committee continued to provide the community with the best in films and lectures, and it has expanded its Classic Film Series to include both semesters.

The Technology Community Association-conducted Charities Drive and Blood Drive were effectively handled by Robert Kessler '60 and Michael A. Rosner '60. Both drives surpassed last year's totals.

L'Amitie, together with similar groups from colleges of the Greater Boston area, sponsored the best in French films.

The Activities Council, a permanent sub-committee of Institute Committee, under the leadership of Lynn Sykes '59 and Thomas Farquhar '60, has consistently gained in prestige and influence and is becoming an increasingly articulate center of thoughtful opinion concerning the place of activities in undergraduate life.

Activities Development Board

The Activities Development Board has been concerned primarily with assistance to two of the major activities: WTBS and *The Tech.*

Professor Robert Mann, Board Chairman, has given more than generously of his time to help WTBS achieve FM stature. To this point, the WTBS trustees have been granted a corporate entity, and the financing of the technical equipment has been arranged. The problem of new studios and of an allotment of a frequency by the FCC remain to be solved.

With the assistance of the Undergraduate Association Finance Board and on the recommendation of the Activities Development

Board, a loan fund was created for *The Tech* which will assist it in overcoming the time lag which results from delays in receiving advertising revenue. This is the first step in an evaluation of the policies and procedures to be carried on by the present managing board of *The Tech.*

The Activities Development Board continues to serve the needs of undergraduate activities with increasing effectiveness.

Institute Committee Activities

Of especial note among the special events is the superb result achieved by Linda Greiner '60 and Dave Butterfield '60 and their committee in arranging the 1959 Open House. Not only was this a most successful Open House, but it achieved a new significance by making extremely effective use of the student membership of the various student-faculty committees and the honorary professional societies.

The Public Relations Committee successfully instituted the publication of a Freshman Picture Book available to the class on their arrival.

The International Program Committee, under the leadership of Jaime H. de Sola '60, brought new imagination and vigor to the International Week Program. The resulting community response has greatly encouraged the Committee to new efforts for 1960.

It is my impression that the "action committees" of the Institute Committee are performing with increasing effectiveness and competence.

JOHN T. RULE

DIRECTOR OF ATHLETICS

The growth which has taken place in the athletic program during the past four years, through the addition of facilities, combined with administrative and faculty interest in the total athletic program, has given our undergraduate students greater respect for what the Institute is attempting to do in the extra-class life of each individual.

The year 1958–59 has seen a greatly increased number of students engaged in some form of physical activity. With the Armory available as an indoor facility for tennis, basketball, volleyball, and badminton, students have been able to enjoy these activities regularly throughout the year. The new David Flett du Pont Tennis Courts have surpassed the most optimistic expectations; approximately six hundred undergraduates played tennis last year. In addition, reconditioned fields have provided both formal and informal team play for dormitory as well as fraternity groups.

The purpose of the M.I.T. athletic program is to supplement rather than confuse the intellectual experience of our student body. The primary requisite for members of the coaching staff has been to recognize the student as an individual and to stimulate those interests which best satisfy the individual's needs.

Because students are viewed as individuals, each member of the Department is able to submit for the Dean of Students an evaluation and appraisal of his experience with each student on the athletic field. These evaluations will help reach the goal of a comprehensive record of the personal traits of character of each undergraduate, to be available to employers or graduate schools.

Athletic Staff

The year saw the addition of Alexander Sotir as head wrestling coach, assistant track coach, and Instructor in Physical Education. Mr. Sotir graduated from Springfield College in 1954 and came to the Institute after five years in the Navy. Ronald L. Keenhold, who graduated from Lehigh University in 1956, served this year as freshman swimming coach and Instructor in Physical Education.

Other staff changes involved the appointment of Jack H. Frailey, who graduated from M.I.T. in 1944, as head crew coach; he replaces Frank S. DuBois, Jr., whose resignation was submitted in December, 1958. John H. Burke, Jr., coach of basketball and golf and Instructor in Physical Education, submitted his resignation this year. Mr. Burke is to be replaced by John G. Barry, who graduated from the University of Michigan and comes to M.I.T. from Methuen High School.

After thirty-seven years' employment, James S. Alexander, squash court attendant, passed away in February. His work made possible the effective use of our limited number of courts, and the friendly atmosphere which he fostered brought students back to the courts throughout their undergraduate and graduate careers.

Physical Education Program

A total of 3,182 individual student registrations were recorded in the thirty physical education class activities offered during the school year 1958–59. Recreational carry-over activities, such as sailing, swimming, tennis, skating, and bowling, led in popularity. Activities which are new to the physical education program and have proven to be popular are elementary diving, lacrosse fundamentals, and Red Cross senior lifesaving.

Intercollegiate Participation

Coach Charles Batterman fielded a soccer team made up of men from thirteen different foreign nations. Although the season was not as outstanding as last year, men with varying backgrounds found team play to be an experience worthy of the time spent. During International Week a game against a semiprofessional German team afforded the opportunity for many casual onlookers to see students from different cultures cooperating in a common team effort.

With seven wins and three losses (Harvard, Brown, and Springfield), the swimming team achieved prominence as the most outstanding in M.I.T. history. In March, the New England Intercollegiate Swimming Championships, held at the Alumni Pool, proved the ability of this team when they finished fourth in the total league — standing behind Williams, Brown, and Springfield. Four M.I.T. records were broken during the year in the medley relay, 100-yard butterfly, 100-yard freestyle, and diving.

During the first year of participation as a formal sport, the ski team won the New England Championships and brought trophies to M.I.T. for first or second places in each of their seven intercollegiate races.

The M.I.T. crew finished the formal part of the racing season by eliminating Princeton, Yale, and Syracuse in the Eastern Collegiate Sprints Regatta held on Lake Carnegie in Princeton. Although they could not defeat the eventual winner of the Sprints Regatta (Harvard), the success at Princeton made the season a success in the eyes of all who watched the crew develop during the year.

One of the important contributions made to sportsmanship was the invitation to the Dartmouth lightweight crew to spend their spring vacation on the M.I.T. campus. This was the first year we have had a chance to repay the spring visits of M.I.T. crews to Hanover.

For the second year in a row, the lacrosse team won the Class C National Lacrosse Championship with a record of ten wins and one loss. The total team effort was such that twenty-six lacrosse players were awarded letters. Benjamin R. Martin, Jr. was designated as coach of the North team in the annual North-South Lacrosse game held in Baltimore.

The baseball team had the most successful season since the inauguration of baseball at M.I.T. in 1949. The team had a record of six wins outside of the Greater Boston Baseball League. Warren Goodnow, captain, and Harold J. Parmelee, a transfer student from Bowdoin, were selected as members of the Greater Boston All-Star Team.

The tennis team completed the season by winning eleven matches and losing four. The year was climaxed at the New England Intercollegiate Tennis Association Championships, when M.I.T. tied Yale for second place.

Student initiative and interest in anything novel brought M.I.T. a second place in a Yale-sponsored intercollegiate bicycle race. Two weeks before the race, five M.I.T. students expressed a desire to enter a team. They trained informally and found themselves second best to Yale out of forty intercollegiate team entries.

During the year a total of 820 students received recognition as having been participants on one of M.I.T.'s intercollegiate teams.

Intramural Participation

Through the careful planning of the students and John S. Merriman, Jr., intramural adviser, the M.I.T. intramural program has again provided competition for more than 420 teams in fourteen activities. During the year approximately 3,500 undergraduate and graduate students competed in one or more activities of their choice. Opportunity to engage in squash, tennis, golf, sailing, bowling, and badminton on an intramural level has stimulated an interest in athletic activity which can be carried on in later life. The basic appeal of the intramural program seems to be the freedom in choice of activity and the less severe demand upon the student's time. The increase in the number of participants for the year 1958–59 may be attributed, at least in part, to the improved organization of the dormitories.

Special mention should be made of the contribution of the entire intramural managerial staff. Their unselfish devotion to what was frequently a thankless task represents student organization and responsibility at its best.

Miscellaneous

Paul H. Ekberg was the recipient of the Athlete of the Year Award for his prominence as a lacrosse and hockey player. Mr. Ekberg's leadership, as displayed during his presidency of the Athletic Association, and his unselfish contribution to the total betterment of M.I.T. athletics made him the choice of the Selection Committee.

David H. Koch was awarded the Q Club Award as the outstanding freshman athlete of the year. His achievement as a basketball player, record-breaking pole vaulter, and honor student made him the unanimous choice of the Quadrangle Club.

An innovation this year was the T Club's Spring Awards Banquet. This year's effort proved most successful; 145 students and faculty attended the banquet honoring the spring sports letter winners.

Throughout the year, the M.I.T. Athletic Board has been actively interested in improving facilities and in reviewing Athletic Department policy. A study of the need to cover the ice rink, development of plans for a new boat house, discussion of intramural versus intercollegiate participation, consideration of training table facilities, and study of the future role of rugby in the M.I.T. program have been a few of the matters considered by the Athletic Board. The responsible leadership of Michael A. Drew and George S. Stivers, intercollegiate and intramural vice presidents of the Athletic Association, respectively, gave strong student representation in the affairs of the Board. Professor Kenneth R. Wadleigh, chairman of the Board, expressed the attitude of all Board members when he said, "It has been an unusually gratifying experience to work with students who have taken such a vital interest in what they are doing."

We continued faculty classes in swimming and golf during the past academic year. In addition, provision was made for skating, swimming, and sailing classes for faculty children.

The M.I.T. Dames carried on their swimming program for the third year. The Institute's contribution of both time at the pool and phonograph facilities has proven most worthwhile for the wives of students.

I wish to express my sincere appreciation to the many faculty members who have served as team advisers throughout the past year. Through their effort, team members were able to learn to know informally the professors who have taken time out of their busy day to observe teams in action. In this regard, Major John E. Keator, USAF, deserves particular thanks for the contribution he made in volunteering his services as freshman baseball coach.

RICHARD L. BALCH

DIRECTOR OF STUDENT AID

During the past decade the Institute, in common with other privately endowed colleges and universities, has been forced to make successive increases in tuition in an attempt to keep in step with the constantly mounting costs of operation. The academic year 1958–59 witnessed another step in this direction, with a tuition increase of $200 effective in September, 1958. During the year it was announced that the tuition fee would be advanced to $1,500 annually, beginning with the Summer Session of 1960.

With these prevailing conditions, the Institute's capital resources for student aid are being taxed to the utmost; nevertheless, it is gratifying to report that for the year past the percentage increase in the number of students assisted and total dollars awarded surpassed the percentage increase in the tuition. From the summary (page 234) it should be noted that 1,430 individuals (almost 40 per cent of the Institute's 3,587 undergraduates) received $1,517,575 in direct financial aid; of this, $969,901 represents scholarships and $547,674 loans. In addition to these grants, some 1,308 undergraduates earned $602,000 in campus employment, making a grand total of $2,118,575 in financial aid furnished by the Institute for the year.

Loan Funds

In the spring of 1958, as reported last year, the terms of the Technology Loan Fund were modified with Corporation approval. The most important change was to make this Institute resource available to entering freshmen. The timing of this decision made it impracticable to publicize the Fund's availability for the Class of 1962; nevertheless, 29 members of the freshman class were assisted with loans during the year.

The Class of 1963 was fully informed of the opportunity for financial assistance from the Technology Loan Fund to supplement available scholarships and campus jobs. Approximately half of the 2,100 financial aid applications from the Class of 1963 requested loan consideration, and more than 160 members of the Class of 1963 will enter in September, 1959, holding loan grants which total better than $70,000. The acceptance of loan offers by entering students was much higher than anticipated. There is little question that the intensive national publicity given the National Defense Loan Act, signed by the President of the United States in September, 1958, did much to focus the attention of many young people and their parents on student loans as a prime means of student aid.

During this year, 1,023 loans were made to undergraduate and graduate students for a total of $727,805; of this amount, 273 graduate students borrowed $180,131. A total of 1,133 applications were filed; 1,082 were presented to the Technology Loan Fund, and 972 — or 90 per cent — were acted on favorably for a total of $681,879. For 1957–58, the corresponding figures were 810, 706, 87 per cent, and $472,119. Thirty-four applicants were assisted from the George J. Mead Fund in the amount of $32,195; seventeen others qualified for grants from other loan funds to the extent of $13,831.

With the opening of the college year in September, 1959, the Institute will have all classes (graduate and undergraduate) holding substantial grants from all the available funds provided for loan purposes. For the year just completed the total borrowed increased by 42 per cent, and it is anticipated that for 1959–60 total loans may exceed $800,000. The Institute has been fortunate that up to this time the capital of the Technology Loan Fund has been adequate to meet the demand; however, projections for 1960–61 indicate that we should be prepared to loan at least $1,000,000.

Serious thought should be given to ways and means of adding to the capital funds for loan purposes, so that in the next few years there will be adequate resources to meet student demands for loan assistance and so that the capacity of the funds to furnish loan help is neither diminished nor impaired.

Installment Credit Plan

At the time of the latest announcement of tuition increase, a new credit plan for tuition payments was inaugurated. This plan, which will begin in September, 1959, provides an installment arrangement for paying any tuition in excess of $1,000, with a maximum of $2,000 under this plan to any one student in a four-year period. Repayment begins six months after the first credit is extended, with interest at 5 per cent on the unpaid balance. Semi-annual payments will be set to insure that payments will be complete within six years after graduation. This plan will be available to all degree candidates in good standing, U. S. citizens who are not simultaneously receiving grants from the Technology Loan Fund. There are no data from which to forecast the demand for this plan, but the experience of the next few years will supply the necessary information.

Scholarships

For 1958–59 some 117 contributors — including industrial companies, corporations, foundations, fraternal organizations, individual

Undergraduate Scholarships and Loans, 1957–59

	1958–59			1957–58		
	Number	*Awards*	*Total*	*Number*	*Awards*	*Total*
UNDERGRADUATE SCHOLARSHIPS						
From M.I.T. endowment funds:						
Freshman scholarships	173	$157,100.00		144	$120,686.25	
Other undergraduate scholarships	201	141,860.00	$298,960.00	201	132,221.30	$252,907.55
From outside sources:						
Freshman scholarships	207	271,529.00		142	159,816.00	
Other undergraduate scholarships	372	399,412.75	670,941.75	302	297,807.00	457,623.00
	953		**$969,901.75**	**789**		**$710,530.55**
UNDERGRADUATE LOANS						
Technology Loan Fund	680	$521,973.00		521	$365,977.00	
Mead Fund	30	23,835.00		39	29,210.00	
Other student loan funds	4	1,866.00	$547,674.00	4	1,900.00	$397,087.00
	1,430*		**$1,517,575.75**	**1174***		**$1,107,617.55**

* This total is modified to allow for individuals receiving both scholarships and loans.

alumni, the M.I.T. Alumni Fund, M.I.T. clubs, trusts, and other friends of the Institute generously furnished over $670,000 to give deeply appreciated support to our undergraduates through scholarships grants. There are several noteworthy factors in this year's total gifts: the amount exceeds the total of undergraduate scholarship grants of two years ago (1956–57), when the tuition fee was $1,100; 60 per cent of the undergraduates receiving scholarships were financed from these "outside sources"; ten contributors subscribed 70 per cent of the total amount; the National Merit Scholarship Corporation supplied 30 per cent of the total amount in furnishing grants to 164 Merit Scholars attending M.I.T.; an additional $167,000 was received by M.I.T. as "grants toward educational expense," an increased amount over 1957–58.

An increase of 6 per cent in undergraduate scholarship endowment resulted during the year from gifts and bequests from the following: Class of 1934 for the Karl T. Compton Memorial Scholarship, Otto Lindberg, Paul W. Litchfield '96, Mrs. Langdon Pearse, Frederick J. Shepard '12, and the estates of Jason E. Bailey, James R. Glazebrook '28, Albert F. Sulzer, and Archer E. Wheeler.

During the past six years the scholarship endowment funds have increased 42 per cent, from $4,006,972 in 1953 to $5,682,742 in 1959; this increase has come from such gifts and bequests as those recorded above. By next year the tuition fee will have increased 62.5 per cent; this emphasizes the fact that our scholarship funds are failing to keep step with the successive tuition increases.

In terms of capital endowment, the total undergraduate scholarship grants for the year represent an investment of $19,000,000, with a 5 per cent yield. Less than one-third of this capital amount is held by M.I.T. Any future curtailment in our "outside sources" for scholarship aid will impose genuine handicaps on the Institute's capacity to assist future deserving candidates.

Mention was made in last year's report that gifts in support of undergraduate scholarships will be reduced in the next few years, inasmuch as some companies and foundations are bringing their scholarship plans to a close. Furthermore, some organizations are considering limiting their awards to obtain "more mileage for their money." For instance, beginning with the fall of 1959 all new National Merit Scholars entering M.I.T. have been placed under a maximum grant of $1,500, even though in many cases their need far exceeds this amount. The future projection of "outside sources" of scholarship help indicates that the demand from Institute funds for supplemental support will be sharply increased. Consequently it is urgently recommended that additional scholarship capital be vigorously sought.

Faculty Children Scholarship Program

In February, 1959, the Executive Committee of the Corporation voted favorably on the recommendation of the Staff-Administration Committee to withdraw from the Tuition Exchange Plan and to provide a scholarship grant equivalent to one-half of the Institute's tuition fee to children of faculty and certain administrative officers. There has been unanimous faculty approval of this new benefit. This fall over seventy faculty children attending colleges and universities other than M.I.T. will each receive a $650 grant toward tuition. For faculty children attending M.I.T. as undergraduates, full tuition grants will be continued.

It would be superfluous to add further comments on the inadequacies and inequalities of the Tuition Exchange Plan, which have been discussed in previous reports. Nevertheless, as a matter of record it should be noted that the Institute will honor commitments already made to "import" students currently in attendance. It is expected that our "import and export credits" will be in balance this year, and the following summary of our experience with the Tuition Exchange Plan will officially close the record.

	Certified	*Accepted in the Plan*	*Rejected in the Plan*
Export, 1953–59	104	36	68
	Certified and admitted	*Admitted and registered*	*Rejected by M.I.T. for the Plan*
Import, 1953–59	38	30	0

Student Employment

Opportunity for campus jobs has been provided on a voluntary basis as part of the Institute's Student Aid Program. For the year, the Manager of Student Personnel reports 1,328 students, mostly undergraduates, were employed in various divisions on the Institute campus and earned $610,000. The average earning is greater than $450 per student, not an insignificant amount in a nine-month college year. A full report on student employment is given elsewhere.

Other Benefits

The following summary shows that 5 per cent of our student population received direct benefits from the Veterans Administration under Public Law 550. Many of these students also received supplementary assistance from the Institute.

	Year	*Number receiving benefits*	*Per cent of total registration*
First term	1958–59	315	5.0%
Second term	1958–59	287	4.9%
Summer term	1959	82	5.1%

It is a pleasure to record that James H. Eacker '55 joined the staff as Assistant to the Director in September, 1958.

THOMAS P. PITRÉ

Treasurer

THE MAIN TRENDS AND DEVELOPMENTS in Institute financial affairs for the fiscal year 1958–59 are summarized in the following exhibit.

	1958–59	*1957–58*	*Change*
Academic operations	$23,125,000	$20,905,000	+$2,220,000
Division of Sponsored Research	59,627,000	54,344,000	+ 5,283,000
Total funds	99,142,000	91,773,000	+ 7,369,000
Plant assets	44,179,000	43,251,000	+ 928,000
Gifts and grants	10,006,000	7,732,000	+ 2,274,000
Investments — market value	155,777,000	132,150,000	+23,627,000
Investments — book value	97,865,000	89,267,000	+ 8,598,000

Operations

The operations of the Institute in 1958–59 and in 1957–58 are set out in the following exhibit.

	1958–59	*1957–58*
Revenues and funds		
Tuition and other income	$7,667,000	$6,485,000
Investment income	1,722,000	1,913,000
Gifts and other receipts	5,344,000	4,481,000
Contract allowances for indirect expenses	6,543,000	6,211,000
Auxiliary activities	1,849,000	1,815,000
Total	**$23,125,000**	**$20,905,000**
Expenses		
Academic	9,816,000	8,718,000
General and administration	7,895,000	7,149,000
Plant operations	3,537,000	3,210,000
Auxiliary activities	1,877,000	1,828,000
Total	**$23,125,000**	**$20,905,000**

The greater part of the increase in academic expenses represented salary and wage adjustments made during the year. Tuition income was higher with the $1,300 tuition in effect. The marked increase in gifts and other receipts included the use of the Faculty Salary Adjustment Fund to meet changes in salaries and wages initiated in part in previous years. Since a special distribution of investment income was made in 1957–58 in anticipation of other sources of income being available in the future, investment income used for expenses decreased moderately in 1958–59. Contract allowances for indirect expenses on sponsored research increased slightly in comparison with the change in general and administration expenses and plant expenses.

Gifts

The gifts for 1958–59 are compared to 1957–58 in this table.

	1958–59	*1957–58*
Gifts for endowment	$947,000	$1,138,000
Gifts for buildings	56,000	195,000
Gifts for current use — invested	4,318,000	1,987,000
Industrial Liaison support	1,185,000	1,188,000
Other funds for current use	3,500,000	3,224,000
Total gifts	**$10,006,000**	**$7,732,000**

The first receipt of the gift of Dr. and Mrs. Cecil H. Green for the earth sciences program, gifts for faculty salaries, and contributions for the academic departments resulted in a substantial increase in gifts for the year under review. Total contributions for the Faculty Salary Adjustment Fund for 1958–59 were $1,991,000 compared with $1,256,000 in 1957–58. Gifts directly to the Alumni Fund of $569,000 are included in gifts for current use — invested, and made up a part of the total credited by the Alumni Office. With the exception of 1955–56, total gifts received in 1958–59 were higher than in any previous year. The list of gifts, grants, and bequests to the Institute for the year 1958–59 is in Section II of this report.

Funds

Endowment and other funds increased $7,369,000 during 1958–59.

	1958–59	*1957–58*
Endowment for general purposes	$36,830,000	$36,162,000
Endowment for designated purposes	22,005,000	20,768,000
Total endowment funds	**$58,835,000**	**$56,930,000**
Other funds	40,307,000	34,843,000
Total funds	**$99,142,000**	**$91,773,000**

Increases in endowment for designated purposes included new resources for the academic departments, for professorships, for graduate fellowships, for undergraduate scholarships, and for plant operations. The larger increase in other funds as compared to endowment funds indicates the expendable nature of most of the increment to the funds during the year. In other funds, additions were substantial to the Faculty Salary Adjustment Fund, the fund for financing faculty tenure salaries and related expenses now met with other sources of income, and the funds for academic departmental activities. The reserve for the transfer of investment real estate to academic plant was again supplemented by drawing on unrestricted funds. A total of $4,440,000 of investment income on hand on June 30, 1959, was set aside for 1959–60 operations. Unallocated investment income increased from $485,000 to $530,000. With retirement funds included, the total book value of the funds on June 30, 1959, was $113,084,000.

Plant Facilities

The David Flett du Pont Athletic Center was nearly completed during the year, bringing the total book value of the educational plant of the Institute on June 30, 1959, to $44,179,000 as compared with $43,251,000 on June 30, 1958.

Investments

The investment position of the Institute on June 30, 1959, and June 30, 1958, is presented in the following table, which is exclusive of the investments of the M.I.T. Pension Association, the Supplementary Retirement Plan, and the Retirement Plan for Employees.

	June 30, 1959		*June 30, 1958*	
	Book value	*Market value*	*Book value*	*Market value*
General investments:				
Bonds	$49,389,000	$46,499,000	$43,759,000	$43,869,000
Stocks	25,093,000	81,833,000	24,054,000	63,754,000
Real estate	11,984,000	11,984,000	12,087,000	12,087,000
Commercial paper	2,463,000	2,463,000	2,471,000	2,471,000
Total	**$88,929,000**	**$142,779,000**	**$82,371,000**	**$122,181,000**
Special investments	6,287,000	10,349,000	4,766,000	7,839,000
Student notes receivable	2,649,000	2,649,000	2,130,000	2,130,000
Total	**$97,865,000**	**$155,777,000**	**$89,267,000**	**$132,150,000**

Funds sharing in the income from the general investments earned 6.22 per cent on the average book value compared to 6.20 per cent last year. This year, 5 per cent was allocated to the funds in comparison to 5.5 per cent last year, when a special distribution of one-half of 1 per cent was added. The total income on the general and special investments in 1958–59 was $4,767,000, compared to $4,548,000 in 1957–58. Of the total investment income of the year, $1,722,000 was used directly for current expenses; $768,000 was added to balances of expendable funds which in turn were used for current operating expenses to the extent of $1,360,000; and $524,000 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 35.9 per cent on June 30, 1958, and 32.5 per cent on June 30, 1959. The proportion of investment income from bonds increased from 33.9 per cent to 35.8 per cent. At market values, the proportion of the general investments in common stocks increased from 51.3 per cent on June 30, 1958, to 57.0 per cent on June 30,

1959. Investment income represented by common stock dividends declined from 54.2 per cent in 1957–58 to 52.3 per cent in 1958–59.

The investments of the M.I.T. Pension Association, the Supplementary Retirement Fund, and the Retirement Plan for Employees on June 30, 1959, and June 30, 1958, are presented in the following exhibit.

	June 30, 1959		*June 30, 1958*	
	Book value	*Market value*	*Book value*	*Market value*
Pension Association	$9,597,000	$13,678,000	$8,390,000	$11,250,000
Supplementary Retirement Fund	3,848,000	4,137,000	2,667,000	2,827,000
Retirement Plan for Employees	400,000	396,000	—	—
Total	**$13,845,000**	**$18,211,000**	**$11,057,000**	**$14,077,000**

General

The trends in the financial affairs of the Institute continued in 1958–59 the underlying patterns of the past ten years. Although the volume of operations was moderated by the transfer to other organizations of two projects, the activities for which the Institute is directly responsible moved on to a higher level of operations. The book value of the educational plant again increased so that the value of the Institute's plant doubled between 1949 and 1959. The book value of the endowment funds increased from $35,093,000 to $58,835,000 during the ten years ended June 30, 1959, while total funds advanced from $48,134,000 to $99,142,000 in the same period, reflecting primarily the greater importance of restricted expendable resources for designated purposes in the finances of the Institute.

JOSEPH J. SNYDER

BALANCE SHEET June 30, 1959

Schedule A

INVESTMENTS			
General investments:			
U. S. Government bonds		$17,668,127	
Other bonds		31,720,699	
Preferred stocks		507,738	
Common stocks		24,585,220	
Real estate (including $5,258,712 devoted to Institute use) and mortgages		11,984,078	
Commercial paper		2,463,025	
		(A-1)	$ 88,928,887
Investments of funds separately invested	(A-2)		6,287,462
Students' notes receivable	(A-13)		2,648,771
Total investments			97,865,120
Less temporary investment of general-purpose cash			2,196,284
			$ 95,668,836
CURRENT AND DEFERRED ASSETS			
Cash:			
General purposes		$ 4,123,885	
Restricted to certain research contracts		902,147	
Students' safe-keeping deposits		79,575	$ 5,105,607
Temporary investment of general-purpose cash			2,196,284
Accounts receivable:			
U. S. Government	(A-14)	$ 3,231,286	
Other	(A-14)	468,842	3,700,128
Contracts in progress, principally U. S. Government	(A-15)		8,485,545
Advances to subcontractors			700,000
Inventories, deferred charges, and other assets	(A-16)		2,145,195
			$ 22,332,759
EDUCATIONAL PLANT			
Land, buildings, and equipment	(A-20)		$ 44,178,921
			$162,180,516

BALANCE SHEET June 30, 1959

Schedule A

INVESTED FUNDS

Endowment funds:			
Income for general purposes	(A-3)	$36,830,468	
Income for designated purposes	(A-4)	22,005,276	$ 58,835,744
Student loan funds	(A-5)		3,816,301
Building funds	(A-6)		407,973
Other expendable funds:			
General purposes	(A-7)	$ 142,295	
Designated purposes	(A-8)	17,408,298	17,550,593
Unexpended endowment income for designated purposes	(A-4)		1,424,768
Agency and annuity funds	(A-9 and A-10)		2,000,274
General investments — gain and loss account	(A-11)		6,663,226
Investment income authorized for distribution to funds in 1959-60	(A-12)		4,440,000
Unallocated investment income	(A-12)		529,957
			$ 95,668,836

CURRENT LIABILITIES AND FUNDS

Accounts payable and accrued wages		$ 3,748,704	
Students' advance fees and deposits	(A-17)	448,187	
Students' safe-keeping deposits		79,575	
Withholdings, deposits, and other credits	(A-18)	906,390	
Advances by the U. S. Government for certain research contracts		11,488,464	
Total current liabilities			$ 16,671,320
Grants for sponsored research			2,187,827
Gifts and other receipts for current expenses	(A-19)		3,473,612
			$ 22,332,759

EDUCATIONAL PLANT CAPITAL

Endowment for educational plant	(A-21)	$ 44,178,921
		$162,180,516

SOURCES OF REVENUES AND FUNDS USED TO MEET EXPENSES OF CURRENT OPERATION
for the year ended June 30, 1959

Schedule B

EDUCATIONAL AND GENERAL

Sources of revenues and funds used

Tuition and other income	(B-1)	$ 7,667,046
Investment income	(B-2)	1,722,317
Gifts and other receipts	(B-2)	5,343,942
Contract allowances for general and administration, and plant operation expenses (see below)	(B-3)	6,542,382
Dining and student housing	(B-7)	1,849,272
		$23,124,959

Expenses of current operation

Academic departments	(B-4)	$ 9,816,095
General and administration	(B-5)	7,894,794
Plant operation	(B-6)	3,537,222
Dining and student housing	(B-7)	1,876,848
		$23,124,959

RESEARCH CONTRACTS*

Revenues

U.S. Government (except Lincoln Laboratory)		$28,444,832
Lincoln Laboratory		35,687,580
Industrial and other sponsors		3,144,408
	(B-3)	**$67,276,820**

Expenses

Direct costs and expenses	(B-3)	59,627,267
Allowance for use of facilities and other reserves	(B-3)	1,107,171
Allowances for general and administration, and plant operation expenses	(B-3)	6,542,382
		$67,276,820

* In addition to the revenues and expenses above, approximately $6,000,000 was received by the Institute and paid to newly formed independent corporations under temporary subcontract arrangements.

STATEMENT OF FUNDS for the year ended June 30, 1959

Schedule C

		Balance June 30, 1958	*Gifts and Other Receipts*	*Investment Income*	*Transfers In — (Out)*	*Expenses*	*Other Charges*	*Balance June 30, 1959*
Endowment funds:								
Income for general purposes	(A-3)	$36,161,692	$ 297,151	$1,817,738	$ (197,339)	$1,248,774	....	$36,830,468
Income for designated purposes	(A-4)	20,768,026	783,801	*	453,449	....	....	22,005,276
Student loan funds	(A-5)	3,459,146	256,474	83,901	19,030	....	$ 2,250	3,816,301
Building funds	(A-6)	608,200	173,055	27,205	(174,067)	....	226,420	407,973
Other expendable funds:								
General purposes	(A-7)	172,923	164,617	12,290	(200,035)	7,500	....	142,295
Designated purposes	(A-8)	14,332,336	5,249,819	755,365	436,122	1,352,146	2,013,198	17,408,298
Unexpended endowment income for designated purposes	(A-4)	1,261,531	2,631	1,125,993	(180,922)	473,543	310,922	1,424,768
Agency and annuity funds	(A-9, A-10)	1,226,858	786,682	70,137	(12,478)	6,750	64,175	2,000,274
General investments — gain and loss account	(A-11)	6,288,876	374,350	....	....	....	....	6,663,226
Investment income authorized for distribution to funds	(A-12)	3,610,000	....	(3,589,605)	4,419,605	....	....	4,440,000
Unallocated investment income	(A-12)	485,106	....	4,464,456	(4,419,605)	....	....	529,957
Total invested funds		**$88,374,694**	**$ 8,088,580**	**$4,767,480**	**$ 143,760**	**$3,088,713**	**$2,616,965**	**$95,668,836**
Gifts and other receipts for current expenses	(A-19)	3,398,398	5,288,611	....	(143,760)	3,977,546	1,092,091	3,473,612
		$91,773,092	**$13,377,191**	**$4,767,480**	**$ ....**	**$7,066,259**	**$3,709,056**	**$99,142,448**

Gifts received during the year	$10,005,841
Appropriations from research contract allowances	1,117,963
Net realized gain on investments	920,575
Other	1,332,812
	$13,377,191

Investment income used to meet expenses of current operation	$1,722,317
Gifts and other receipts used to meet expenses of current operation	5,343,942
	$7,066,259

Scholarship and fellowship awards	$1,206,312
Expenditures for buildings added to educational plant	927,948
Direct research costs charged to gifts designated therefor	468,637
Investment in veterans' housing charged to reserves	459,493
Other charges to funds not representing operating expenses	646,666
	$3,709,056

* Investment income on endowment funds for designated purposes is included under "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 at June 30, 1959.

Schedule B — Sources of Revenues and Funds Used to Meet Expenses of Current Operation for the Year Ended June 30, 1959.

Schedule C — Statement of Funds for the Year Ended June 30, 1959.

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, 1959, 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 14, 1959

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, 1959, and their certificate is submitted herewith.

Respectfully,

RALPH LOWELL
GILBERT M. RODDY
HAROLD B. RICHMOND, *Chairman*

GIFTS, GRANTS, AND BEQUESTS

Received during the year ended June 30, 1959

The following list shows gifts, grants, and bequests received by the Institute during the twelve-month period ending June 30, 1959. Donors are listed alphabetically except in the cases of those who gave to such group efforts as the Alumni Fund, Class Funds, parents' gifts, etc. Total gifts through 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.

IRVING ABRAMS '22	
M.I.T. Boston Stein Club — New England Scholarship Fund	$ 50.00
FRANK W. AND CARL S. ADAMS TRUST	
Frank W. and Carl S. Adams Memorial Fund	20,500.00
ROGER ADAMS	
Vannevar Bush Room	300.00
A.D.L. FOUNDATION	
Affiliates of the School of Industrial Management	1,500.00
Industrial Liaison Program	20,000.00
AIR FORCE AID SOCIETY	
Undergraduate scholarship	1,500.00
THE ALCOA FOUNDATION	
General purposes	125.00
PHILIP M. ALDEN '22	
Faculty Salary Adjustment Fund	100.00
BISSELL ALDERMAN '35	
Faculty Salary Adjustment Fund	500.00
ALDON PRODUCTS COMPANY	
Technology Loan Fund	100.00
HARL P. ALDRICH '47	
Charles B. Breed ('97) Fund	100.00
ALLEGHENY LUDLUM STEEL CORPORATION	
Research in metallurgy	8,000.00
VICTOR B. ALLEN '25	
Technology Loan Fund	100.00
ALLIED CHEMICAL MANUFACTURERS' CORPORATION	
Plastic Materials Manufacturing Association	3,500.00
Fellowship in chemistry	3,500.00
ALLIS-CHALMERS FOUNDATION, INC.	
Grant to supplement tuition	500.00

MYER L. ALPERT '22	
M.I.T. Boston Stein Club — New England Scholarship Fund	$ 200.00
ALFRED S. ALSCHULER, JR. '35	
M.I.T. Club of Chicago Scholarship Fund	25.00
Faculty Salary Adjustment Fund	167.00
ALUMINIUM LABORATORIES, LTD.	
Industrial Liaison Program	20,000.00
AMBASSADE DE FRANCE	
French Government Fund	250.00
AMERICAN BRAKE SHOE COMPANY	
Professorship in metallurgy	25,000.00
Operating fund	3,500.00
Undergraduate scholarship	1,300.00
AMERICAN BUREAU OF SHIPPING	
Ship Model Towing Tank carriage	1,000.00
AMERICAN CAN COMPANY	
General purposes	500.00
Industrial Liaison Program	15,000.00
Faculty Salary Adjustment Fund	1,200.00
AMERICAN CANCER SOCIETY, INC.	
Research in biology	500.00
AMERICAN CHEMICAL SOCIETY	
Petroleum research in chemistry	9,000.00
AMERICAN CHICLE COMPANY	
Research in chemistry	8,000.00
Fellowship in food technology	2,800.00
Undergraduate scholarship	1,800.00
AMERICAN CYANAMID COMPANY	
Fellowship in chemical engineering	20,000.00
Fellowship in chemistry	7,400.00
Soil Stabilization Laboratory	5,000.00
AMERICAN HEART ASSOCIATION, INC.	
Research in biology	500.00
AMERICAN IRON AND STEEL INSTITUTE	
Corrosion research in civil engineering	5,000.00
Comminution research in metallurgy	10,000.00
AMERICAN PETROLEUM INSTITUTE	
Research in chemical engineering	5,000.00
High voltage research in electrical engineering	27,500.00
AMERICAN RADIATOR STANDARD SANITARY CORPORATION	
General purposes	2,000.00
AMERICAN SOCIETY OF CIVIL ENGINEERS	
Fellowship in civil engineering	1,500.00
AMERICAN SOCIETY OF MECHANICAL ENGINEERS	
Steam research secretary	2,500.00
AMERICAN SOCIETY FOR METALS	
Undergraduate scholarship	300.00
AMERICAN SOCIETY FOR METALS FUND FOR EDUCATION RESEARCH	
Fellowship in metallurgy	4,200.00
Undergraduate scholarship	500.00

AMERICAN VISCOSE CORPORATION	
Fellowship in the School of Chemical Engineering Practice	$ 2,700.00
Research in food technology	5,000.00
AMHERST COLLEGE	
Falk Foundation grant	500.00
AMOCO FOUNDATION	
Fellowship in the School of Chemical Engineering Practice	200.00
AMP, INCORPORATED	
Industrial Liaison Program	20,000.00
AMPERITE COMPANY, INC.	
Faculty Salary Adjustment Fund	500.00
ANACONDA WIRE AND CABLE COMPANY	
Research in mechanical engineering	8,725.00
AXEL H. ANDERSON	
Dean's Chapel Fund	720.00
HERBERT W. ANDERSON '15	
Faculty Salary Adjustment Fund	333.33
ROBERT A. AQUADRO '47	
Faculty Salary Adjustment Fund	333.33
BENNETT ARCHAMBAULT '32	
M.I.T. Club of Chicago Scholarship Fund	25.00
ARNOLD A. ARCHIBALD '28	
Faculty Salary Adjustment Fund	300.00
ARMCO FOUNDATION	
Fellowship in metallurgy	1,267.83
Undergraduate scholarships	2,600.00
General purposes	2,000.00
ARMCO STEEL CORPORATION	
Industrial Liaison Program	10,000.00
GEORGE E. ARMINGTON '26	
Faculty Salary Adjustment Fund	5,600.25
ARMOUR AND COMPANY	
Soil Stabilization Laboratory	5,000.00
Research in food technology	2,500.00
RICHARD M. ARMSTRONG COMPANY	
Technology Loan Fund	3,000.00
ANTHONY B. ARNOLD '07	
Henry Dyer Arnold Fund	17,106.25
ASARCO FOUNDATION	
Equipment for metallurgy	500.00
Undergraduate scholarship	500.00
THE ASIA FOUNDATION	
Asia Fund (Center for International Studies)	500.00
ASSOCIATED FACTORY MUTUAL FIRE INSURANCE COMPANIES	
Industrial Liaison Program	10,000.00
ATLANTIC REFINING COMPANY	
Faculty Salary Adjustment Fund	2,000.00
AVCO MANUFACTURING COMPANY	
Geology Thesis Fund	25.00
RESEARCH AND ADVANCED DEVELOPMENT DIVISION	
Industrial Liaison Program	12,500.00

B-I-F INDUSTRIES, INC.	
Technology Loan Fund	$ 250.00
THE BABCOCK AND WILCOX COMPANY	
Faculty Salary Adjustment Fund	3,050.00
BADGER MANUFACTURING COMPANY	
Technology Loan Fund	500.00
BRUCE R. BAGLEY '35	
Faculty Salary Adjustment Fund	333.00
W. HAROLD BAGLEY, JR. '35	
Faculty Salary Adjustment Fund	250.00
ESTATE OF JASON S. BAILEY	
Endowment for scholarships	5,220.28
RICHARD O. BAILEY '15	
Anonymous D Fund	125.00
DOUGLAS B. BAKER '15	
Anonymous D Fund	150.00
THE BANK OF NEW YORK	
Matching gift	15.00
BARDES FUND	
Faculty Salary Adjustment Fund	2,000.00
JAMES M. BARKER '07	
M.I.T. Club of Chicago Scholarship Fund	25.00
WARREN N. BARR, JR. '49	
M.I.T. Club of Chicago Scholarship Fund	25.00
JOHN W. BARRIGER, III '21	
Faculty Salary Adjustment Fund	250.00
MR. ('29) AND MRS. W. L. BARROW	
Vannevar Bush Room	100.00
DAVID A. BARTLETT '39	
Faculty Salary Adjustment Fund	500.00
BATH IRON WORKS CORPORATION	
Undergraduate scholarship	1,500.00
Ship Model Towing Tank carriage	1,000.00
C. A. BATSON COMPANY	
Technology Loan Fund	250.00
BAUSCH AND LOMB OPTICAL COMPANY	
Spectroscopy research	8,000.00
WALTER J. BEADLE '17	
For general purposes	850.00
BECHTEL CORPORATION	
Undergraduate scholarship	1,500.00
LEO M. BECKWITH '35	
Louis I. Beckwith Memorial in the M.I.T. Boston Stein Club — New England Scholarship Fund	100.00
BELL AIRCRAFT CORPORATION	
Industrial Liaison Program	10,000.00
THE BELL FOUNDATION, INCORPORATED	
Undergraduate scholarships	3,350.00
Miscellaneous gifts	1,500.00
J. F. BELL	
Vannevar Bush Room	5,000.00

BELL TELEPHONE LABORATORIES, INC.	
Fellowship in electrical engineering	$ 8,000.00
Industrial Liaison Program	30,000.00
ALAN C. BEMIS '30	
Faculty Salary Adjustment Fund	1,069.00
BENDIX AVIATION CORPORATION	
Fellowship in electrical engineering	4,500.00
Undergraduate scholarship	1,100.00
RALPH D. BENNETT	
Vannevar Bush Room	100.00
WILLIAM PERRY BENTLEY '04	
Faculty Salary Adjustment Fund	500.00
BERKE MOORE COMPANY, INC.	
Technology Loan Fund	200.00
SAMUEL BERKE '15	
Language Laboratory equipment	5,000.00
Industrial Management Association of M.I.T. Award	2,500.00
Anonymous D Fund	250.00
Affiliates of School of Industrial Management	5,000.00
STEVEN R. BERKE '16	
Faculty Salary Adjustment Fund	1,000.00
GEORGE A. BERNAT '28	
Faculty Salary Adjustment Fund	500.00
GEORGE A. ('28) AND RUTH BERNAT	
M.I.T. Boston Stein Club — New England Scholarship Fund	750.00
BETHLEHEM STEEL COMPANY, INC.	
General purposes	28,000.00
ERIC A. BIANCHI '29	
Faculty Salary Adjustment Fund	100.00
GORDON Y. BILLARD '24	
Gordon Y. Billard Fund	970.08
BIRD AND SONS	
Matching gifts	60.00
RAYMOND H. BLANCHARD '17	
Faculty Salary Adjustment Fund	125.00
ROBERT WOODS BLISS	
Vannevar Bush Room	1,000.00
BLONDER-TONGUE FOUNDATION	
Award in electrical engineering	500.00
BOEING AIRPLANE COMPANY	
Wind Tunnel research	10,000.00
Fellowship in aeronautical engineering	2,700.00
Industrial Liaison Program	10,000.00
HORATIO L. BOND '23	
Faculty Salary Adjustment Fund	100.00
RALPH D. BOOTH '20	
Faculty Salary Adjustment Fund	1,000.00
BOSTON INSULATED WIRE AND CABLE COMPANY	
Faculty Salary Adjustment Fund	400.00

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
EDWARD L. BOWLES '22	
Vannevar Bush Room	100.00
MARION W. BOYER '25	
Faculty Salary Adjustment Fund	650.00
THE BOYS' CLUB OF NEW YORK, INC.	
Undergraduate scholarship	1,200.00
LINDSAY BRADFORD	
Vannevar Bush Room	25.00
R. TULLY BRADFORD '45	
Faculty Salary Adjustment Fund	25.00
MAURICE F. BRANDT	
Anonymous D Fund	250.00
HARRY BRAUDE '13	
M.I.T. Boston Stein Club — New England Scholarship Fund	1,000.00
DAVID F. BREMNER, JR. '29	
Faculty Salary Adjustment Fund	300.00
BRISTOL LABORATORIES, INC.	
Research in chemistry	8,000.00
BRITISH TABULATING MACHINE COMPANY	
Fellowship in electrical engineering	700.00
EVERETT C. BROWN '23	
Faculty Salary Adjustment Fund	10.00
GORDON S. BROWN '31	
For electrical engineering	250.00
PHILIP S. BROWN '20	
Faculty Salary Adjustment Fund	100.00
S. L. BROWN SCHOLARSHIP TRUST	
Undergraduate scholarship	375.00
BROWN AND SHARPE FOUNDATION	
Industrial Relations Section	250.00
BRUNIE FOUNDATION	
Vannevar Bush Room	200.00
BUCK PRINTING COMPANY	
General purposes	100.00
THE BUDD COMPANY	
General purposes	1,800.00
HAROLD BUGBEE '20	
Faculty Salary Adjustment Fund	200.00
BULLARD COMPANY CHARITY FOUNDATION, INC.	
General purposes of electrical engineering	575.00
General purposes of mechanical engineering	575.00
DENNISON K. BULLENS '09	
D. K. Bullens Scholarship and Loan Fund	5,000.00
BULOVA WATCH COMPANY FOUNDATION, INC.	
General purposes	500.00

HARVEY H. BUNDY	
Vannevar Bush Room	$ 100.00
THE BUNKER FOUNDATION, INC.	
Faculty Salary Adjustment Fund	500.00
CHARLES T. BURKE '23	
Vannevar Bush Room	100.00
HOMER A. BURNELL '28	
M.I.T. Club of Chicago Scholarship Fund	50 00
GEORGE H. BURT '20	
M.I.T. Club of Chicago Scholarship Fund	25.00
HELEN L. BURTON	
Class of 1909 Memorial Fund	100.00
CALIFORNIA RESEARCH CORPORATION	
Research in chemical engineering	10,000.00
CALVIN A. CAMPBELL '25	
Faculty Salary Adjustment Fund	300.00
JOHN M. CAMPBELL '25	
Faculty Salary Adjustment Fund	1,000.00
CAMPBELL SOUP COMPANY	
Flavor research in food technology	5,000.00
Graduate fellowship in food technology	300.00
Faculty Salary Adjustment Fund	10,000.00
CARBORUNDUM COMPANY	
Comminution research in metallurgy	2,500.00
FRANK M. CARHART '05	
Faculty Salary Adjustment Fund	1,000.00
CARNATION COMPANY	
Research in food technology	5,000.00
CARNEGIE CORPORATION OF NEW YORK	
Engineering science curriculum	100,000.00
Humanities and social science	100,000.00
Center of International Studies	73,166.66
WILLIAM K. CARPENTER	
R. R. M. Carpenter ('01) Fellowship in chemical engineering	2,500.00
CENTRAL CONSTRUCTION COMPANY	
Faculty Salary Adjustment Fund	333.32
NORMAN B. CHAMP, JR. '50	
Faculty Salary Adjustment Fund	50.00
CHAMPION PAPER FOUNDATION	
Undergraduate scholarship	1,100.00
CHANCE VOUGHT AIRCRAFT, INC.	
Industrial Liaison Program	10,000.00
ALFRED P. CHANDLER, JR.	
Business organization research	300.00
CHARLES A. CHAYNE '19	
Faculty Salary Adjustment Fund	1,000.00
CHEMICAL CLUB OF NEW ENGLAND, INC.	
Undergraduate scholarship	300.00
THE CHEMSTRAND CORPORATION	
General purposes	500.00

FRANCIS J. CHESTERMAN '05	
Faculty Salary Adjustment Fund	$ 500.00
CHICAGO COMMUNITY TRUST	
Undergraduate scholarship	250.00
CINCINNATI MILLING MACHINE COMPANY	
Cincinnati Milling Machine Scholarship	800.00
Technology Press	1,500.00
CITIES SERVICE RESEARCH AND DEVELOPMENT COMPANY	
Industrial Liaison Program	25,000.00
CIVIL AIR PATROL, INC.	
Undergraduate scholarship	2,000.00
CLARK FOUNDATION, INC.	
Undergraduate scholarships	6,500.00
COATS AND CLARK, INC.	
Fellowship in mechanical engineering	2,000.00
THE COFFEE BREWING INSTITUTE, INC.	
Research in food technology	2,500.00
JOHN R. COFFIN '17	
Faculty Salary Adjustment Fund	972.63
EVERETT S. COLDWELL '15	
Anonymous D Fund	1,200.94
PHILIP L. COLEMAN '23	
M.I.T. Club of Chicago Scholarship Fund	100.00
Faculty Salary Adjustment Fund	500.00
Philip L. Coleman Fund	10,000.00
EMILIO G. COLLADO '31	
Faculty Salary Adjustment Fund	172.88
THE COMMONWEALTH FUND	
General purposes	1,000.00
RANDOLPH P. COMPTON	
W. Danforth Compton ('47) Memorial Fund	10,276.45
COMPTON TRUST	
Research in humanities	3,000.00
COMSTOCK AND WESCOTT, INC.	
Faculty Salary Adjustment Fund	300.00
ESTATE OF ARTHUR J. CONNER '88	
General purposes	6,856.33
CONSOLIDATED ELECTRODYNAMICS CORPORATION	
Industrial Liaison Program	10,000.00
CONTINENTAL CAN COMPANY, INC.	
Industrial Liaison Program	10,000.00
CONTINENTAL OIL COMPANY	
Industrial Liaison Program	10,000.00
CARLE C. CONWAY SCHOLARSHIP FOUNDATION	
Undergraduate scholarship	1,300.00
WILLIAM J. COOK FUND	
Undergraduate scholarships	3,275.00
ESTATE OF GEORGE R. COOKE '08	
George R. Cooke Fund	2,500.00
CORN PRODUCTS COMPANY	
General purposes	160.00

CORNING GLASS WORKS	
Matching gift	$ 66.00
WILLIAM H. CORREALE '24	
Faculty Salary Adjustment Fund	100.00
GEORGE T. COTTLE '98	
Faculty Salary Adjustment Fund	5,000.00
COYNE ENGINEERING AND EQUIPMENT COMPANY	
Technology Loan Fund	50.00
RUTH W. CRITCHETT	
Class of 1909 Memorial Scholarship Fund	100.00
WILLIAM D. CROWELL '02	
Faculty Salary Adjustment Fund	100.00
HENRY F. DALEY, SR. '15	
Anonymous D Fund	250.00
MARSHALL B. DALTON '15	
Anonymous D Fund	200.00
C. GEORGE DANDROW '22	
Faculty Salary Adjustment Fund	333.33
JOHN L. DANFORTH '40	
Faculty Salary Adjustment Fund	100.00
RALPH V. DAVIES '16	
Faculty Salary Adjustment Fund	200.00
CHESTER P. DAVIS '14	
Faculty Salary Adjustment Fund	100.00
MRS. JOHN F. DAVIS	
Class of 1909 Memorial Scholarship Fund	235.00
RALPH H. DAVIS '31	
Faculty Salary Adjustment Fund	100.00
ROBERT T. DAWES '26	
Faculty Salary Adjustment Fund	500.00
ADMIRAL LUIS DE FLOREZ '11	
Admiral Luis de Florez Awards	2,252.50
MARY W. DELAFIELD	
Benjamin T. Delafield Memorial Fund	5,000.00
OSCAR A. DE LIMA '19	
Faculty Salary Adjustment Fund	333.50
DELTA RADIO COMPANY	
Faculty Salary Adjustment Fund	75.00
DENNISON FOUNDATION, INC.	
Industrial Relations Section	250.00
JOSEPH DESLOGE '12	
Faculty Salary Adjustment Fund	200.00
THOMAS C. DESMOND '09	
Geology Faculty Fund	1,000.00
Thomas C. Desmond Scholarship	1,200.00
Faculty Salary Adjustment Fund	5,000.00
DIAMOND ALKALI COMPANY	
Soil Stabilization Laboratory	7,560.00
DIAMOND GARDNER CORPORATION — GARDNER DIVISION	
Undergraduate scholarship	500.00

CHARLES R. DIEBOLD	
Faculty Salary Adjustment Fund	$ 1,080.00
JOSEPH E. DIETZGEN '41	
M.I.T. Club of Chicago Scholarship Fund	25.00
Faculty Salary Adjustment Fund	25.00
PHILIP M. DINKINS '18	
Faculty Salary Adjustment Fund	100.00
F. W. DODGE CORPORATION	
Faculty Salary Adjustment Fund	350.00
HENRY L. DOHERTY EDUCATIONAL FOUNDATION	
Undergraduate scholarship	400.00
DONNER FOUNDATION, INC.	
Donner Foundation Professorship	100,000.00
DOUGLAS AIRCRAFT COMPANY, INC.	
Fellowship in aeronautical engineering	2,750.00
Industrial Liaison Program	10,000.00
DOW CHEMICAL COMPANY	
Fellowship in chemical engineering	2,500.00
Matching gift	20.00
MARGARET C. DOW	
Class of 1909 Memorial Scholarship Fund	10.00
PHILIP B. DOWNING TRUST	
Philip B. Downing Scholarship	505.00
CARBON C. DUBBS '35	
Faculty Salary Adjustment Fund	333.33
DONALD L. DUECKER '50	
Technology Loan Fund	24.20
CHARLES O. DUEVEL, JR. '24	
Faculty Salary Adjustment Fund	100.00
JAMES W. DUNHAM '26	
M.I.T. Club of Chicago Scholarship Fund	25.00
CARL T. DUNN '15	
M.I.T. Club of Chicago Scholarship Fund	50.00
E. I. DU PONT DE NEMOURS AND COMPANY, INC.	
Fundamental research in chemical engineering	5,000.00
Fellowship in chemical engineering	4,625.00
Instructorship in chemistry	3,680.00
Fundamental research in chemistry	15,000.00
Fellowship in mechanical engineering	4,000.00
Fundamental research in mechanical engineering	5,000.00
Fellowship in physics	3,680.00
E. I. du Pont de Nemours Teaching Fund	4,000.00
FRANCIS V. DU PONT '17	
Francis V. du Pont Fund	103,402.50
MRS. LAMMOT DU PONT	
David F. du Pont ('56) Athletic Center	27,280.00
REYNOLDS DU PONT '43	
Faculty Salary Adjustment Fund	21,085.31
WILLIS H. DU PONT	
David F. du Pont ('56) Athletic Center	5,010.00
DWIGHT DUPLEX, INC.	
Faculty Salary Adjustment Fund	150.00

ROLAND D. EARLE '28	
Development Fund	$ 100.00
Faculty Salary Adjustment Fund	350.00
EASTERN TOOL AND STAMPING COMPANY	
Undergraduate scholarship	1,000.00
MELVILLE EASTHAM	
Vannevar Bush Room	250.00
EASTMAN KODAK COMPANY	
Fellowship in chemical engineering	2,000.00
Industrial Liaison Program	40,000.00
General purposes	7,500.00
GEORGE O. EATON '15	
Anonymous D Fund	125.00
DANIEL W. EDGERLY '98	
M.I.T. Club of Chicago Scholarship Fund	50.00
EDGERTON, GERMESHAUSEN, AND GRIER, INC.	
Stroboscopy research	2,500.00
Edgerton, Germeshauser, and Grier research	3,203.60
Student aid	1,200.00
GEORGE P. EDMONDS '26	
Faculty Salary Adjustment Fund	1,667.00
EDUCATIONAL FACILITIES LABORATORIES	
Language Laboratory research	16,114.00
EITEL-MCCULLOUGH, INC.	
Undergraduate scholarship	500.00
ELECTRIC REGULATOR CORPORATION	
Endowment for scholarship	1,000.00
ELECTROLUX CORPORATION	
Industrial Liaison Program	10,000.00
ELKS NATIONAL FOUNDATION	
Undergraduate Scholarship	2,000.00
C. ELLIS ELLICOTT, JR. '15	
Faculty Salary Adjustment Fund	100.00
ESTATE OF WILLIAM EMERSON	
Endowment for scholarships	12,144.52
Faculty Salary Adjustment Fund	3,344.38
ESTATE OF MARY C. EMERY	
Fred Parker and Mary C. Emery endowment for general purposes	60,534.21
BRADFORD M. ENDICOTT '49	
General purposes	7,500.00
ENGINEERS CLUB OF DALLAS	
Undergraduate scholarship	250.00
WILLIAM ENGS '27	
Faculty Salary Adjustment Fund	75.00
ERVITE-VICARY FOUNDATION	
Faculty Salary Adjustment Fund	100.00
ESSO EDUCATION FOUNDATION	
Research in chemical engineering	30,000.00
Esso Education Foundation Fund	20,000.00
Industrial Relations Section	1,500.00

ESSO RESEARCH AND ENGINEERING COMPANY	
Enjay Laboratories Research Fund	$ 7,000.00
ESSO STANDARD OIL COMPANY	
Fellowship in the School of Chemical Engineering Practice	29,025.00
ETHICON, INC.	
Research in biology	5,000.00
ETHYL CORPORATION	
Research in mechanical engineering	5,000.00
ESTATE OF ELIZABETH BOWDITCH EUSTIS	
Endowment for general purposes	25,000.00
JAMES M. EWELL '37	
Faculty Salary Adjustment Fund	100.00
MAURICE AND LAURA FALK FOUNDATION	
Research in the social sciences	16,000.00
ROBERT S. FAUROT '44	
M.I.T. Club of Chicago Scholarship Fund	25.00
RICHARD D. FAY '17	
Vannevar Bush Room	200.00
FIRESTONE TIRE AND RUBBER COMPANY	
Undergraduate scholarships	8,115.00
FIRMENICH, INC.	
Research in chemistry	32,000.00
FIRST NATIONAL BANK OF BOSTON	
Industrial Relations Section	1,000.00
FIRST NATIONAL CITY BANK OF NEW YORK	
General purposes	1,260.00
FIRST NATIONAL STORES, INC.	
For food technology	2,000.00
Industrial Relations Section	500.00
HAROLD W. FISHER '27	
Faculty Salary Adjustment Fund	1,142.50
ESTATE OF THOMAS CHATFIELD FISHER '12	
Endowment for general purposes	6,801.00
JOHN F. FITCH	
Dean M. Fuller Memorial	25.00
RALPH A. FLETCHER '16	
Faculty Salary Adjustment Fund	1,091.25
SAXTON W. FLETCHER '18	
Faculty Salary Adjustment Fund	985.94
FLUOR FOUNDATION	
For general purposes	3,000.00
WILLIAM M. FOLBERTH, JR. '41	
Faculty Salary Adjustment Fund	50.00
FOOD MACHINERY AND CHEMICAL CORPORATION	
Soil Stabilization Laboratory	3,000.00
FORD FOUNDATION	
Fellowship in industrial management	9,120.00
Research in industrial management	60,000.00
International economics seminar	17,067.00
Graduate program in economics	50,000.00

Ford Foundation Business Thesis Fellowship	$18,595.00
Special scientific projects	25,000.00
HAROLD E. FORD '29	
M.I.T. Club of Chicago Scholarship Fund	50.00
HORACE S. FORD	
Faculty Salary Adjustment Fund	1,000.00
FORD MOTOR COMPANY	
General purposes	4,500.00
JAY H. FORRESTER '32	
Faculty Salary Adjustment Fund	100.00
FORTE, DUPEE, SAWYER CHARITABLE FOUNDATION, INC.	
Technology Loan Fund	250.00
NEWELL L. FOSTER '15	
Anonymous D Fund	500.00
FOUNDRY EDUCATIONAL FOUNDATION	
Scholarship in metallurgy	4,000.00
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 COMPANY	
Karl T. Compton Laboratories	100.00
FRANKLIN INSTITUTE	
General Undergraduate Scholarship Endowment	135.00
J. EARL FRAZIER '24	
Faculty Salary Adjustment Fund	375.00
ALFRED FRENCH, JR. '26	
Faculty Salary Adjustment Fund	100.00
FRIEDLANDER AND GOLDEN, INC.	
Faculty Salary Adjustment Fund	166.66
ESTATE OF ISRAEL FRIEDLANDER	
The Philip Jacob Friedlander ('48) Fund	1,000.00
DONALD R. FUNK '29	
Faculty Salary Adjustment Fund	333.00
ESTATE OF FARLEY GANNETT '02	
Faculty Salary Adjustment Fund	1,000.00
GARRETT CORPORATION	
Industrial Liaison Program	10,000.00
GENERAL DYNAMICS CORPORATION	
Fellowship in chemical engineering	4,600.00
Fellowship in electrical engineering	4,600.00
Industrial Liaison Program	20,000.00
CONVAIR DIVISION	
Fellowship in aeronautics and astronautics	7,100.00
ELECTRIC BOAT DIVISION	
Research in naval architecture	5,000.00
GENERAL ELECTRIC COMPANY	
Turbo machine research	20,000.00
Affiliates of the School of Industrial Management	1,000.00

GENERAL ELECTRIC EDUCATIONAL AND CHARITABLE FOUNDATION	
Coffin fellowship in chemistry	$ 3,400.00
Fellowship in chemistry	3,050.00
Fellowship in metallurgy	3,800.00
Fellowship in physics	3,800.00
General purposes	15,550.00
Matching gifts	4,196.00
GENERAL FOODS CORPORATION — RESEARCH CENTER	
Food research	1,000.00
GENERAL MOTORS CORPORATION	
Undergraduate scholarship	91,850.00
Industrial Liaison Program	100,000.00
Fellowship in mechanical engineering	3,200.00
ALLISON DIVISION	
Turbo machine research	20,000.00
NEW DEPARTURE DIVISION	
Research in mechanical engineering	5,000.00
GENERAL RADIO COMPANY	
Vannevar Bush Room	1,500.00
Industrial Relations Section	1,050.00
GERBER BABY FOOD FUND	
Fellowship in food technology	2,500.00
IVAN A. GETTING '33	
Vannevar Bush Room	100.00
WILLIAM FRANCIS GIBBS	
Ship Model Towing Tank carriage	500.00
CITIZENS COMMITTEE FOR THE ROSAMOND GIFFORD COMMUNITY SCHOLARSHIP	
Undergraduate scholarship	1,665.00
WALTER S. GIFFORD	
Vannevar Bush Room	250.00
HENRY S. GILBERT '48	
M.I.T. Boston Stein Club — New England Scholarship Fund	10.00
THE GILLETTE COMPANY	
Industrial Liaison Program	20,000.00
EDWIN R. GILLILAND '33	
Faculty Salary Adjustment Fund	500.00
GILMAN FOUNDATION, INC.	
Undergraduate scholarship	2,000.00
WILLIAM C. GILMAN '22	
Faculty Salary Adjustment Fund	965.00
THE GLASTIC CORPORATION	
General purposes	75.00
ESTATE OF JAMES R. GLAZEBROOK '28	
Endowment for scholarships	60,000.00
CHARLES F. GLORE, JR. '43	
M.I.T. Club of Chicago Scholarship Fund	25.00
EDWIN J. GOHR '26	
Faculty Salary Adjustment Fund	623.44

CHARLES GOODMAN '54	
M.I.T. Club of Chicago Scholarship Fund	$ 25.00
B. F. GOODRICH COMPANY	
Research in civil engineering	3,953.64
HERBERT F. GOODWIN '37	
General purposes — School of Industrial Management	300.00
GOODYEAR FOUNDATION, INC.	
Undergraduate scholarship	1,500.00
Industrial Liaison Program	20,000.00
Fellowship in economics	3,250.00
MORRIS J. ('22) AND ANNA GORDON	
M.I.T. Boston Stein Club — New England Scholarship Fund	250.00
RICHARD H. GOULD '42	
M.I.T. Boston Stein Club — New England Scholarship Fund	5.00
MORTON E. GOULDER '42	
Faculty Salary Adjustment Fund	352.50
FELIX AND CECILE GOULED FOUNDATION	
Undergraduate scholarship	1,250.00
W. R. GRACE COMPANY — DEWEY AND ALMY CHEMICAL DIVISION	
General purposes	250.00
Industrial Relations Section	250.00
POLYMER CHEMICALS DIVISION	
Research in chemical engineering	3,200.00
HAROLD GRAHAM '40	
M.I.T. Club of Chicago Scholarship Fund	25.00
FREDERICK B. GRANT '39	
Faculty Salary Adjustment Fund	1,512.50
ELISHA GRAY, II '28	
M.I.T. Club of Chicago Scholarship Fund	50.00
GREAT ATLANTIC AND PACIFIC TEA COMPANY	
Industrial Relations Section	500.00
CECIL ('23) AND IDA GREEN	
Earth Sciences Fund	860,625.00
GREEN FOUNDATION	
Vannevar Bush Room	5,000.00
Faculty Salary Adjustment Fund	3,000.00
GREEN GIANT COMPANY	
For food technology	1,000.00
JAMES D. GREEN '28	
M.I.T. Club of Chicago Scholarship Fund	25.00
JOSEPH H. GREENBERG '40	
M.I.T. Club of Chicago Scholarship Fund	12.50
GROISSER AND SHLAGER IRON WORKS	
M.I.T. Boston Stein Club Technion	200.00
LESLIE R. GROVES, JR. '17	
Vannevar Bush Room	50.00
SAMUEL A. GROVES '34	
Technology Loan Fund	311.25

GRUMMAN AIRCRAFT ENGINEERING CORPORATION	
General purposes	$ 4,500.00
Industrial Liaison Program	10,000.00
HERBERT AND ERNST GRUNFELD TRUST	
Special equipment	350.00
ERNEST A. GRUNSFELD '18	
Grunsfeld Fellowship	1,850.00
B. SUMNER GRUZEN '26	
M.I.T. Boston Stein Club — National Scholarship Fund	200.00
ERNST A. GUILLEMIN '24	
William Edgerton Music Fund	10.00
GULF OIL CORPORATION	
Geology Thesis Fund	1,000.00
General purposes	2,132.76
Matching gift	240.00
GULF RESEARCH AND DEVELOPMENT COMPANY	
Fellowship in geology	3,300.00
Geology Faculty Fund	500.00
Industrial Liaison Program	20,208.75
ROBERT C. GUNNESS '34	
M.I.T. Club of Chicago Scholarship Fund	25.00
Faculty Salary Adjustment Fund	333.33
LAWRENCE R. HAFSTAD	
Vannevar Bush Room	200.00
HAGAN CHEMICALS AND CONTROLS, INC.	
Industrial Liaison Program	10,000.00
WILLIAM M. HALL '28	
Vannevar Bush Room	25.00
G. WARREN HAMBLET, JR. '26	
Allan Winter Rowe ('01) Memorial Fund	500.00
WILLIAM A. HANPETER '46	
Faculty Salary Adjustment Fund	15.00
ROBERT J. HANSEN '48	
Structural Laboratory donations	101.04
WARREN HARDING FATHER'S CLUB	
Undergraduate scholarship	200.00
FORREST G. HARMON '23	
Faculty Salary Adjustment Fund	400.00
JOSEPH HARRINGTON, JR. '30	
Faculty Salary Adjustment Fund	400.00
MAYNARD L. HARRIS '24	
Faculty Salary Adjustment Fund	200.00
HART PRODUCTS CORPORATION	
Faculty Salary Adjustment Fund	1,000.00
RALPH HART '15	
Anonymous D Fund	500.00
CARYL P. HASKINS	
Vannevar Bush Room	4,646.25
ESTATE OF CHARLES N. HASKINS '97	
Endowment for general purposes	28,610.88

RAYMOND B. HAYNES '13	
Faculty Salary Adjustment Fund	$ 350.00
CRAIG HAZELET '18	
Faculty Salary Adjustment Fund	350.00
EDWARD W. HAZEN FOUNDATION	
Research in humanities	1,500.00
HARVARD K. HECKER '38	
Faculty Salary Adjustment Fund	100.00
HENDERSON FOUNDATION	
Faculty Salary Adjustment Fund	666.67
DOROTHY AND JOHN ('24) HENNESSY FOUNDATION, INC.	
Faculty Salary Adjustment Fund	1,000.00
BARKLIE MC KEE HENRY	
Vannevar Bush Room	25.00
JAMES W. HENRY TRUST	
James W. Henry Fund	614.01
WILLIAM T. HENRY ('70) TRUST	
General purposes	35,700.00
GEORGE W. HENYAN	
General Undergraduate Scholarship Endowment	25.00
HERCULES POWDER COMPANY	
Industrial Liaison Program	15,000.00
FANNIE AND JOHN HERTZ ENGINEERING SCHOLARSHIP FOUNDATION	
Undergraduate scholarship	1,800.00
HEVI-DUTY ELECTRIC COMPANY FOUNDATION, INC.	
Faculty Salary Adjustment Fund	1,000.00
HEWLETT-PACKARD COMPANY	
Vannevar Bush Room	250.00
HENRY B. HIBBARD '25	
For general purpose endowment	250.00
HIGH VOLTAGE ENGINEERING CORPORATION	
High voltage research in electrical engineering	5,000.00
E. BRUCE HILL '05	
Faculty Salary Adjustment Fund	1,000.00
LUCIUS T. HILL '17	
Faculty Salary Adjustment Fund	100.00
MRS. GERTRUDE S. HINCKLEY '10	
M.I.T. Club of Chicago Scholarship Fund	25.00
CHARLES B. HOLLAND ('37) TRUST	
General purposes	1,709.49
PHILETUS H. HOLT '30	
Faculty Salary Adjustment Fund	250.00
HOLYOKE MACHINE COMPANY	
Technology Loan Fund	100.00
SAMUEL E. HOMSEY '26	
Faculty Salary Adjustment Fund	250.00
HONEYMEAD PRODUCTS COMPANY	
Technology Loan Fund	200.00

H. P. HOOD AND SONS	
For food technology	$ 2,000.00
Industrial Relations Section	100.00
OSCAR H. HOROVITZ '22	
Oscar H. Horovitz Fund	1,000.00
SOLOMON HORWITZ '29	
Faculty Salary Adjustment Fund	333.33
THEODORE V. HOUSER	
Endowment for scholarship	217.18
ALAN F. HOWARD '18	
Faculty Salary Adjustment Fund	333.33
JOHN H. HOWARD '39	
Vannevar Bush Room	100.00
PAUL H. HOWARD '18	
Faculty Salary Adjustment Fund	200.00
GEORGE S. HUBBARD '28	
Faculty Salary Adjustment Fund	250.00
MALCOLM M. HUBBARD '29	
Vannevar Bush Room	100.00
RICHARD HUESSENER '32	
Faculty Salary Adjustment Fund	300.00
HUGHES AIRCRAFT COMPANY	
Industrial Liaison Program	10,000.00
Faculty Salary Adjustment Fund	15,000.00
HUMBLE OIL AND REFINING COMPANY	
Industrial Liaison Program	25,000.00
JEROME C. HUNSAKER '12	
General purposes — aeronautics and astronautics	175.00
SAMUEL P. HUNT ('95) FOUNDATION	
Undergraduate scholarship	300.00
GODFREY M. HYAMS TRUST	
Research in electrical engineering	18,000.00
I-T-E FOUNDATION	
Undergraduate scholarship	700.00
General purposes	700.00
MRS. DORA D. IDE	
Undergraduate scholarships	13,200.00
UNIVERSITY OF ILLINOIS	
Research in biology	2,500.00
Research Laboratory of Electronics — Neurological Research	300.00
H. O. C. INGRAHAM '06	
Faculty Salary Adjustment Fund	50.00
INLAND STEEL-RYERSON FOUNDATION, INC.	
Undergraduate scholarships	3,000.00
General purposes	2,000.00
INSTITUTE OF FOOD TECHNOLOGISTS	
Food Research Fund	1,600.00
INSTRON ENGINEERING CORPORATION	
Technology Loan Fund	200.00

INTERNATIONAL BUSINESS MACHINES CORPORATION	
Fellowship in physics	$ 3,100.00
Competitive fellowship	3,100.00
Industrial Liaison Program	37,500.00
Fellowship in economics	1,000.00
President's Special Fund	2,000.00
INTERNATIONAL NICKEL COMPANY, INC.	
Comminution research in metallurgy	500.00
Fellowship in metallurgy	8,470.83
Undergraduate scholarships	4,633.00
Industrial Liaison Program	10,000.00
ITT LABORATORIES	
Industrial Liaison Program	20,000.00
DUGALD C. JACKSON, JR. '21	
Dugald C. Jackson Professorship	80.00
JACKSON AND MORELAND, INC.	
Vannevar Bush Room	1,500.00
WILLIAM R ('30) AND LUCILLA S. JACKSON CHARITABLE TRUST	
Faculty Salary Adjustment Fund	250.00
JACOB J. JAEGER '34	
Vannevar Bush Room	100.00
JAKOBSON SHIPYARD, INC.	
Undergraduate scholarship	1,000.00
WILL B. JAMISON '39	
Faculty Salary Adjustment Fund	500.00
JARRELL-ASH COMPANY	
Spectroscopy research	2,000.00
JOHN HANCOCK MUTUAL LIFE INSURANCE COMPANY	
Industrial Liaison Program	20,000.00
JOHNS-MANVILLE SALES CORPORATION	
General purposes	1,000.00
HENRY D. JOHNSTON '27	
Faculty Salary Adjustment Fund	25.00
JONES AND LAUGHLIN STEEL CORPORATION	
Metallurgy equipment	2,500.00
Undergraduate scholarships	5,830.00
Faculty Salary Adjustment Fund	700.00
Matching gift	160.00
THE JONSSON FOUNDATION	
Faculty Salary Adjustment Fund	2,000.00
JUNIOR ACHIEVEMENT OF HARTFORD, INC.	
Undergraduate scholarship	100.00
HENRI P. JUNOD '23	
Faculty Salary Adjustment Fund	1,000.00
KAHN PAPER COMPANY	
Faculty Salary Adjustment Fund	350.00
KAISER ALUMINUM AND CHEMICAL CORPORATION	
General purposes	2,000.00
RICHARD A. KANE '55	
Undergraduate scholarship	100.00

SYDNEY ('37) AND SYLVIA KAROFSKY	
M.I.T. Boston Stein Club — New England Scholarship Fund	$ 100.00
MAURICE N. KATZ '42	
Faculty Salary Adjustment Fund	250.00
MITCHELL B. KAUFMAN ('15) CHARITABLE FOUNDATION	
Faculty Salary Adjustment Fund	1,000.00
ALBERT L. KAYE '31	
M.I.T. Club of Chicago Scholarship Fund	25.00
SIDNEY L. KAYE '30	
Undergraduate scholarship	650.00
PARRY KELLER '15	
Anonymous D Fund	100.00
THOMAS P. KELLY '18	
Faculty Salary Adjustment Fund	166.67
KENDALL COMPANY	
Industrial Relations Section	500.00
KENNECOTT COPPER CORPORATION	
Fellowship in metallurgy	4,000.00
HERBERT W. KENWAY '05	
Faculty Salary Adjustment Fund	100.00
KENWOOD OIL COMPANY	
Faculty Salary Adjustment Fund	500.00
BREENE M. KERR '51	
Faculty Salary Adjustment Fund	250.00
JAMES R. KILLIAN, JR. '26	
General purposes	300.00
KIMBERLY-CLARK FOUNDATION, INC.	
Fellowship in chemical engineering	3,810.00
E. B. KIMMEL	
General undergraduate scholarship endowment	5.00
CHARLES A. ('96) AND MARJORIE KING	
Research in biology	12,500.00
FREDERICK J. KING '09	
General purpose endowment	500.00
ROBERT J. KING '03	
Karl T. Compton Laboratory	1,000.00
EDWARD J. KINGSBURY '15	
Faculty Salary Adjustment Fund	100.00
WILLIAM A. KINSMAN '99	
William A. Kinsman Fund	11,126.25
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	100.00
JOHN R. KIRKPATRICK '48	
Faculty Salary Adjustment Fund	200.00
HAYDEN B. KLINE '24	
Faculty Salary Adjustment Fund	1,000.00

GEORGE O. KNAPP ('37) FOUNDATION	
Knapp Memorial Scholarships	$ 1,500.00
JOHN E. KNECHT	
General purposes	10.00
SEMON E. KNUDSEN '36	
Faculty Salary Adjustment Fund	11,146.88
FRED C. KOCH ('22) FOUNDATION, INC.	
Faculty Salary Adjustment Fund	5,000.00
HAROLD E. KOCH '22	
Faculty Salary Adjustment Fund	200.00
HERBERT W. KOCHS '24	
M.I.T. Club of Chicago Scholarship Fund	25.00
KOEHLER MANUFACTURING COMPANY	
Technology Loan Fund	50.00
KOPPERS COMPANY, INC.	
Industrial Liaison Program	10,000.00
KULJIAN CORPORATION	
Undergraduate scholarship	1,000.00
JOHN KUNSTADTER '49	
M.I.T. Club of Chicago Scholarship Fund	25.00
CLIVE W. LACY '15	
Anonymous D Fund	330.06
ROBERT LACY '98	
Faculty Salary Adjustment Fund	25.00
LAHEY FOUNDATION	
Research in electrical engineering	15,000.00
ROBERT E. LAMB, INC.	
General undergraduate scholarship endowment	200.00
PETER T. LAMONT '22	
Faculty Salary Adjustment Fund	600.00
BERNARD LANDERS '15	
Anonymous D Fund	250.00
WILLIAM H. LANE '52	
General purposes	500.00
WILLIAM H. LANG '22	
Faculty Salary Adjustment Fund	500.00
EDWARD W. LARKIN '14	
Faculty Salary Adjustment Fund	150.00
PIERRE F. LAVEDAN '20	
Faculty Salary Adjustment Fund	250.00
JOHN M. LEBOLT '42	
M.I.T. Club of Chicago Scholarship Fund	25.00
CHARLES T. LEEDS '00	
Faculty Salary Adjustment Fund	100.00
MAC ('25) AND ANNE LEVINE	
M.I.T. Boston Stein Club — New England Scholarship Fund	200.00
NORMAN LEVINSON '33	
M.I.T. Boston Stein Club — New England Scholarship Fund	100.00

EDWARD C. LEVY ('52) FOUNDATION	
Technology Loan Fund	$ 1,300.00
LEWIS-SHEPARD FUND	
Frederick J. Shepard, Jr. ('12) Scholarship Endowment Fund	10,000.00
HARRIS B. LIBBY	
M.I.T. Boston Stein Club Technion	150.00
LIBERTY MUTUAL INSURANCE COMPANY	
Industrial Liaison Program	10,000.00
LIGHTOLIER FUND, INC.	
Technology Loan Fund	500.00
LILLY VARNISH COMPANY	
Faculty Salary Adjustment Fund	166.66
OTTO G. LINDBERG	
Gustof R. Lindberg Endowed Scholarship	10,000.00
JOHN LINDSLEY ('25) TRUST	
John Lindsley Fund	500.00
PAUL W. LITCHFIELD ('96) CHARITABLE TRUST	
Litchfield Scholarship Fund	126,582.96
Faculty Salary Adjustment Fund	2,906.25
JOSEPH M. LIVERMORE '15	
Anonymous D Fund	50.00
LOCKHEED AIRCRAFT CORPORATION	
Industrial Liaison Program	20,000.00
General purposes	1,500.00
LOCKHEED LEADERSHIP FUND	
Lockheed Leadership Fellowship	2,700.00
Undergraduate scholarships	14,300.00
CARL M. LOEB, JR. '28	
Faculty Salary Adjustment Fund	20,539.08
RICHARD O. LOENGARD '17	
Faculty Salary Adjustment Fund	1,140.00
GROVER LOENING	
Aeronautics Archives Fund	400.00
ALFRED L. LOOMIS	
President's Fund	10,000.00
WESLEY H. LOOMIS, III '35	
M.I.T. Club of Chicago Scholarship Fund	100.00
Faculty Salary Adjustment Fund	500.00
KENNETH S. LORD '26	
Faculty Salary Adjustment Fund	50.00
LORD MANUFACTURING COMPANY	
Research in civil engineering	11,120.00
ESTATE OF EDWARD H. LORENZ '05	
Endowment for general purposes	23,132.52
ROBERT A. LOVETT	
Faculty Salary Adjustment Fund	500.00
LOYAL ORDER OF MOOSE — LEOMINSTER LODGE	
Undergraduate scholarship	450.00
LOYAL ORDER OF MOOSE — PITTSFIELD LODGE	
Undergraduate scholarship	400.00

SAMUEL E. LUNDEN AND ASSOCIATES	
Faculty Salary Adjustment Fund	$ 50.00
NORMAN MAC BETH, JR. '39	
Faculty Salary Adjustment Fund	33.00
CLYDE MAC CORMACK '03	
Faculty Salary Adjustment Fund	1,000.00
PHILIP R. MACHT '48	
Faculty Salary Adjustment Fund	200.00
FREDERICK F. MAC KENTEPE '14	
M.I.T. Club of Chicago Scholarship Fund	50.00
Faculty Salary Adjustment Fund	1,000.00
CHARLES T. MAIN, INC.	
Charles T. and Charles R. Main Memorial Fund	1,000.00
THEODORE A. MANGELSDORF '26	
Faculty Salary Adjustment Fund	500.00
MANUFACTURING CHEMISTS ASSOCIATION, INC.	
Building construction research in civil engineering	10,000.00
FRANK MARCUCELLA '27	
Faculty Salary Adjustment Fund	500.00
RICHARD J. MARCUS '32	
M.I.T. Boston Stein Club Technion	450.00
RICHARD J. ('32) AND DIANA L. MARCUS	
M.I.T. Boston Stein Club — National Scholarship Fund	750.00
ROBERT G. ('31) AND NATALIE MARCUS	
M.I.T. Boston Stein Club — National Scholarship Fund	500.00
H. TYLER MARCY '40	
Vannevar Bush Room	25.00
LEROY MAREK '30	
Faculty Salary Adjustment Fund	500.00
MARINE CORPS LEAGUE OF HAVERHILL, MASSACHUSETTS	
Undergraduate scholarship	250.00
BERNARD M. MARKSTEIN, JR. '32	
Faculty Salary Adjustment Fund	30.00
LOU AND GENE MARRON FOUNDATION	
Research in biology	1,500.00
ESTATE OF ALICE G. MARTIN	
Augustus B. Martin, Jr., Fund	601.59
THE MARTIN COMPANY	
Undergraduate scholarships	6,600.00
Industrial Liaison Program	20,000.00
DOLPHE MARTIN '12	
Development Fund	10.00
MRS. SAMUEL MARX	
General purposes	1,000.00
COMMONWEALTH OF MASSACHUSETTS	
Joint Highway Research Project	60,000.00
MASSACHUSETTS ELKS ASSOCIATION	
Undergraduate scholarship	2,500.00
MASSACHUSETTS EYE AND EAR INFIRMARY	
Research Laboratory Electronics research	22,093.88

MASSACHUSETTS GENERAL HOSPITAL Research in biology	$ 1,300.00
THE MASSACHUSETTS HEART ASSOCIATION, INC. Research in biology	3,358.00
M.I.T. CLUB OF CHICAGO M.I.T. Club of Chicago Scholarship Fund	500.00
M.I.T. CLUB OF CLEVELAND Undergraduate scholarship	1,250.00
M.I.T. CLUB OF ROCHESTER Undergraduate scholarship	1,000.00
M.I.T. CLUB OF SOUTHERN CALIFORNIA Undergraduate scholarship	1,000.00
MASSACHUSETTS MUTUAL LIFE INSURANCE COMPANY General purposes	146.46
KATHRYN B. MATSON General undergraduate scholarship endowment	15.00
HOWARD MAXWELL General undergraduate scholarship endowment	15.00
OSCAR MAYER AND COMPANY Research in food technology	10,000.00
OSCAR MAYER FOUNDATION, INC. Undergraduate scholarships	2,500.00
CHARLES B. MC COY '32 Faculty Salary Adjustment Fund	1,000.00
GEORGE W. MC CREERY '19 Faculty Salary Adjustment Fund	333.33
HAROLD A. MC CRENSKY '38 M.I.T. Boston Stein Club — New England Scholarship Fund	100.00
MC CUNE FOUNDATION Undergraduate scholarship	500.00
MC DERMOTT FOUNDATION Faculty Salary Adjustment Fund	2,000.00
MC DONNELL AIRCRAFT CORPORATION Industrial Liaison Program	10,000.00
J. F. MC ELWAIN COMPANY Industrial Relations Section	100.00
OWEN J. MC GARRAHAN COMPANY M.I.T. Boston Stein Club — New England Scholarship Fund	2,000.00
MC GRAW-HILL PUBLISHING COMPANY, INC. Aviation Week Fellowship	2,900.00
ESTATE OF RICHARD V. MC KAY Richard V. McKay Fund	1,000.00
MC KINSEY FOUNDATION Research in industrial management	7,500.00
THE MEDICAL FOUNDATION, INC. Research in biochemistry	7,450.00
ROBERT C. MEISSNER '43 M.I.T. Club of Chicago Scholarship Fund	25.00

MELPAR, INC.	
Fellowship in electrical engineering	$ 5,000.00
JAMES C. MELVIN TRUST	
James C. Melvin Scholarships	15,000.00
ALVIN M. MENDLE '39	
Faculty Salary Adjustment Fund	170.00
MERCK AND COMPANY, INC.	
Research in chemistry	5,000.00
THE MERCK COMPANY FOUNDATION	
Vannevar Bush Room	5,000.00
MEREDITH AND GREW, INC.	
Technology Loan Fund	500.00
MERRILL LYNCH, PIERCE, FENNER AND SMITH, INC.	
Industrial Liaison Program	10,000.00
General purposes	200.00
MERRITT-CHAPMAN AND SCOTT CORPORATION	
Undergraduate scholarship	1,000.00
General purposes	1,000.00
ESTATE OF ALICE METCALF	
Leonard Metcalf ('92) Memorial Fund	3,998.79
STEPHEN B. METCALFE '23	
Faculty Salary Adjustment Fund	200.00
F. RICHARD MEYER, III '42	
M.I.T. Club of Chicago Scholarship Fund	25.00
JACK MEYERHOFF ('44) AND SONS FOUNDATION, INC.	
Faculty Salary Adjustment Fund	333.00
NICHOLAS A. MILAS	
Research in chemistry	12,324.00
MARGARET C. MILLER	
Vannevar Bush Room	5,000.00
SIDNEY E. MILLER '26	
Faculty Salary Adjustment Fund	300.00
FRANK R. MILLIKEN '34	
Faculty Salary Adjustment Fund	250.00
MINE SAFETY APPLIANCES COMPANY	
Industrial Liaison Program	10,000.00
MINNEAPOLIS-HONEYWELL REGULATOR COMPANY	
Fellowship in electrical engineering	3,900.00
Industrial Liaison Program	20,000.00
HECTOR A. MOINEAU '27	
Faculty Salary Adjustment Fund	250.00
MONSANTO CHEMICAL COMPANY	
Plastics in housing design	9,000.00
Fellowship in chemistry	7,700.00
Industrial Liaison Program	15,000.00
MOOG VALVE COMPANY, INC.	
Research in mechanical engineering	3,750.00
ESTATE OF C. LILLIAN MOORE	
John A. Grimmons ('21) Fund	6,260.00
LEWIS MOORE '33	
Faculty Salary Adjustment Fund	350.00

ROBERT L. MOORE '21	
Fellowship in industrial economics	$ 750.00
Faculty Salary Adjustment Fund	666.66
HENRY S. MORGAN	
Vannevar Bush Room	5,000.00
PHILIP E. MORRILL '14	
Faculty Salary Adjustment Fund	200.00
HERMAN E. MORSE '15	
Anonymous D Fund	1,435.00
ESTATE OF F. ESTELLE MOSMAN	
Endowment for general purposes	64,896.60
MOTOR OILS REFINING COMPANY	
Undergraduate scholarship	1,426.00
MOTOROLA, INC.	
Industrial Liaison Program	10,000.00
SEELEY G. MUDD	
Vannevar Bush Room	5,000.00
CARL M. MUELLER '41	
Faculty Salary Adjustment Fund	100.00
WILLIAM H. MUESER '22	
Faculty Salary Adjustment Fund	500.00
WALTER F. MUNFORD '23	
Faculty Salary Adjustment Fund	400.00
MURCHISON FUND	
Faculty Salary Adjustment Fund	1,666.66
FRANCIS E. MURPHY '15	
Anonymous D Fund	20.00
MUSCULAR DYSTROPHY ASSOCIATIONS OF AMERICA, INC.	
Research in biology	11,031.50
MUTUAL BOILER AND MACHINERY INSURANCE COMPANY	
Industrial Relations Section	100.00
J. MARTIN MYERS	
General undergraduate scholarship endowment	10.00
NATIONAL ASSOCIATION OF ENGINE AND BOAT MANUFACTURERS, INC.	
Undergraduate scholarships	1,500.00
NATIONAL ASSOCIATION OF SECONDARY SCHOOL PRINCIPALS SCHOLARSHIP FUND	
Undergraduate scholarship	500.00
NATIONAL CASH REGISTER COMPANY	
Industrial Liaison Program	10,000.00
NATIONAL DISTILLERS AND CHEMICAL CORPORATION	
Industrial Liaison Program	10,000.00
Matching gift	55.00
NATIONAL GEOGRAPHIC SOCIETY	
Edgerton film research	18,500.00
NATIONAL INSTITUTES OF HEALTH	
Charles A. and Marjorie King Fund	500.00
Research in biology — Chung	500.00
Research in biology — Robinson	678.00
Research in biology — Tessman	500.00

Research in biology — Schurin	$ 500.00
Research in biology — Weiberg	500.00
Research in chemistry — Meschino	500.00
Research in chemistry — Burrows	500.00
Research in economics	500.00
Special studies	200,000.00
Special research	8,000.00
Special research — Gerstein	500.00
Special research — Berger	500.00
NATIONAL MERIT SCHOLARSHIP CORPORATION	
National Merit Scholarships	234,647.50
NATIONAL SHAWMUT BANK OF BOSTON	
Industrial Relations Section	500.00
NATIONAL STEEL CORPORATION	
Fellowship in metallurgy	5,000.00
JAMES B. NEAL '15	
Anonymous D Fund	200.00
GEORGE ('24) AND BETTY NEITLICH	
M.I.T. Boston Stein Club — New England Scholarship Fund	100.00
THOMAS P. NELLIGAN '36	
M.I.T. Club of Chicago Scholarship Fund	25.00
THE NESTLÉ COMPANY, INC.	
Research in food technology	5,000.00
WALTER A. NETSCH '43	
M.I.T. Club of Chicago Scholarship Fund	50.00
NEW BEDFORD CORDAGE COMPANY	
Faculty Salary Adjustment Fund	500.00
THE PORT OF NEW YORK AUTHORITY	
Computation Center research	5,000.00
MRS. LENA M. NEWELL	
Joseph S. Newell ('19) Memorial Library	500.00
E. MORTIMER NEWLIN ('14) TRUST	
For general purposes	1,657.75
ERIC P. NEWMAN '32	
Faculty Salary Adjustment Fund	1,003.75
NEWMONT EXPLORATION LIMITED	
Audio Telluric Equipment Fund	4,660.00
NEWPORT NEWS SHIPBUILDING DRY DOCK COMPANY	
Ship Model Towing Tank carriage	1,000.00
R. A. NICHOLS	
Dean's Chapel Fund	20.00
CLARENDON NICKERSON ('97) TRUST	
Endowment for general purposes	17,015.24
JOHN P. NISSEN, JR. '23	
Faculty Salary Adjustment Fund	200.00
NORTH AMERICAN AVIATION, INC.	
Industrial Liaison Program	10,000.00
Faculty Salary Adjustment Fund	30,000.00
THE NORTHWEST PAPER FOUNDATION	
Faculty Salary Adjustment Fund	1,000.00

NORTON COMPANY	
Technology Press	$ 1,500.00
E. I. NOXON CONSTRUCTION COMPANY	
Technology Loan Fund	40.00
NUTRITION FOUNDATION, INC.	
Karl T. Compton Fellowship in Nutrition	10,200.00
Research in food technology	4,300.00
DANIEL J. O'CONNELL '29	
Faculty Salary Adjustment Fund	300.00
THOMAS O'CONNOR AND COMPANY, INC.	
Faculty Salary Adjustment Fund	2,000.00
BRUCE S. OLD '38	
Faculty Salary Adjustment Fund	25.00
HENRY A. OLKO '53	
Frances and William Emerson Fund	25.00
ORTHOPAEDIC RESEARCH AND EDUCATION FOUNDATION	
Research in biology	4,140.00
THE EDWARD ORTON, JR., CERAMIC FOUNDATION	
Fellowship in metallurgy	2,100.00
SAMUEL S. OTIS '15	
Anonymous D Fund	20.00
PAUL B. OWEN '14	
Development Fund	170.00
OWENS-CORNING FIBERGLAS CORPORATION	
Research in building construction — civil engineering	12,250.00
Industrial Liaison Program	10,000.00
JACK C. PAGE '48	
M.I.T. Club of Chicago Scholarship Fund	50.00
WILLIAM A. PAINE, II '49	
For student aid	100.00
PAN AMERICAN WORLD AIRWAYS	
General purposes	5,000.00
PARKE DAVIS AND COMPANY	
New England Colleges Fund	272.89
ROBERT D. PATTERSON '20	
Faculty Salary Adjustment Fund	100.00
WILLIAM G. PAYNE '27	
Faculty Salary Adjustment Fund	100.00
MRS. LANGDON PEARSE	
Langdon Pearse ('01) Memorial Scholarship	25,000.00
BENJAMIN W. PEPPER '09	
Faculty Salary Adjustment Fund	1,017.50
PHILIP H. PETERS '37	
Faculty Salary Adjustment Fund	66.66
PETROLEUM HEAT AND POWER COMPANY, INC.	
Faculty Salary Adjustment Fund	250.00
JOHN G. PEW '26	
Faculty Salary Adjustment Fund	1,000.00
CHARLES PFIZER COMPANY, INC.	
Research in chemistry	6,000.00

PHILCO CORPORATION	
Industrial Liaison Program	$10,000.00
PHILIP MORRIS, INC.	
Undergraduate scholarship	500.00
General purposes	1,300.00
CHARLOTTE PALMER PHILLIPS FOUNDATION, INC.	
General undergraduate scholarship endowment	100.00
WALDO F. PIKE '15	
Anonymous D Fund	250.00
LOUIS PIROLA '26	
M.I.T. Club of Chicago Scholarship Fund	25.00
HAROLD M. PITMAN COMPANY	
Undergraduate scholarship	1,200.00
PITNEY-BOWES, INC.	
General purposes	500.00
PITTSBURGH PLATE GLASS COMPANY	
Research in civil engineering	2,500.00
Research in chemical engineering	3,000.00
EDWARD J. POITRAS '28	
Faculty Salary Adjustment Fund	1,000.00
PONCE CEMENT CORPORATION	
Faculty Salary Adjustment Fund	33,333.00
HAROLD W. POPE '39	
Faculty Salary Adjustment Fund	400.00
ALFRED J. POTE '26	
Vannevar Bush Room	25.00
RENE POUCHAIN '17	
Faculty Salary Adjustment Fund	50.00
LEWIS J. POWERS '23	
Faculty Salary Adjustment Fund	300.00
H. W. PRENTIS, JR.	
Vannevar Bush Room	100.00
GWILYM A. PRICE	
Faculty Salary Adjustment Fund	500.00
MRS. ODETTE S. PRICE	
Raymond B. Price ('94) Memorial Fund	5,000.00
RICHARD P. PRICE '25	
Faculty Salary Adjustment Fund	100.00
PROCTER AND GAMBLE COMPANY	
Fellowship in chemical engineering	6,800.00
Fellowship in chemistry	4,600.00
Fatty acid research in food technology	7,000.00
Fellowship in mechanical engineering	6,900.00
Undergraduate scholarships	16,400.00
Industrial relations section	1,000.00
Faculty Salary Adjustment Fund	20,000.00
CHARLES D. PROCTOR '17	
Faculty Salary Adjustment Fund	500.00
THE PRODUCTO FOUNDATION, INC.	
Faculty Salary Adjustment Fund	500.00

GEORGE M. PULLMAN EDUCATIONAL FOUNDATION	
Undergraduate scholarships	$ 2,500.00
PURDUE UNIVERSITY	
National Institutes of Health special	10,000.00
JOHN C. RAAEN '33	
M.I.T. Club of Chicago Scholarship Fund	25.00
SAMUEL ('40) AND JOY B. RABINOWITZ	
M.I.T. Boston Stein Club — New England Scholarship Fund	200.00
RADIO CORPORATION OF AMERICA	
General purposes	500.00
Industrial Liaison Program	20,000.00
ALBERT S. RAIRDEN '22	
Faculty Salary Adjustment Fund	25.00
RAMO-WOOLDRIDGE CORPORATION	
Fellowship in electrical engineering	8,400.00
Fellowship in mathematics	4,400.00
RAND MC NALLY AND COMPANY	
Undergraduate scholarships	2,000.00
RAYONIER FOUNDATION	
Undergraduate scholarship	1,000.00
THE RAYTHEON COMPANY	
Vannevar Bush Room	5,000.00
General purposes	2,110.00
Industrial Liaison Program	10,000.00
READER'S DIGEST FOUNDATION	
Undergraduate scholarship	1,500.00
REED AND BARTON FOUNDATION, INC.	
Industrial Relations Section	250.00
HENRY REGNERY '34	
Faculty Salary Adjustment Fund	500.00
REPUBLIC AVIATION CORPORATION	
Industrial Liaison Program	10,000.00
RESEARCH CORPORATION	
Vitamin research in chemistry	12,341.00
Research in chemistry	5,900.00
REYNOLDS METALS COMPANY	
Research in architecture	2,000.00
MRS. JULIAN RICE '15	
Anonymous D Fund	25.00
HOWARD L. RICHARDSON '31	
Vannevar Bush Room	100.00
HAROLD B. RICHMOND '14	
Vannevar Bush Room	25.00
KENNETH C. RICHMOND '17	
Faculty Salary Adjustment Fund	100.00
JOSEPH G. AND MYER RIESMAN FOUNDATION	
M.I.T. Boston Stein Club Technion	450.00
FREDERICK A. RITCHIE '31	
Faculty Salary Adjustment Fund	50.00

DONALD G. ROBBINS '07	
Faculty Salary Adjustment Fund	$ 500.00
JOSEPH K. ROBERTS '28	
M.I.T. Club of Chicago Scholarship Fund	25.00
Faculty Salary Adjustment Fund	1,000.00
VIRGINIA ROBINSON	
Ralph C. Robinson ('01) Memorial Scholarship endowment	10.00
JAMES J. ROBSON '32	
Class of 1932 Scholarship endowment	286.50
ROCKEFELLER FOUNDATION	
Research in city planning	3,087.54
Center for International Studies	65,179.94
Computation Center research	31,029.62
General purposes	5,000.00
GILBERT M. RODDY '31	
Faculty Salary Adjustment Fund	500.00
ANTONIO H. RODRIGUEZ '21	
Faculty Salary Adjustment Fund	5,000.00
CLARENCE SAGE ROE '13	
Faculty Salary Adjustment Fund	1,000.00
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
ELIHU ROOT, JR.	
Vannevar Bush Room	5,000.00
WALTER A. ROSENBLITH	
Vannevar Bush Room	20.00
WILLIAM ROSENWALD '24	
Faculty Salary Adjustment Fund	200.00
ROTH LABORATORY	
Faculty Salary Adjustment Fund	300.00
HARTLEY ROWE	
Vannevar Bush Room	100.00
FRED M. ROWELL '21	
Faculty Salary Adjustment Fund	100.00
GEORGE L. ROY '17	
Faculty Salary Adjustment Fund	100.00
DAMON RUNYON MEMORIAL FUND FOR CANCER RESEARCH, INC.	
High voltage research	20,000.00
Research in biochemistry	8,000.00
EDWIN D. RYER '20	
Faculty Salary Adjustment Fund	500.00
ST. ANTHONY EDUCATIONAL FOUNDATION, INC.	
Undergraduate scholarship	200.00
JAMES A. ST. LOUIS '28	
Faculty Salary Adjustment Fund	350.00
HOWARD J. SAMUELS '41	
Faculty Salary Adjustment Fund	500.00

JOSEPH SANDERS	
Class of 1931 Compton Scholarship	$ 462.07
Class of 1934 Compton Scholarship	462.07
ASSOCIATED STUDENT BODY — SANTA MONICA HIGH SCHOOL	
Undergraduate scholarship	750.00
C. BALDWIN SAWYER '17	
Faculty Salary Adjustment Fund	160.00
LUKE E. SAWYER '10	
Faculty Salary Adjustment Fund	200.00
OLIVER H. SCHARNBERG '32	
Faculty Salary Adjustment Fund	100.00
SCHERING FOUNDATION, INC.	
Matching gift for Faculty Salary Adjustment Fund	372.19
SCHLUMBERGER FOUNDATION	
Fellowship in electrical engineering	3,600.00
SCHLUMBERGER WELL SURVEYING CORPORATION	
Research in geology	10,000.00
SOLOMON SCHNEIDER '15	
Anonymous D Fund	100.00
EUGENE A. SCHNELL '44	
Research in food technology	2,500.00
ERNEST SCHOENWALD '44	
Faculty Salary Adjustment Fund	100.00
O. H. SCHOENWALD	
Faculty Salary Adjustment Fund	100.00
NATHAN SCHOOLER '24	
Faculty Salary Adjustment Fund	556.18
SCIENTIFIC DESIGN COMPANY, INC.	
Fellowship in chemical engineering	4,375.00
SAMUEL SCOTT '40	
Scholarship in architecture	1,107.50
SEARS-ROEBUCK FOUNDATION	
Fellowship in city planning — urban renewal	4,000.00
Undergraduate scholarship	200.00
LOUIS AND SAMUEL SEIDEN FOUNDATION, INC.	
Undergraduate scholarship	1,500.00
ESTATE OF LEWIS J. SEIDENSTICKER '98	
Class of 1898 Fund	100.00
EDGAR F. SEIFERT '19	
M.I.T. Club of Chicago Scholarship Fund	25.00
Faculty Salary Adjustment Fund	1,000.00
HERVEY SELEY '55	
General purposes	2,500.00
WILLIAM C. SESSIONS '26	
Faculty Salary Adjustment Fund	109.00
SHAWINIGAN CHARITABLE TRUST	
Equipment in chemistry	2,000.00
SHELL COMPANIES FOUNDATION, INC.	
Research in chemical engineering	7,500.00
Fellowship in mechanical engineering	4,100.00
Research in mechanical engineering	7,500.00

Research in metallurgy	$ 7,500.00
Fellowship in physics	4,100.00
DAVID A. SHEPARD '26	
Faculty Salary Adjustment Fund	524.38
SHERATON FOUNDATION, INC.	
Faculty Salary Adjustment Fund	200.00
BENJAMIN H. SHERMAN '19	
M.I.T. Club of Chicago Scholarship Fund	25.00
WILLIAM J. SHERRY '21	
General purposes	226.11
J. J. SHEVLIN, JR.	
General undergraduate scholarship endowment	25.00
WICKLIFFE SHREVE	
Undergraduate scholarship	1,000.00
SHURE MANUFACTURING CORPORATION	
Faculty Salary Adjustment Fund	100.00
GEORGE M. SIEGEL '34	
Faculty Salary Adjustment Fund	680.00
ROBERT L. SILBERMAN '48	
M.I.T. Club of Chicago Scholarship Fund	525.00
SIMPLEX WIRE AND CABLE COMPANY	
Industrial Liaison Program	20,000.00
Industrial Relations Section	350.00
SINCLAIR AND VALENTINE COMPANY	
Undergraduate scholarship	1,000.00
ALVIN J. SITEMAN '48	
Faculty Salary Adjustment Fund	333.33
SKIDMORE, OWINGS, AND MERRILL	
Undergraduate scholarship	1,200.00
DAVID W. SKINNER	
Faculty Salary Adjustment Fund	2,000.00
ELMER A. SKONBERG '29	
Faculty Salary Adjustment Fund	10.00
H. NELSON SLATER '15	
Graduate study in flight transportation	192,517.18
H. NELSON SLATER, JR. '50	
General purposes — School of Industrial Management	150.00
ALFRED P. SLOAN ('95) FOUNDATION, INC.	
For School of Industrial Management	275,000.00
Executive Development Program	157,000.00
Executive Development Program Contingency Fund	7,500.00
Teaching Internship	50,000.00
Research in chemistry — Garland	6,875.00
Research in chemistry — Greene	8,750.00
Research in chemistry — Waugh	8,750.00
Fellowship in electrical engineering	6,308.62
Research in mathematics — Ray	12,500.00
Research in mathematics — Singer	15,625.00
Research in physics — Cochran	16,250.00
Research in physics — Frisch	3,750.00
Foreign post-doctoral fellowships	70,000.00
Atmospheric research	45,000.00

ALFRED P. SLOAN ('95) FOUNDATION, INC. — *continued*	
National Scholarship Program	$ 108,000.00
Student aid travel	248.32
Faculty Salary Adjustment Fund	1,250,000.00
ISIDOR SLOTNIK '19	
Faculty Salary Adjustment Fund	166.66
A. O. SMITH CORPORATION	
Industrial Liaison Program	10,000.00
BEAUCHAMP E. SMITH	
Faculty Salary Adjustment Fund	500.00
FREDERICK G. C. SMITH, JR. '19	
Faculty Salary Adjustment Fund	25.00
GEORGE WARREN SMITH '26	
Faculty Salary Adjustment Fund	200.00
REGINALD H. SMITHWICK '21	
Faculty Salary Adjustment Fund	350.00
EUGENE R. SMOLEY '19	
Faculty Salary Adjustment Fund	333.33
BRIGADIER GENERAL JOHN F. SMOLLER	
Undergraduate scholarship	500.00
SOCIAL SCIENCE RESEARCH COUNCIL	
Research in industrial management — Schein	4,000.00
SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS	
Undergraduate scholarships	4,000.00
SOCONY MOBIL OIL COMPANY	
Research in geology	175.00
Industrial Liaison Program	20,000.00
Geology Thesis Fund	225.00
Industrial Relations Section	1,000.00
SOUTHWEST RESEARCH INSTITUTE	
Research in naval architecture	1,550.00
H. SPARKS	
General undergraduate scholarship endowment	15.00
HENRY K. SPENCER '09	
Faculty Salary Adjustment Fund	2,519.62
PERCY SPENCER	
Vannevar Bush Room	500.00
WILLIAM B. SPENCER '15	
Faculty Salary Adjustment Fund	150.00
SPERRY GYROSCOPE COMPANY	
Industrial Liaison Program	15,000.00
SPRAGUE ELECTRIC COMPANY	
Research in industrial management	12,639.63
Industrial Liaison Program	20,000.00
STANDARD OIL COMPANY (INDIANA)	
Industrial Liaison Program	20,000.00
STANDARD OIL COMPANY OF CALIFORNIA	
Fellowship in geology	2,800.00
Undergraduate scholarship	750.00
Industrial Liaison Program	50,000.00
Geology Thesis Fund	750.00
General purposes	10,500.00

STANDARD OIL COMPANY OF TEXAS	
Undergraduate scholarship	$ 750.00
Geology Thesis Fund	750.00
STANDARD OIL FOUNDATION, INC.	
Fellowship in chemical engineering	3,500.00
Undergraduate scholarship	750.00
Standard Oil Foundation Fund	25,000.00
STANDARD PLASTICS COMPANY, INC.	
Faculty Salary Adjustment Fund	500.00
ESTATE OF PERCY A. STAPLES '04	
Alfred E. Burton Memorial Fund	2,076.88
STEEL FOUNDERS' SOCIETY OF AMERICA	
Taylor Research Fund	23,812.00
DAVID ('13) AND DELLA STERN	
M.I.T. Boston Stein Club — New England Scholarship Fund	100.00
ESTATE OF ELIZABETH R. STEVENS	
Albert G. Boyden Fund	19.07
EZRA F. STEVENS '27	
Faculty Salary Adjustment Fund	200.00
G. RADCLIFFE STEVENS '17	
M.I.T. Club of Chicago Scholarship Fund	50.00
RAYMOND STEVENS '17	
Raymond Stevens Fund	1,020.00
EARL P. STEVENSON '19	
Vannevar Bush Room	50.00
JOHN G. STEVENSON '49	
Faculty Salary Adjustment Fund	50.00
CHESTER C. STEWART '19	
Faculty Salary Adjustment Fund	300.00
STEWART IN-FRA-RED, INC.	
Undergraduate scholarship	500.00
STEWART-WARNER FOUNDATION	
Vannevar Bush Room	5,000.00
Faculty Salary Adjustment Fund	10,000.00
WILLIAM L. STEWART, JR. '23	
Development Fund	1,200.00
Faculty Salary Adjustment Fund	1,200.00
STOP AND SHOP FOUNDATION	
Industrial Relations Section	250.00
OLIVER W. STORER SCHOLARSHIP FUND	
Undergraduate scholarships	1,700.00
RAYMOND B. STRINGFIELD '15	
Faculty Salary Adjustment Fund	200.00
Anonymous D Fund	200.00
STUDENT-FACULTY COMMITTEE	
Vannevar Bush Room	50.00
ESTATE OF ALBERT F. SULZER '01	
Undergraduate scholarship endowment	33,962.47
SUN OIL COMPANY	
Fellowship in chemistry	4,100.00
Industrial Relations Section	1,000.00

THE SUNNEN FOUNDATION	
Faculty Salary Adjustment Fund	$ 200.00
KENNETH SUTHERLAND '22	
Faculty Salary Adjustment Fund	100.00
SYLVANIA ELECTRIC PRODUCTS, INC.	
Industrial Liaison Program	10,000.00
Industrial Relations Section	300.00
DONALD TABER '25	
Faculty Salary Adjustment Fund	200.00
EDGAR W. TAFT '13	
Faculty Salary Adjustment Fund	150.00
VERNON M. F. TALLMAN '14	
Faculty Salary Adjustment Fund	400.00
S. JOSEPH TANKOOS, JR. '43	
Faculty Salary Adjustment Fund	200.00
TASTY BAKING COMPANY	
For food technology	5,000.00
JOHN E. TAYLOR '46	
Faculty Salary Adjustment Fund	50.00
RICHARD TAYLOR '34	
Vannevar Bush Room	100.00
TEAGLE FOUNDATION, INC.	
Teagle Foundation Scholarships	23,035.00
TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY	
Research in civil engineering	12,385.89
TELECHROME MANUFACTURING CORPORATION	
Technology Loan Fund	100.00
TELEVISION SHARES MANAGEMENT CORPORATION	
Television Shares Management Corporation Prizes	2,000.00
EDWIN A. TERKELSEN '22	
Faculty Salary Adjustment Fund	200.00
TERRY STEAM TURBINE COMPANY	
Technology Loan Fund	3,000.00
TEXAS INSTRUMENTS, INC.	
Industrial Liaison Program	10,000.00
TEXTRON FOUNDATION	
Faculty Salary Adjustment Fund	5,000.00
HAROLD E. THAYER '34	
Faculty Salary Adjustment Fund	100.00
THIOKOL CHEMICAL CORPORATION	
Industrial Liaison Program	10,000.00
CHARLES ('24) AND MARGARET THOMAS CHARITABLE TRUST	
Faculty Salary Adjustment Fund	1,000.00
L. G. L. THOMAS '20	
Faculty Salary Adjustment Fund	1,000.00
THOMPSON AND LICHTNER COMPANY, INC.	
Faculty Salary Adjustment Fund	500.00
HUGH THOMSON	
Memorial to Ralph C. Robinson '01	10.00

FLETCHER P. THORNTON, JR. '36	
Faculty Salary Adjustment Fund	$ 200.00
TIDEWATER OIL COMPANY	
Industrial Liaison Company	10,000.00
TI-GSI FOUNDATION	
Texas Instrument Company Fund	1,000.00
ROBERT A. TONON '22	
Faculty Salary Adjustment Fund	400.00
TOWLE MANUFACTURING COMPANY	
Industrial Relations Section	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	1,500.00
THE THEODORE P. TSOLAINOS FOUNDATION	
Undergraduate scholarship	1,300.00
TUBED CHEMICALS CORPORATION	
Technology Loan Fund	25.00
TUDOR METAL PRODUCTS CORPORATION	
Technology Loan Fund	50.00
HOWARD S. TURNER '36	
Faculty Salary Adjustment Fund	650.00
JAMES E. TURNER '33	
Faculty Salary Adjustment Fund	300.00
ARTHUR F. UNDERWOOD '26	
Faculty Salary Adjustment Fund	963.75
WILLIAM UNDERWOOD COMPANY	
Food research	2,500.00
UNION CARBIDE CORPORATION	
Industrial Liaison Program	30,000.00
UNION CARBIDE CHEMICALS COMPANY DIVISION	
Fellowship in chemical engineering	4,400.00
Research in mechanical engineering	1,250.00
UNION CARBIDE METALS COMPANY DIVISION	
Comminution research in metallurgy	4,400.00
Union Carbide Fellowship in metallurgy	3,800.00
VISKING COMPANY DIVISION	
Visking Company Fellowship	3,800.00
UNION CARBIDE EDUCATIONAL FUND	
Undergraduate scholarships	14,500.00
General purposes	4,800.00
UNION OIL COMPANY OF CALIFORNIA	
Industrial Liaison Program	30,000.00
UNION REALTY COMPANY	
Technology Loan Fund	100.00
UNITED AIR LINES FOUNDATION	
Technology Loan Fund	500.00
UNITED AIRCRAFT CORPORATION	
Industrial Liaison Program	20,000.00

UNITED AIRCRAFT CORPORATION — *continued*	
HAMILTON STANDARD DIVISION	
Research in mechanical engineering — Richardson	$10,000.00
Research in mechanical engineering — Shearer	10,000.00
General purposes	500.00
PRATT WHITNEY DIVISION	
General purposes	1,500.00
SIKORSKY DIVISION	
General purposes	500.00
UNITED-CARR FASTENER CORPORATION	
Technology Loan Fund	1,000.00
Industrial Relations Section	250.00
UNITED ENGINEERING TRUSTEES, INC.	
Corrosion research in civil engineering	1,000.00
Research in metallurgy — Adams	1,250.00
Research in metallurgy — Cohen	2,500.00
Comminution research	5,000.00
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	18,205.00
UNITED SHOE MACHINERY CORPORATION	
Industrial Relations Section	2,500.00
UNITED STATES RUBBER COMPANY FOUNDATION	
Fellowship in chemistry	3,300.00
Undergraduate scholarships	4,950.00
UNITED STATES STEEL CORPORATION	
Industrial Liaison Program	25,000.00
Industrial Relations Section	1,000.00
UNITED STATES STEEL FOUNDATION, INC.	
U. S. Steel Foundation Fellowship	7,200.00
UNIVERSAL CYCLOPS FOUNDATION	
Fellowship in metallurgy	5,000.00
THE UPJOHN COMPANY	
Fellowship in biology	3,000.00
CHARLES H. URBAN '91	
Faculty Salary Adjustment Fund	10.00
VANADIUM-ALLOYS STEEL COMPANY	
Fellowship in metallurgy	3,500.00
HAROLD S. VAN BUREN '23	
Faculty Salary Adjustment Fund	300.00
DWIGHT VANDEVATE '22	
Faculty Salary Adjustment Fund	100.00
EMERSON J. VAN PATTEN '24	
Faculty Salary Adjustment Fund	33.00
KARL R. VAN TASSEL '25	
Faculty Salary Adjustment Fund	500.00
VOORHEES, WALKER, SMITH, SMITH AND HAINES	
Fellowship in architecture	2,500.00
RAYMOND H. WALCOTT '15	
Anonymous D Fund	150.00

SCOTT WALKER '40	
Faculty Salary Adjustment Fund	$ 500.00
WALLACE AND TIERNAN. INC. — LUCIDOL DIVISION	
Research in chemistry	6,000.00
GEORGE E. WALLIS '09	
George E. Wallis Fund	5,000.00
J. PRINCE WARNER '26	
Faculty Salary Adjustment Fund	500.00
ESTATE OF HENRY E. WARREN '94	
General purpose endowment	10,000.00
DALE E. WASHBURN '23	
Faculty Salary Adjustment Fund	100.00
ROBERT E. WATERMAN '21	
Faculty Salary Adjustment Fund	365.62
THOMAS J. WATSON, JR.	
Faculty Salary Adjustment Fund	1,017.00
W. H. WATT	
General undergraduate scholarship endowment	5.00
JAMES WEBB	
Faculty Salary Adjustment Fund	500.00
N. CONANT WEBB '22	
General purposes	990.00
LEBURTON D. WEBSTER '33	
Faculty Salary Adjustment Fund	120.00
WILLIAM WEBSTER '23	
Vannevar Bush Room	673.75
Stratton Portrait Fund	673.75
ALBERT H. WECHSLER '21	
Faculty Salary Adjustment Fund	500.00
M.I.T. Boston Stein Club Technion	450.00
ALBERT H. ('21) AND PEARL K. WECHSLER	
M.I.T. Boston Stein Club — New England Scholarship Fund	1,000.00
WEDEMEYER AND HECKER ASSOCIATES	
Faculty Salary Adjustment Fund	100.00
D. REID WEEDON, JR. '41	
Faculty Salary Adjustment Fund	200.00
ROBERT W. WEEKS '13	
Faculty Salary Adjustment Fund	500.00
EUGENE S. WEIL '21	
Faculty Salary Adjustment Fund	100.00
THOMAS E. WEIL '49	
Faculty Salary Adjustment Fund	75.00
S. K. WELLMAN	
Technology Loan Fund	100.00
DAVID Q. WELLS '30	
Faculty Salary Adjustment Fund	100.00
EDWARD H. WELLS, JR. '27	
Faculty Salary Adjustment Fund	160.00

ESTATE OF EVERETT WESTCOTT	
General purposes endowment	$ 1,800.00
ESTATE OF MARION WESTCOTT	
General purposes endowment	633.40
WESTERN ELECTRIC COMPANY	
Undergraduate scholarships	4,200.00
WESTINGHOUSE EDUCATIONAL FOUNDATION	
George Westinghouse Professorship	15,000.00
Nuclear reactor	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
Undergraduate scholarship	1,500.00
ESTATE OF ARCHER E. WHEELER '95	
Archer E. Wheeler Scholarship Endowment	18,000.00
C. H. WHEELER MANUFACTURING COMPANY FOUNDATION	
Faculty Salary Adjustment Fund	1,000.00
OLGA M. WHEELER	
General purposes	4,919.68
JOSHUA C. WHETZEL '17	
Faculty Salary Adjustment Fund	1,000.00
WHIRLPOOL CORPORATION	
Whirlpool Corporation research	3,000.00
Research in mechanical engineering	1,562.50
Industrial Liaison Program	20,000.00
JAMES N. WHITE	
Vannevar Bush Room	100.00
WHITEHALL FOUNDATION, INC.	
Undergraduate scholarship	1,500.00
JAMES L. WICK, JR. '06	
Faculty Salary Adjustment Fund	250.00
WICKWIRE SPENCER STEEL COMPANY	
Faculty Salary Adjustment Fund	50.00
BENJAMIN WILBUR '32	
Vannevar Bush Room	25.00
WILKIE FOUNDATION	
History of Technology	7,000.00
ESTATE OF H. SYLVIA A. H. G. WILKS	
General purposes	53.46
JOHN A. WILLARD '09	
Faculty Salary Adjustment Fund	300.00
FRANK W. WILLEY '08	
Faculty Salary Adjustment Fund	10.00
ESTATE OF ARTHUR WILLIAMS	
Undergraduate scholarships	3,000.00
CHARLES W. WILLIAMS '15	
Anonymous D Fund	50.00

JOHN H. WILLS '26	
M.I.T. Club of Chicago Scholarship Fund	$ 50.00
ALBERT O. WILSON, JR. '38	
Faculty Salary Adjustment Fund	50.00
CARROLL L. WILSON '32	
Vannevar Bush Room	100.00
IRVING W. WILSON '11	
Faculty Salary Adjustment Fund	3,250.00
ROBERT E. WILSON '16	
M.I.T. Club of Chicago Scholarship Fund	25.00
WOODROW WILSON NATIONAL FELLOWSHIP FOUNDATION	
Woodrow Wilson National Fellowships	40,000.00
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 Second Fund	8,841.25
JOHN G. WOLBACH	
President's Special Fund	400.00
WOMEN'S AUXILIARY TO THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS	
Undergraduate scholarship	500.00
V. WOODCOCK	
General undergraduate scholarship endowment	15.00
THE WORCESTER FOUNDATION	
Biophysics programming	2,500.00
ROBERT E. WORDEN '36	
Faculty Salary Adjustment Fund	1,666.68
WORLD UNIVERSITY SERVICE	
Undergraduate scholarship	750.00
THE WORTHINGTON FOUNDATION	
General purposes	1,000.00
MAX I. WOYTHALER '15	
Anonymous D Fund	100.00
ESTATE OF MADELINE WRIGHT	
R. Kendrick Wright ('13) Memorial Fund for general purposes	49,998.08
WYMAN GORDON COMPANY	
Industrial Relations Section	250.00
LOUIS H. ZEPFLER '15	
Anonymous D Fund	30.00
ZISKIND FOUNDATION	
M.I.T. Boston Stein Club Technion	1,850.00
MILES M. ZOLLER '21	
Faculty Salary Adjustment Fund	100.00

GIFTS TO OTHER FUNDS

M.I.T. Alumni Fund	$568,753.41
Olive Barnard Memorial Fund	943.50
Parents' gifts	3,816.08
Proctor Portrait Fund	391.00

Class gifts in addition to those in the Alumni Fund total:

Class of 1908	3,274.41
Class of 1916	1,004.00
Class of 1917	4,616.38
Class of 1919	3,287.50
Class of 1921	3,270.50
Class of 1922	18,465.00
Class of 1933	552.60
Class of 1933 — Reunion	100.00
Class of 1935	1,250.00
Class of 1937	763.23
Class of 1944	974.58
Class of 1947	240.67
Class of 1949	360.37
Class of 1950	684.67
Class of 1952	386.93
Class of 1954	286.71
Class of 1955	328.55
Class of 1956	354.36
Other classes	223.86

SUMMARY OF GIFTS, GRANTS, AND BEQUESTS RECEIVED

	1959	1958	1957	1956	1955	1954	1953	1952	1951	1950
GIFTS FOR ENDOWMENT:										
Real estate	....	....	....	....	$ 275,000	....	....	....	....	....
Funds for general purposes	$ 297,151	$ 660,898	$ 545,710	$ 61,264	111,956	$ 82,558	$ 50,128	$ 7,740	$ 86,586	$1,030,511
Funds for designated purposes	650,121	476,719	1,834,944	2,342,351	499,495	677,230	538,077	340,532	523,599	382,069
GIFTS FOR STUDENT LOANS	27,750	8,647	250	2,200	4,550	9	905	2,973	227,756	10
GIFTS FOR BUILDING FUNDS	56,100	195,236	731,350	1,133,990	1,530,684	274,400	15,004	40,308	3,797,212	1,268,266
OTHER GIFTS:										
Unexpended balances of endowment fund income	2,488	1,287	1,350	6,450	6,340	7,786	5,800	5,425	5,775	2,525
Funds for general purposes — invested	164,618	78,576	180,268	191,826	765,680	391,881	1,403,533	2,850,889	2,206,364	2,066,934
Funds for designated purposes — invested	3,379,507	1,814,320	1,035,440	1,871,291	922,299	293,548	1,108,931	1,537,653	554,665	245,454
Funds for designated purposes — not invested	4,684,761	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
	$ 9,262,496	**$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**
MISCELLANEOUS GIFTS:										
Agency funds	47,345	$ 49,597	$ 52,390	$ 30,539	$ 137,598	$ 26,171	$ 38,728	$ 45,711	$ 38,751	$ 18,247
Annuity funds	696,000	35,287	60,739	74,169	55,688	6,625	24,500	28,000	47,000	50,310
	743,345	$ 84,884	$ 113,129	$ 104,708	$ 193,286	$ 32,796	$ 63,228	$ 73,711	$ 85,751	$ 68,557
Total	**$10,005,841**	**$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**

GENERAL INVESTMENTS
Schedule A-1

Par Value		Book Value	Net Income
	U. S. GOVERNMENT BONDS		
	Treasury Bills		
$1,000,000	3.16%, 8-6-59	$ 984,463.33	....
1,000,000	3.45%, 1-15-60	972,535.70	....
	Treasury Notes		
1,000,000	4%, Series B, 8-15-62	1,000,000.00	$ 40,000.00
2,500,000	4%, Series B, 5-15-63	2,492,968.75	(5,372.92)
	Treasury Bonds		
25,000	2⅛%, 11-15-60	25,000.00	531.25
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	30,081.52
1,000,000	2⅝%, 2-15-65	1,000,000.00	17,548.30
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	40,000.00
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	....	24,495.14
	Total U. S. Gov't bonds	**$17,668,127.25**	**$ 382,243.39**
	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	8,856.00
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	9,343.13
200,000	Interprovincial Pipe Line 1st C, 4%, 4-1-73	200,000.00	8,000.00
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	9,680.00

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	$ 23,244.79
500,000	Canadian Acceptance Corp., Ltd., 5¾%, 6-1-79......	521,181.65	....
500,000	G.M.A.C. of Canada Deb., 4¾%, 12-15-69........	500,000.00	24,655.46
	Income from bonds sold....	....	3,503.11
	Total Canadian bonds.....	**$ 2,705,191.36**	**$ 108,292.49**
	INDUSTRIAL BONDS		
$ 500,000	Aluminum Co. of America Deb., 3⅞%, 4-1-83......	$ 498,000.00	$ 19,375.00
300,000	Armco Steel Corporation Deb., 4.35%, 4-1-84.....	300,000.00	(250.74)
112,000	Atlantic Refining Co. Sub. Conv. Deb., 4½%, 8-15-87	112,000.00	5,040.00
300,000	Caterpillar Tractor Co. Deb., 4½%, 11-1-77....	298,500.00	13,500.00
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
500,000	Douglas Aircraft Company Deb., 5%, 4-1-78.......	500,000.00	25,000.00
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 Corporation 1st Mtg., 4¼%, 4-1-81..........	300,000.00	12,750.00
300,000	Kaiser Steel Corporation 1st Mtg., 4¾%, 5-1-76.....	300,000.00	14,250.00
300,000	LaGloria Oil & Gas Co. Deb., 5½%, 5-1-74.....	290,999.00	16,500.00
300,000	Minneapolis-Honeywell Reg. Co. Deb., 3¾%, 8-1-76..	298,500.00	11,250.00
209,000	Phillips Petroleum Co. Conv. Sub. Deb., 4¼%, 2-15-87	209,098.70	8,840.00
600,000	Pittston Company Sub. Deb., 6¼%, 10-1-76.........	600,000.00	37,500.00

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	$ 18,375.00
600,000	Sears, Roebuck and Company Deb., 4¾%, 8-1-83	600,000.00	10,472.73
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	11,000.00
300,000	Standard Oil Company (Indiana) Deb., 4½%, 10-1-83	297,000.00	6,718.71
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
68,000	United States Steel Corp. Deb., 2.40–2.65%, 8-1-64/59	68,000.00	1,714.50
300,000	United States Steel Corp. Deb., 4%, 7-15-83	300,000.00	4,210.00
	Income from bonds sold, called, or matured	....	2,405.00
	Total industrial bonds	**$ 6,789,097.70**	**$ 272,870.20**
	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	11,875.00
200,000	Niagara Mohawk Power Corp., 3⅝%, 5-1-86	200,000.00	7,250.00

GENERAL INVESTMENTS *Schedule A-1 — continued*

Par Value		Book Value	Net Income
	PUBLIC UTILITY BONDS — *continued*		
$ 200,000	Pacific Tel. & Tel. Company Deb., 5⅛%, 8-1-80	$ 200,000.00	$ 10,250.00
300,000	So. California Edison Co. 1st G, 3⅝%, 4-15-81	297,318.00	10,875.00
250,000	Southwestern Bell Telephone Co. Deb., 4¾%, 10-1-92	275,000.00	11,875.00
200,000	Wisconsin Electric Power Co. 1st, 3⅞%, 4-15-86	200,000.00	7,750.00
	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
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 from bonds sold	....	6,513.89
	Total public utility bonds	**$ 5,728,680.41**	**$ 235,270.14**
	COMMON CARRIER BONDS		
$ 878,000	Blackships, Inc. Series A thru G, 5%, 4-1-75/73	$ 878,000.00	$ 43,900.00
382,000	Blackships, Inc. Mtg. Bond Reg., 5%, 10-1-85	382,000.00	3,839.10
637,000	Delrovia Corporation, 4¾%, 11-1-79	637,000.00	12,084.36
521,000	Great Lakes Pipe Line Co. Deb., 4%, 2-1-74	521,000.00	20,840.00
400,000	Great Lakes Pipe Line Co. Deb., 5%, 6-1-79	400,000.00	....

GENERAL INVESTMENTS *Schedule A-1* — *continued*

Par Value		*Book Value*	*Net Income*
	COMMON CARRIER BONDS — *continued*		
$ 500,000	Great Lakes Pipe Line Co. Deb., 4¾%, 4-1-82	$ 500,000.00	$ 23,750.00
400,000	Shell Pipe Line Corp. Note, 3.30%, 12-15-67/59	392,438.06	13,200.00
158,000	Southern Pacific Company, 4½%, 5-1-81	156,081.75	7,110.00
	Income from bonds called, sold, or matured	....	5,013.34
	Total common carrier bonds	**$3,866,519.81**	**$ 129,736.80**
	FINANCIAL BONDS		
$1,850,000	Associates Investment Co. Note, 3%, 12-1-64	$ 1,850,000.00	$ 55,500.00
500,000	Associates Investment Co. Note, 4¾%, 1-15-67	500,000.00	23,750.00
433,000	Associates Investment Co. Sub.NoteB,4¾%,10-1-68	433,000.00	20,567.50
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	4,750.00
500,000	G.M.A.C. Deb., 3%, 4-1-60	500,000.00	15,000.00
1,002,000	G.M.A.C. Deb., 3⅞%, 9-15-61	1,002,000.00	38,827.50
2,000,000	G.M.A.C. Deb., 4⅜%, 5-15-62	2,000,000.00	41,710.31
1,145,000	G.M.A.C. Deb., 2¾%, 7-15-64	1,133,609.91	31,487.50
235,000	G.M.A.C.Deb.,3%,7-15-69	235,000.00	7,050.00
500,000	G.M.A.C. Jr. Sub. Note, 3¾%, 4-1-73	500,000.00	18,750.00
800,000	G.M.A.C. Deb., 3⅝%, 9-1-75	776,500.00	24,347.92
500,000	G.M.A.C. Sub. Note, 5⅛%, 11-1-84	500,000.00	9,467.01
500,000	Int'l Bank for Recon. and Dev., 3¾%, 5-15-68	500,000.00	18,750.00
500,000	Int'l Bank for Recon. and Dev., 4½%, 12-1-73	500,000.00	11,125.00

GENERAL INVESTMENTS *Schedule A-1 — continued*

Par Value		Book Value	Net Income
	FINANCIAL BONDS — *continued*		
$300,000	Int'l Bank for Recon. and Dev., 3%, 3-1-76	$ 300,000.00	$ 9,000.00
300,000	Int'l Bank for Recon. and Dev., 4¾%, 11-1-80	300,000.00	14,250.00
	Income from bonds sold, called, or matured	....	75,028.02
	Total financial bonds	**$12,629,109.91**	**$ 466,860.76**
	Small holdings	**$ 2,100.00**	**$ 2.50**
Shares			
	PREFERRED STOCKS		
1,000	Anderson-Prichard Oil Corp. 4¼% Cum. Conv.	$ 51,657.52	$ 2,125.00
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
1,800	Tropical Gas Company, Inc., $6.25	180,000.00	10,512.00
1,015	Tropical Gas Company, Inc. 6% Conv. Pfd.	101,500.00	3,572.80
	Small holdings	4,860.00	155.00
	Income from preferred stocks sold	....	15,250.00
	Total preferred stocks	**$ 507,737.52**	**$ 40,285.48**
	INDUSTRIAL COMMON STOCKS		
	Automobile		
5,560	Ford Motor Company	$ 358,718.60	$ 9,984.00
156,414	General Motors Corporation	2,660,486.59	312,477.00
	Building Supplies		
15,758	Johns-Manville Corporation	328,032.61	31,441.00
12,877	National Lead Company	120,781.76	41,800.25
7,350	Pittsburgh Plate Glass Co.	138,604.46	16,170.00
	Chemical and Drugs		
4,434	Allied Chemical & Dye Corporation	181,087.03	13,302.00
360	Christiana Securities Co.	1,825,474.35	162,000.00
562	Diamond Alkali Company	21,784.75	1,011.60

GENERAL INVESTMENTS *Schedule A-1 — continued*

Shares		Book Value	Net Income
	INDUSTRIAL COMMON STOCKS — *continued*		
4,560	Dow Chemical Company...	$ 84,106.09	$ 5,472.00
3,042	E. I. du Pont de Nemours & Company.............	481,930.27	17,754.00
21,035	Hercules Powder Company.	346,311.82	25,242.00
19,605	Merck & Company, Inc....	144,608.40	29,332.75
14,924	Monsanto Chemical Co....	170,889.62	14,127.50
14,507	Union Carbide Corporation	343,108.17	52,077.60
500	Victor Chemical Works....	14,531.25	600.00
	Containers		
15,060	American Can Company...	418,577.13	30,120.00
10,086	Owens-Illinois Glass Co....	292,701.89	25,215.00
	Electrical Equipment		
31,656	General Electric Company.	485,754.17	63,175.00
6,440	General Radio Co., Conv...	74,830.00	....
7,030	McGraw-Edison Company.	75,687.64	9,842.00
625	Sprague Electric Company.	34,487.50	750.00
8,053	Westinghouse Electric Corp.	225,462.65	16,106.00
	Food and Beverages		
5,000	United Fruit Company....	87,570.20	12,500.00
	Machinery		
8,655	Caterpillar Tractor Co.....	92,383.18	20,769.60
6,167	Draper Corporation.......	100,327.98	6,167.00
	Non-Ferrous Metal		
432	Anaconda Company......	6,680.00	864.00
4,000	International Nickel Co. of Canada...............	134,488.60	10,400.00
4,136	Kennecott Copper Corp....	265,632.42	20,680.00
	Office Equipment		
8,097	International Business Machines Corporation......	511,278.69	13,606.55
13,040	National Cash Register Co..	231,199.23	15,648.00
	Oil		
21,750	Commonwealth Oil Refining Company, Inc.......	4,500.00	....
726	Continental Oil Company..	25,828.60	1,161.60
10,169	Gulf Oil Corporation......	250,449.63	24,682.52
11,020	Ohio Oil Company.......	223,301.25	17,572.00
21,614	Phillips Petroleum Co......	484,185.32	36,692.80
22,485	Socony Mobil Oil Co., Inc.	397,201.56	44,940.00
25,230	Standard Oil Co. of Calif...	353,570.15	50,460.00
14,635	Standard Oil Co. (Indiana).	304,798.70	24,656.31

GENERAL INVESTMENTS *Schedule A-1 — continued*

Shares		*Book Value*	*Net Income*
	INDUSTRIAL COMMON STOCKS — *continued*		
107,949	Standard Oil Co. (N. J.). .	$ 1,214,592.61	$ 242,469.60
12,063	Texaco, Inc.	271,801.57	30,342.15
27,954	Tropical Gas Company, Inc.	6,491.20	. . . .
	Paper		
13,381	International Paper Co.. . . .	208,541.95	39,659.02
	Retail Trade		
5,158	J. C. Penney Company. . . .	168,807.01	21,896.75
23,591	Sears, Roebuck & Company	227,357.29	28,201.30
	Rubber		
300	B. F. Goodrich Company. .	14,325.00	660.00
1,391	Goodyear Tire & Rubber Company.	139,492.85	2,248.80
	Soap		
15,344	Procter & Gamble Co.	277,483.30	32,138.40
	Steel		
505	Bethlehem Steel Corp..	26,235.31	486.00
18,000	Inland Steel Company.	198,474.49	28,200.00
6,650	National Steel Corporation.	153,556.84	19,837.50
	Miscellaneous		
66,988	Eastman Kodak Company.	391,603.91	98,467.96
3,150	General Dynamics Corp. . . .	53,551.11	6,300.00
838	Halliburton Oil Well Cementing Company.	50,491.13	1,821.00
975	Minneapolis-Honeywell Regulator Company.	69,117.31	1,611.25
10,608	Minnesota Mining & Manufacturing Company.	151,558.00	13,790.40
750	Simplex Wire & Cable Co. .	20,250.00	375.00
500	Technology Instrument Corporation	10,500.00	. . . .
7,012	Texas Instruments, Inc.	650,942.57	. . . .
	Income from stocks sold	. . . .	16,459.25
	Total industrial stocks.	**$16,606,525.71**	**$1,763,764.46**
	PUBLIC UTILITY COMMON STOCKS		
	Electric and Other		
28,816	American Electric Power Co.	$ 358,540.75	$ 47,834.56
4,338	American Tel. & Tel. Co. . .	183,899.39	12,827.25
7,140	Commonwealth Edison Co.	172,198.06	14,140.00
9,050	Florida Power & Light Co.	163,826.10	7,401.25

GENERAL INVESTMENTS *Schedule A-1 — continued*

Shares		Book Value	Net Income
	PUBLIC UTILITY COMMON STOCKS — *continued*		
7,350	General Public Utilities Corporation	$ 216,624.04	$ 14,899.59
5,000	Idaho Power Company	206,861.93	8,125.00
10,080	Illinois Power Company	202,166.83	15,120.00
3,700	Kansas Gas & Electric Co.	128,562.50	4,272.00
10,600	Middle South Utilities, Inc.	293,301.33	19,345.00
5,000	Montana Power Company	169,075.59	10,000.00
7,500	Northern Indiana Public Service Company	309,665.00	14,250.00
5,623	Ohio Edison Company	274,503.56	14,844.72
4,000	Southern Calif. Edison Co.	138,089.14	10,000.00
10,000	Southern Company	272,350.72	9,308.75
6,000	Utah Power & Light Co.	145,750.00	7,200.00
41,438	Virginia Elec. & Power Co.	529,339.36	42,424.89
	Gas and Gas Transmission		
5,013	Northern Illinois Gas Co.	98,196.84	4,556.11
7,220	Tennessee Gas Trans. Co.	200,000.00	2,527.00
4,100	Texas Eastern Trans. Corp.	1.00	5,740.00
6,754	Texas Gas Trans. Corp.	102,685.56	7,363.40
19,025	Transcontinental Gas Pipe Line Corporation	336,809.67	16,525.00
	Income on stock sold	....	6,192.75
	Total public utility stocks	**$ 4,502,447.37**	**$ 294,897.27**
	RAILROAD COMMON STOCKS		
21,630	Atchison, Topeka & Santa Fe Railway	$ 211,196.11	$ 31,363.50
2,062	Great Northern Railway Co.	51,195.56	6,186.00
	Total railroad stocks	**$ 262,391.67**	**$ 37,549.50**
	BANK COMMON STOCKS		
4,200	Bankers Trust Co., N. Y.	$ 226,824.05	$ 11,370.00
4,109	Continental Illinois Nat'l Bk. & Trust Co., Chicago	179,986.40	16,436.00
5,819	First Nat'l Bank of Boston	330,301.66	18,311.70
7,194	First Nat'l City Bank of N.Y.	295,092.35	21,582.00
7,622	Hanover Bank, New York	233,813.88	15,244.00
7,297	Morgan-Guaranty Trust Company, New York	344,901.11	29,180.00
	Total bank stocks	**$ 1,610,919.45**	**$ 112,123.70**

GENERAL INVESTMENTS *Schedule A-1 — continued*

Shares		*Book Value*	*Net Income*
	INSURANCE COMMON STOCKS		
8,334	Boston Insurance Company	$ 197,914.51	$ 15,001.20
4,469	Continental Insurance Co. of New York	78,485.55	8,938.00
8,676	Fireman's Fund of Calif.	210,583.69	15,616.80
3,828	Hartford Fire Ins. Company	143,838.44	11,484.00
9,317	Ins. Co. of North America	171,288.05	25,621.76
	Total insurance stocks	**$ 802,110.24**	**$ 76,661.76**
	OTHER COMMON STOCKS		
40,971	Century Shares Trust	$ 192,447.89	$ 6,901.89
86,284	Colonial Fund, Inc.	458,019.14	22,938.90
1,000	National Research Corp.	30,000.00	....
806	Photon, Inc.	12,976.28	....
812	Rockwell Mfg. Company	10,026.23	1,204.10
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	41,943.64	2,111.83
	Income from stocks sold	....	11,999.00
	Total other common stocks	**$ 800,826.03**	**$ 49,303.24**
	MORTGAGE NOTES		
	Dover	$ 28,425.67	$ 1,160.12
	Goldfinch Street, San Diego, California	6,195.23	380.66
	Collincote Street, Stoneham	500.00	20.00
	Maude Terrace, Watertown	942.03	46.40
	Summer Street, Watertown	3,021.59	158.58
	Beta Theta Pi	9,000.00	487.50
	Delta Kappa Epsilon	4,500.00	168.75
	Kappa Sigma	6,000.00	300.00
	Lambda Chi Alpha	1,090.50	73.59
	Phi Kappa	14,075.00	762.62
	450 Beacon Street, Inc.	5,000.00	275.00
	Sigma Chi	3,500.00	175.00
	Tau Epsilon Phi	26,300.00	1,395.94
	Total mortgage notes	**$ 108,550.02**	**$ 5,404.16**
	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

GENERAL INVESTMENTS *Schedule A-1 — continued*

	Book Value	Net Income
REAL ESTATE DEVOTED TO INSTITUTE USE — *continued*		
Baker House	$ 2,064,180.53	$ 61,926.00
Burton House	1,453,380.37	43,602.09
Burton House (mortgage)	289,477.64	11,844.65
Westgate veterans' housing	....	13,784.78
Total dormitories and housing	**$4,480,990.48**	**$ 151,377.43**
Research		
565 Memorial Drive, Camb.	$ 200,560.50	$ 11,030.83
209 Mass. Ave., Cambridge	100,000.00	5,500.00
Wood Street, Lexington	57,161.49	3,669.27
68-92 Albany Street, Camb.	100,000.00	5,500.00
Computation Center	320,000.00	14,400.00
Total for research	**$ 777,721.99**	**$ 40,100.10**
OTHER REAL ESTATE		
10 Albany St., Cambridge	$ 468,298.17	$ 14,778.38
180–194 Main St., Camb.	182,737.11	3,843.98
36–44 Memorial Dr., Camb.	784,016.35	37,191.72
80 Memorial Drive, Camb.	809,682.51	40,473.89
100 Memorial Drive, Camb.	153,510.85	6,399.96
333 Memorial Drive, Camb.	40,000.00	....
500 Memorial Drive, Camb.	18,366.20	1,051.36
540–550 Memorial Drive, Cambridge	351,524.51	14,050.66
628 Memorial Drive, Cambridge (land)	9,211.94	....
640 Memorial Drive, Camb.	1,160,482.88	(19,595.43)
76–94 Mass. Ave., Camb.	403,678.74	5,202.37
Bexley Hall, Cambridge	110,280.61	7,435.30
Gloversville, New York	213,667.98	10,727.47
New London, Connecticut	191,240.51	9,252.14
Plattsburg, New York	117,901.80	5,531.83
Taunton, Massachusetts	156,373.52	7,166.43
Waltham, Massachusetts	619,601.88	31,081.86
Willimantic, Connecticut	129,157.51	5,913.01
Worcester, Massachusetts	268,989.27	13,239.96
Canadian Petrofina, Ltd., leases	219,239.69	9,058.86
Royalite Oil Co., Ltd., leases	208,853.76	8,683.60
Total other real estate	**$6,616,815.79**	**$ 211,487.35**

GENERAL INVESTMENTS *Schedule A-1 — continued*

Par Value		*Book Value*	*Net Income*
	COMMERCIAL PAPER		
$ 500,000	Continental Can Company, 3¼%, 8-20-59..........	$ 492,642.36	....
500,000	Dow Chemical Company, 3½%, 9-24-59..........	492,513.89	....
500,000	Dow Chemical Company, 3⅝%, 10-29-59.........	492,246.52	....
500,000	Philip Morris, Inc., 3¼%, 7-30-59................	491,152.78	....
500,000	Sperry Rand Corp., 3⅜%, 7-16-59................	494,468.75	....
	Income from maturities....	....	$ 85,885.43
	Total commercial paper....	**$ 2,463,024.30**	**$ 85,885.43**
	Total general investments..	**$88,928,887.01** (Schedule A)	**$4,464,116.16**

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 Com..	**$ 76,200.00**	....
	BABSON FUND		
	U. S. Government Bonds		
$ 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 $4.20 2nd Conv..	1,284.62	20.00
	Common Stocks		
30	E. I. du Pont de Nemours & Co.	3,565.36	180.00
100	Standard Oil Company (Indiana)	3,258.36	170.00
	Income from bonds called	....	22.50
	Total of the Babson Fund	**$ 22,049.01**	**$ 1,021.25**
	GORDON Y. BILLARD FUND		
	Common Stocks		
30	Eastern Airlines, Inc.	$ 1,146.04	$ 15.00
50	Standard Oil Co. of California	3,107.38	50.00
50	Standard Oil Company (N. J.)	2,950.34	55.00
	Total of the Billard Fund	**$ 7,203.76**	**$ 120.00**
	DENNISON K. BULLENS FUND		
	Bonds		
$ 100	Neapco Products, Inc. 1st K, 4%, 9-1-60	$ 100.00	$ 4.00
700	Neapco Products, Inc. 1st L, 4%, 9-1-61	700.00	28.00
1,700	Neapco Products, Inc. 1st M, 4%, 9-1-62	1,700.00	68.00
1,700	Neapco Products, Inc. 1st N, 4%, 9-1-63	1,700.00	68.00

FUNDS SEPARATELY INVESTED *Schedule A-2 — continued*

Par Value or Shares		Book Value	Net Income
	DENNISON K. BULLENS FUND — *continued*		
$ 1,700	Neapco Products, Inc. 1st O, 4%, 9-1-64	$ 1,700.00	$ 68.00
1,700	Neapco Products, Inc. 1st P, 4%, 9-1-65	1,700.00	4.00
1,700	Neapco Products, Inc. 1st Q, 4%, 9-1-66	1,700.00	....
1,700	Neapco Products, Inc. 1st R, 4%, 9-1-67	1,700.00	....
	Total of the Bullens Fund	**$ 11,000.00**	**$ 240.00**
	CLASS OF 1908 — OSBORNE FUND		
	Paid up life insurance policy	**$ 10,702.38**	....
	CLASS OF 1908 — TOWLE FUND		
	Paid up life insurance policy	**$ 3,164.06**	....
	EBEN S. DRAPER FUND		
	U. S. Government Bonds		
$ 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	1,483.61
5,000	Northern Pacific Ry., 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		
2,496	Colonial Fund, Inc.	23,687.04	723.84
100	E. I. du Pont de Nemours & Co.	4,731.05	600.00
186	Standard Oil Company (N. J.)	2,274.78	418.50
240	Tennessee Gas Transmission Co.	6,162.50	336.00
	Income from bonds matured	....	480.00
	Total of the Draper Fund	**$ 107,453.68**	**$ 5,241.95**
	FRANCIS V. DU PONT FUND		
	Municipal Bonds		
$ 15,000	Alexandria, La., Util. Rev., 3.10%, 5-1-77	$ 13,466.45	$ 144.67
3,000	Boynton Beach, Fla. Water Rev., 4%, 6-1-61	3,010.96	44.59
2,000	Boynton Beach, Fla., Water Rev., 4%, 6-1-62	2,006.26	30.52

FUNDS SEPARATELY INVESTED *Schedule A-2 — continued*

Par Value or Shares		Book Value	Net Income
	FRANCIS V. DU PONT FUND — *continued*		
$ 3,000	Boynton Beach, Fla., Water Rev., 4%, 6-1-63	$ 3,002.04	$ 47.07
2,000	Boynton Beach, Fla., Water Rev., 4%, 6-1-64	1,997.15	31.56
10,000	Chattanooga, Tenn., A Sewer Rev., 3.20%, 1-1-76	9,053.35	....
10,000	Cocoa, Fla., Water Rev., 4%, 7-1-63	10,328.50	....
10,000	East Bay, Calif., Mun. Util. Dist., 3.40%, 3-1-83	9,918.83	....
10,000	Elizabeth, N. C., Public Imp., 3¼%, 4-1-60	10,044.00	52.03
15,000	Gainesville, Fla., Water and Elec. Rev., 3¼%, 1-1-75	13,953.95	....
10,000	Los Angeles, Calif., Water and Power Rev., 3.60%, 1-1-84	10,000.00	....
10,000	Phoenix, Ariz., Water Rev., 3.60%, 7-1-80	10,000.00	....
10,000	Salt River Proj., Ariz., Ag. Imp. and Power Dist., 3.60% 1-1-81	10,074.93	....
	Total of the du Pont Fund	**$ 106,856.42**	**$ 350.44**
	EARTH SCIENCES FUND		
	Bonds		
$ 649,000	U. S. Treasury Bills, 3.95%, 4-15-60	$ 624,931.11	....
	Common Stock		
5,000	Texas Instruments, Inc.	430,312.50	....
	Total of the Earth Sciences Fund	**$1,055,243.61**	....
	FRED P. & MARY C. EMERY FUND		
	Income from real estate	....	**$ 950.90**
	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

FUNDS SEPARATELY INVESTED *Schedule A-2 — continued*

Par Value or Shares		*Book Value*	*Net Income*
	JOSEPH HEWETT FUND — *continued*		
	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	2,472.66
10,000	Northern Pacific Ry., 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
	Industrial Common Stocks		
440	American Can Company	8,570.00	880.00
200	E. I. du Pont de Nemours & Co.	8,271.55	1,200.00
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	674.63
1,427	Standard Oil Company (N. J.)	12,786.94	3,208.45
300	Union Carbide Corporation	6,944.20	1,080.00
	Public Utility Common Stocks		
300	Central Louisiana Electric Co.	11,625.00	525.00
1,100	Transcontinental Gas Pipe Line Corporation	18,975.00	1,100.00
	Bank Common Stocks		
120	Bankers Trust Co., New York	4,775.00	360.00
132	Morgan-Guaranty Trust Company, New York	5,078.70	528.00
	Insurance Common Stock		
230	St. Paul Fire & Marine Insurance Company	4,812.50	276.00
	Total of the Hewett Fund	**$ 223,890.01**	**$ 17,164.49**
	INCOME FUND "A"		
	U. S. Government Bonds		
$ 100,000	Treasury Notes A, 4%, 8-1-61/59	$ 100,218.75	....
100,000	Treasury Notes D, 4%, 2-15-62	99,937.50	....
50,000	Treasury Bonds, 2¼%, 6-15-62/59	47,343.75	$ 139.08
50,000	Treasury Bonds, 2⅝%, 2-15-65	45,750.00	....

FUNDS SEPARATELY INVESTED *Schedule A-2 — continued*

Par Value or Shares		*Book Value*	*Net Income*
	INCOME FUND "A" — *continued*		
	Other Bonds		
$ 50,000	Associates Investment Company Note Reg., 3%, 12-1-64.....	$ 46,000.00	$ 125.00
50,000	G.M.A.C. Deb., 2¾%, 7-15-64	45,000.00	....
50,000	Shell Pipe Line Corporation, 3.3%, 12-15-63............	46,937.50	201.66
	Common Stocks		
200	Gulf Oil Corporation.........	22,862.50	125.00
1,000	Northern Illinois Gas Company	28,750.00	....
500	Southern Company...........	18,375.00	....
500	Standard Oil Company (N. J.). .	26,468.75	275.00
	Total of Income Fund "A". ...	**$ 527,643.75**	**$ 865.74**
	INDUSTRIAL MANAGEMENT RESEARCH FUND		
	U. S. Government Bonds		
50,000	Treasury Notes B, 4%, 5-15-63. .	$ 49,328.13	$ (493.09)
	Other Bonds		
200,000	G.M.A.C. Deb., 3%, 4-1-60....	197,000.00	6,000.00
450,000	G.M.A.C. Deb., 4⅜%, 5-15-62	450,375.00	4,498.64
150,000	G.M.A.C. Deb., 2¾%, 7-15-64	145,875.00	4,125.00
200,000	G.M.A.C. Deb., 4%, 3-1-79....	197,000.00	8,000.00
	Common Stocks		
40,000	General Motors Corporation...	682,539.69	80,000.00
	Income from bonds called.....	....	9,458.33
	Total of Industrial Management Research Fund.............	**$1,722,117.82**	**$111,588.88**
	GUSTAV R. LINDBERG FUND		
500	General Drafting Co., 6% Pfd. A.	**$ 50,000.00**	**$ 3,300.00**
	MUSEUM OF SCIENCE COOPERATIVE FUND		
500	Textron, Inc................	**$ 12,281.30**	**$ 500.00**
	RICHARD LEE RUSSEL FUND		
	Mortgage		
	111 Bay State Road, Boston....	$ 1,000.00	$ 81.26
	229 Commonwealth Ave., Boston	1,000.00	12.51

FUNDS SEPARATELY INVESTED *Schedule A-2 — continued*

Par Value or Shares		*Book Value*	*Net Income*
	RICHARD LEE RUSSEL FUND — *continued*		
	Common Stocks		
20	General Electric Company.....	$ 930.00	$ 40.00
53	General Public Utilities Corp...	1,848.25	107.68
40	Standard Oil Company (N. J.).	1,626.13	90.00
	Total of the Russel Fund......	**$ 6,404.38**	**$ 331.45**
	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	60.00
5,000	Godfrey L. Cabot, Inc.........	647,700.00	40,000.00
80	El Paso Natural Gas Company. .	2,570.00	104.00
1,950	General Electric Company.....	32,468.22	3,900.00
21	Gulf Oil Corporation.........	2,355.36	51.24
324	Mission Corporation..........	6,291.00	405.00
	Total of the Solar Energy Fund.	**$ 719,232.71**	**$ 45,051.49**
	TECHNOLOGY LOAN FUND		
	U. S. Government Bonds		
$ 50,000	Treasury Notes B, 4%, 5-15-63. .	$ 49,328.13	$ (493.09)
46,000	Treasury Bonds, 2¼%, 6-15-62/59	46,000.00	1,035.00
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 Telephone & Telegraph Co. Deb., 2¾%, 8-1-80.....	35,000.00	962.50
15,000	Pacific Gas & Electric Company, 3%, 6-1-74................	15,000.00	450.00
	Industrial Common Stocks		
1,980	American Can Company......	40,814.83	3,960.00
2,000	Burroughs Corporation........	38,174.69	2,000.00
400	E. I. du Pont de Nemours & Co.	14,652.00	2,400.00
3,000	General Electric Company.....	25,813.25	6,000.00
1,479	Gulf Oil Corporation.........	28,929.67	3,616.26
2,192	National Cash Register Company	19,168.26	2,630.40
1,050	Pittsburgh Plate Glass Company	53,780.85	2,310.00
1,500	Procter & Gamble Company. . .	29,511.45	3,150.00
1,375	Socony-Mobil Oil Company. . .	49,843.96	2,750.00
3,358	Standard Oil Company (N. J.).	21,117.29	7,555.50
1,200	Union Carbide Corporation....	27,726.00	4,320.00

FUNDS SEPARATELY INVESTED *Schedule A-2 — continued*

Par Value or Shares		*Book Value*	*Net Income*
	TECHNOLOGY LOAN FUND — *continued*		
	Bank Common Stocks		
1,302	First Nat'l City Bank of New York	$ 46,023.19	$ 3,906.00
1,062	Morgan-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
	Income from securities matured or sold	....	9,184.72
	Total of Technology Loan Fund	**$ 786,096.47**	**$ 66,370.29**
	JAMES E. TURNER FUND		
$ 2,500	Meadville Community Hotel, 4%, Due 7-1-86	**$ 2,500.00**	....
	WAYNE FUND		
23	International Paper Company	**$ 2,114.97**	**$ 67.83**
	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		
$ 45,000	Treasury Notes B, 4%, 5-15-63	$ 44,395.31	$ (443.78)
50,000	Treasury Bonds, 2⅝%, 2-15-65	50,000.00	877.42
50,000	Savings Bonds, 2.76%, 7-1-66	50,000.00	1,380.00
	Other Bonds		
40,000	American Telephone & Telegraph Co. Deb., 3¼%, 9-15-84	40,500.00	1,200.00
40,000	G.M.A.C. of Canada, 4¾%, 12-15-69	40,000.00	1,778.14
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	2,400.00
1,500	General Electric Company	13,188.05	3,000.00
1,200	Inland Steel Company	16,120.12	1,880.00
988	International Paper Company	15,003.73	2,948.52
500	Socony Mobil Oil Company	24,082.11	1,000.00
1,600	Southern Company	50,516.37	2,000.00
1,997	Standard Oil Company (N. J.)	15,174.41	4,493.25
	Public Utility Common Stocks		
1,200	Idaho Power Company	49,071.00	1,950.00
1,200	Northern Indiana Public Service Company	52,200.00	2,400.00

FUNDS SEPARATELY INVESTED *Schedule A-2 — continued*

Par Value or Shares		*Book Value*	*Net Income*
	JONATHAN WHITNEY FUND — *continued*		
	Bank and Insurance Common Stocks		
748	Boston Insurance Company....	$ 19,145.78	$ 1,346.40
468	First Nat'l. City Bank of New York	20,567.75	1,404.00
396	Morgan-Guaranty Trust Company, New York............	18,087.30	1,584.00
	Other Common Stocks		
5,300	Colonial Fund, Inc.............	57,293.00	....
	Income from securities matured and sold..................	....	5,070.34
	Total of the Whitney Fund....	**$ 630,624.03**	**$ 37,468.29**
	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	American Telephone & Tleegraph Co. Deb., 2¾%, 2-1-71.....	4,949.55	137.50
5,000	G.M.A.C. of Canada, 4¾%, 12-15-69.................	5,000.00	247.27
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
	Industrial Common Stocks		
200	American Home Products Corp.	5,468.00	760.00
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
300	Parke, Davis & Company......	4,412.50	340.00
110	Shell Oil Company...........	5,928.54	220.00
138	Socony-Mobil Oil Company, Inc.	6,761.18	276.00
752	Sperry Rand Corporation.....	3,930.88	601.60
310	Standard Oil Company (N. J.).	3,124.08	697.50
100	Union Carbide Corporation....	2,713.10	360.00
	Public Utility Common Stocks		
155	American Electric Power Co....	5,501.66	257.30
153	Commonwealth Edison Company	4,388.57	303.00
225	General Public Utilities Corp.. .	7,821.50	458.92
269	Middle South Utilities Company	3,241.58	490.93
100	Niagara Mohawk Power Corp..	2,850.00	180.00

FUNDS SEPARATELY INVESTED *Schedule A-2 — continued*

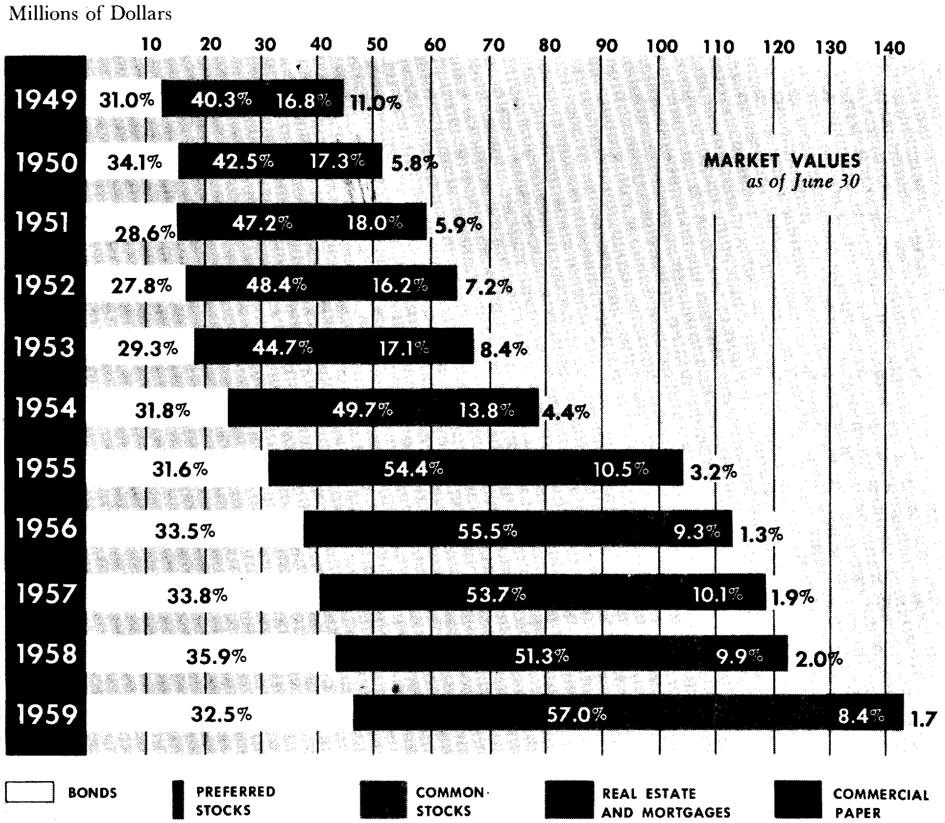
Par Value or Shares		*Book Value*	*Net Income*
	GEORGE S. WITMER FUND — *continued*		
200	Pacific Gas & Electric Company	$ 7,648.00	$ 494.00
100	Pacific Lighting Corporation...	3,262.50	240.00
300	United Gas Corporation.......	2,125.01	450.00
	Railroad Common Stocks		
675	Denver & Rio Grande Western Railroad..................	4,500.00	590.64
	Bank Common Stocks		
65	Bankers Trust Company, N. Y..	3,071.50	195.00
132	Morgan-Guaranty Trust Company, New York............	5,920.20	528.00
105	Irving Trust Company, N. Y....	3,213.40	164.02
	Insurance Common Stocks		
138	St. Paul Fire & Marine Insurance Company............	2,887.50	165.60
	Other Common Stocks		
100	C.I.T. Financial Corporation...	3,300.00	240.00
	Mortgage		
	539 South Atlantic Ave., Ormond Beach, Florida.............	15,505.25	802.37
	Total of the Witmer Fund.....	**$ 150,842.27**	**$ 11,237.15**
	GEORGE S. WITMER 2ND FUND		
	Bonds		
$ 3,000	W. R. Grace & Co. Conv. Deb., 3½%, 5-15-75.............	$ 3,153.75	....
5,000	Montana Dakota Utilities Co., 4⅞%, 6-1-78.............	5,687.50	$ 243.75
	Total of the Witmer 2nd Fund	**$ 8,841.25**	**$ 243.75**
	Total of funds separately invested	**$6,287,461.88** (Schedule A)	**$303,363.90**

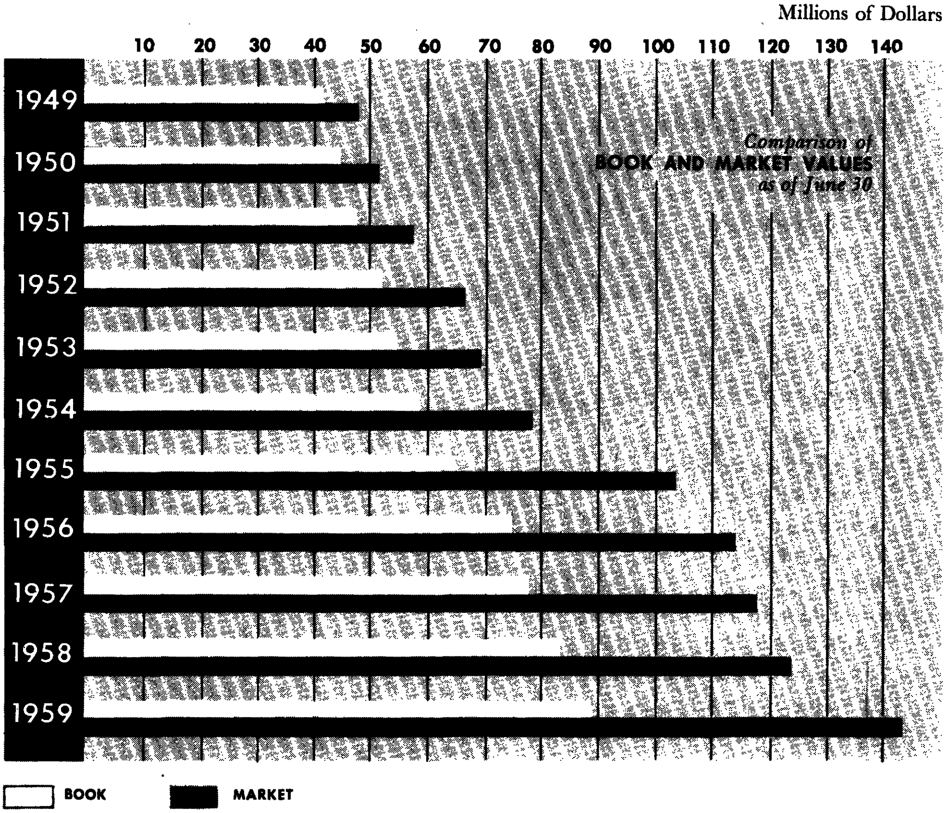
SUMMARY OF INVESTMENTS — JUNE 30, 1959

	Book Value	Market Value Amount	Market Value Per Cent	Net Income Amount	Net Income Per Cent
GENERAL INVESTMENTS					
Bonds					
U. S. Government	$17,668,127	$ 16,771,152	11.8	$ 382,243	8.6
Canadian	2,705,191	2,580,895	1.8	108,292	2.4
Industrial	6,789,098	6,602,692	4.6	272,870	6.1
Public utility	5,728,680	5,064,360	3.5	235,270	5.3
Common carrier	3,866,520	3,718,632	2.6	129,737	2.9
Financial	12,629,110	11,761,404	8.2	466,861	10.5
Other	2,100	....	....	3	....
Total	**$49,388,826**	**$ 46,499,135**	**32.5**	**$1,595,276**	**35.8**
Preferred Stocks	**$ 507,738**	**$ 500,785**	**0.4**	**$ 40,285**	**0.9**
Common Stocks					
Industrial	$16,606,526	$ 64,390,770	45.1	$1,763,764	39.6
Public utility	4,502,447	8,614,651	6.1	294,897	6.6
Railroad	262,392	773,641	0.5	37,550	.8
Bank	1,610,919	3,109,037	2.2	112,124	2.5
Insurance	802,110	2,906,037	2.0	76,662	1.7
Other	800,826	1,537,952	1.1	49,303	1.1
Total	**$24,585,220**	**$ 81,332,088**	**57.0**	**$2,334,300**	**52.3**
Mortgage Notes	**$ 108,550**	**$ 108,550**	**0.1**	**$ 5,404**	**0.1**
Real Estate					
For Institute use	$ 5,258,712	$ 5,258,712[1]	3.7	$ 191,478	4.3
Other property	6,616,816	6,616,816[1]	4.6	211,487	4.7
Total	**$11,875,528**	**$ 11,875,528**	**8.3**	**$ 402,965**	**9.0**
Commercial paper	**$ 2,463,025**	**$ 2,463,025**	**1.7**	**$ 85,886**	**1.9**
Total general investments	**$88,928,887**	**$142,779,111**	**100.0**	**$4,464,116**	**100.0**
OTHER INVESTMENTS					
Separately invested funds	$ 6,287,462	$ 10,348,569		$ 303,364	
Students' notes receivable	2,648,771	2,648,771		†	
Total investments	**$97,865,120**	**$155,776,451**		**$4,767,480**	
Less: Temporary investment of general purpose cash	$ 2,196,284				
Investments (Schedule A)	**$95,668,836**				

[1] Book value used in lieu of market appraisal. † Interest credited directly to student loan funds.

GENERAL INVESTMENTS, 1949-1959





INCOME ON THE GENERAL INVESTMENTS, 1949-1959

	Income	*Per cent yield on market value*[1]	*Per cent yield on book value*[1]
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
1959	4,464,116	3.37	5.21

[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..	$13,534,770	$13,470,517	$1,419,535	$28,424,822
Materials and services	15,887,179	6,877,552	941,555	23,706,286
Subcontracts.......	2,024,115	1,789,827	5,023	3,818,965
Travel.............	777,656	587,014	96,540	1,461,210
	$32,223,720	**$22,724,910**	**$2,462,653**	**$57,411,283**

CONTRACT ADMINISTRATION EXPENSES

Salaries and wages....................................	$ 694,651
Materials and services....................................	88,343
Depreciation on equipment....................................	59,676
Insurance....................................	55,414
Professional meetings expenses....................................	33,666
Travel....................................	15,966
Occupational medical service....................................	77,480
Unclaimed contract expenses....................................	27,244
Research services — Computation Center....................................	74,141
Allowances for vacations....................................	973,666
Allowances for extended sick leave, industrial accidents and severance pay....................................	54,754
Other....................................	60,983
	$ 2,215,984
Total direct costs and expenses (Schedule B)..............	**$59,627,267**

ALLOWANCES FOR INDIRECT EXPENSES

Appropriations added to invested funds (Schedule A-8):		
General and administration and plant operation expenses..		$ 6,542,382
Reserve for use of facilities..................	$645,270	
Industrial fund..................	106,201	
Investment income for use of funds..........	25,700	
Research reserve..................	200,000	
Provision for variation of allowances..........	130,000	1,107,171
Total contract revenues..............................		**$67,276,820** (Schedule B)

Other Administrative Officers

VICE PRESIDENT

On-Campus Sponsored Research

For the third successive year sponsored research in campus laboratories at M.I.T. showed a noticeable increase — more than 20 per cent, measured in dollar volume. The employment record indicates also a continuing increase in participation of academic personnel in these research programs, giving gratifying evidence of close interrelationship between research and teaching.

Comparative figures for the fiscal years 1958 and 1959 are as follows.

Research in Campus Laboratories, 1957–59

DOLLAR VOLUME:		
	1957–58	*1958–59*
Government	$11,354,009	$14,241,776
Industrial and foundations	2,434,575	2,369,815
	$13,788,584	**$16,611,591**
PERSONNEL EMPLOYED:		
	June 30, 1958	*June 30, 1959*
D.S.R. staff	285	282
Academic staff devoting time to research projects	861	948
Support personnel	567	611
	1,713	**1,841**

It will be noted that the 1959 increase resulted from added government support. Thus our scientific interest in this work, and our recognition of its national importance, must be tempered by our recognition also of problems of relatively short-term funding associated with most government contracts.

Transfer of the contract covering the Laboratory for Nuclear Science from the Office of Naval Research to the Atomic Energy Commission places the latter agency in a more prominent position on our list of sponsors. The National Institutes of Health also have increased their sponsorship of our academic research during the past year.

Considering the distribution by departments, nearly every department and laboratory has shown an increase of sponsored research, although by far the largest increases have occurred in the Laboratory for Nuclear Science and the Research Laboratory of Electronics. The Department of Nuclear Engineering, with its nuclear reactor operating at full power during 1959, has also shown a large increase in sponsored research over the previous year.

During the fall of 1958, a new corporation known as Educational Services, Inc., was formed under auspices of the Institute and other educational institutions to take over responsibility for the work of the Physical Science Study Committee in the field of secondary school physics; it is operating, however, under a subcontract from the Institute, which continues to be the grantee organization. Financial support, at this advanced stage of the project, comes mainly from the National Science Foundation. Expenditures under this contract during the last seven months of the fiscal year totaled approximately $944,000.

The Defense Laboratories

The Institute's research participation in major national defense programs has continued at a high level, as the following tabulations indicate.

Research in Defense Laboratories, 1957–59

	1957–58	*1958–59*
Dollar volume	**$47,615,199**	**$50,884,008**
PERSONNEL EMPLOYED:		
	June 30, 1958	*June 30, 1959*
Defense research staff	1,082	907
M.I.T. staff	30	27
Supporting personnel	2,002	1,697
	3,114	**2,631**

Acting on a request from the Air Force, we sponsored the organization of the new, independent, non-profit Mitre Corporation to perform the urgent and complex tasks of technical integration of aircraft, missiles, communications, and data gathering and processing equipment associated with the SAGE system, developed by the Lincoln Laboratory. Operating from September 1, 1958, under a subcontract with M.I.T., the new corporation accepted on January 1 the transfer of some five hundred members of Lincoln Laboratory and had reached a strength of approximately nine hundred by the end of the fiscal year. By this latter date, expenditures under the subcontract for ten months of operation had totaled approximately $5 million. Mitre was then declared ready to assume the responsibility under prime contract with the government, relieving M.I.T.

LINCOLN LABORATORY

At Lincoln Laboratory, a major reorientation in program and objectives has been accomplished. The year-end professional strength was 530, down from 760 before the transfers to Mitre. Concurrently with this disengagement from SAGE system responsibilities, Lincoln Laboratory has deepened its research program in physics and electronics and has begun work on new projects sponsored by the Advanced Research Projects Agency of the Department of Defense and by the National Aeronautics and Space Administration as well as by the three military services. The Air Force continues as the Laboratory's principal sponsor and proposes to support at Lincoln on a long-term, stable basis a program of research in air defense electronics and related fields and in the early development of advanced systems which may emerge from such research.

Highlights of the Laboratory's technical accomplishments during the year range from interplanetary radar measurements to the better understanding and control of basic electromagnetic properties of elemental and intermetallic substances.

Radar echoes from Venus were received at Lincoln's Millstone Hill Radar Observatory after a round trip of some 56 million miles. The success of this experiment, which established the first two-way contact with any celestial body beyond the moon at a radar range more than one hundred times greater than ever previously achieved, was made possible by close coordination of advanced techniques in three widely diverse fields of science and technology: high-power radar with an accurately steerable antenna of large aperture; low-noise solid-state maser receiver amplifiers; and sophisticated weak-signal detection techniques using a digital computer for signal processing. This experiment marks an important milestone in establishing interplanetary radar astronomy, uniquely capable of accurate distance measurement, as a worthy partner to optical astronomy, capable of highly accurate angular measurement.

A twin of the Millstone Hill radar has been installed by Lincoln at the Prince Albert Radar Laboratory in Saskatchewan, Canada. This facility, built under international agreement between the U. S. Air Force and the Defence Research Board of Canada, was opened in June for cooperative research on long-range radar performance, with particular emphasis on the effects of such electrical disturbances as the aurora borealis. The occasion was marked by a greeting from President Eisenhower, transmitted from Millstone to Prince Albert by way of the moon, a distance of approximately half a million miles.

Lincoln's newest experimental radar went into operation in September, 1958, atop Boston Hill in North Andover, Massachusetts. A high-power UHF search radar of advanced design, it will be used for research on many aspects of radar system performance. The antenna is a singly curved paraboloid, 120 feet wide by 30 feet high, with a feed horn 19 feet high. The rotating structure weighs fifty tons and rides on the largest integral gear-and-ball bearing ever built.

Solid state research and component development at the Laboratory produced a profusion of new ideas and new devices, of which the following are examples. The discovery of the fundamental phenomenon of spin-wave resonance provides for the first time a method for direct determination of the exchange constants associated with ferromagnetism. Further development of solid state maser amplifiers in various configurations has broadened the possibilities of their application over a wide range of operating frequencies.

Invention of the cryosar, a tiny switching device utilizing breakdown and recombination of impurity carriers in germanium at liquid helium temperature, offers a promising new computer component with a switching time of less than one ten thousandth of a microsecond and of a size that should permit up to 200,000 cryosar units to be packed into a one-inch cube.

Arrays of photorectifiers, light-actuated solid-state circuit elements which behave as diodes when illuminated and as open circuits when in the dark, and which are now producible in quantity, present many potential applications for function tables and control memory elements in modern computer technology. Continuing research on thin magnetic films, directed toward the development of computer memories that are faster, more compact, and easier to fabricate than the toroidal core memories now in use, has led to the construction of an experimental prototype thin-film memory with a capacity of 32 ten-bit words, sufficient for evaluation testing, and an operating cycle time of one-half microsecond, about ten times faster than present core memories.

THE INSTRUMENTATION LABORATORY

For the Instrumentation Laboratory the year has been one of growth and increased activity in the fields of missiles and space technology. At year's end the Laboratory numbered 310 professional staff, up from 290 a year earlier. Significant achievements of Laboratory projects were keynoted by successful THOR flights. The missile guidance system, produced by General Motors' AC Spark Plug Division, is based on techniques pioneered and developed by the Laboratory. In the same pattern of Institute-industrial cooperation, it is gratifying to note that an advanced system, built by the Laboratory, has been selected by the Air Force for application to the TITAN missile.

Flight tests of the equipment developed for guidance of the POLARIS missile are proceeding with good success. Development of second generation guidance equipment for this missile has been initiated. This system will utilize many new techniques developed by the Laboratory to provide greater accuracy coupled with considerable reduction in size and weight.

The development and application of "self-optimalizing" equipment to automatic pilots was announced. This concept makes possible the realization of desired optimum dynamic response associated with vehicle control over a great range of operating environments — for example, in a manned vehicle returning to earth from the moon.

Laboratory testing of developmental inertial guidance equipment and components was considerably enhanced by the use of a newly acquired precision centrifuge. One of the largest in the country, the centrifuge has a 32-foot arm weighing 18 tons and is powered by a 450 h.p. hydraulic drive. It is capable of rotating with a tip speed of 120 miles per hour and thereby exerting a force of 30 times gravity on equipment mounted at the end of the arm.

Initial efforts in the field of self-contained guidance for space navigation have generated the recent publication of a four-volume report titled "A Recoverable Interplanetary Space Probe," presenting a new and complete engineering work pointing the way into space.

THE NAVAL OPERATIONS EVALUATION GROUP

Continuing under M.I.T. contract, the Operations Evaluation Group and its associated Naval Warfare Analysis Group are the principal organizations doing operations research for the Chief of Naval Operations and for the Naval operating forces. The bulk of the approximately sixty-five professional staff are located in the Pentagon, the remainder being assigned on rotation for work with the fleets and the Operations Research Center at M.I.T.

Sharing a common directorate, the two groups advise the Chief of Naval Operations and fleet commanders in operational problems susceptible to quantitative scientific analysis, such as the evaluation of new weapons, operational techniques, tactics, the formulation of new requirements, the technical aspects of strategic planning, and the correlation of research and development with naval needs. These studies are designed to provide objective assessments of defensive and offensive capabilities in today's constantly changing military environment.

The influence on naval operations of improved sensor devices, the increased mobility and concealment resulting from nuclear propulsion, and the greater speeds with which enormously destructive weapons can be delivered demand extensive analysis by both these groups to help determine the best composition and employment of future naval forces. Recommendations are derived from such studies for the improvement of naval doctrine, tactics, and operational procedures, and for new statements of operational requirements.

THE INSTITUTE FOR DEFENSE ANALYSES

This organization, formed in 1956 under sponsorship of M.I.T. and other educational institutions at the request of the Secretary of Defense to provide technical support for the Weapons Systems Evaluation Group of the Joint Chiefs of Staff, became altogether administratively independent in 1959. I.D.A. is a nonprofit membership corporation governed by a board of trustees elected annually by its members: California Institute of Technology, Case Institute of Technology, Stanford University, Tulane University, and M.I.T.

The organization was financed initially by a grant of $500,000 from The Ford Foundation. The board now includes officials and faculty members from seven leading universities, together with knowledgeable and patriotic citizens from other professional areas.

The organization has expanded to a professional strength of approximately 150 to serve several agencies of the executive department concerned with the national security. Its headquarters are in Washington. As M.I.T.'s role in this endeavor is reduced to parallel those of our university associates, we report satisfaction in having served usefully, we believe, in furthering the national interest in this area.

JAMES MC CORMACK

SECRETARY OF THE INSTITUTE

As a matter of record, the Corporation on December 1, 1958, confirmed the appointment by the Executive Committee of Dr. Julius A. Stratton as President of the Institute, effective January 1, 1959. At the same time, the Corporation elected Dr. James R. Killian, Jr., as Chairman and Dr. Vannevar Bush as Honorary Chairman.

Participation in the Institute's affairs by members of the Corporation continued at a high level. More than two-thirds of the active members attended the four regularly scheduled meetings; twenty of the twenty-four visiting committees met during the year to look closely at the educational and research activities of the several departments. In addition to the business sessions, the Corporation met informally at each of the first three meetings to hear presentations on architecture, by Dean Pietro Belluschi; on atmospheric research, by Professors Henry G. Houghton and Jule G. Charney; and on materials, by Professors John C. Slater and Nicholas J. Grant.

On July 1, the following joined the Corporation as term members for five years: Donald W. Douglas '14, Cecil H. Green '23, Robert C. Gunness '34, Clarence H. Linder, and Gilbert M. Roddy '31. John J. Wilson '29 became an ex-officio member as President of the Alumni Association. At the close of the year, the following completed their five-year terms: Theodore V. Houser, Horatio L. Bond '23, Ray P. Dinsmore '14, and William J. Sherry

'21. Each contributed effectively in a variety of ways to strengthening the Institute. The Institute lost, through death on March 18, Paul W. Litchfield '96, a member of the Corporation from 1918–1923 and 1926–1931.

John Cowles, President of the Minneapolis Star & Tribune Company, spoke at Commencement on "The Future is Now."

Development Activities

Total gifts for the year were just over $10,000,000, the second highest amount in the last ten years. The total is the more impressive because there was no special objective such as the Compton Memorial or the Faculty Salary Program. Of this, just over $3,000,000 came from foundations, $3,000,000 from industry, and over $2,100,000 from alumni, including the Alumni Fund. The large number of contributors is most significant; it is clear that M.I.T. has a very broad base of support among alumni and friends as well as foundations and industry. Widespread participation is a source of real strength; in addition to assuring some stability in total annual gifts, it prompts those who are in a position to do so to make substantial contributions.

The whole Institute community is grateful to Alfred P. Sloan, Jr., for his continuing interest and financial support. Deserving, too, of special mention are Mr. and Mrs. Cecil H. Green for their magnificent gift of $2,500,000 for the Earth Sciences Center. As a long-time member of the Visiting Committee on the Earth Sciences and more recently as a member of the Corporation, Mr. Green has contributed effectively to the planning of the whole earth sciences program.

The Industrial Liaison Program continued to provide a means of maintaining a close relationship with research leaders in industry and at the same time of bringing major unrestricted financial support to the Institute. Many of the companies in the Program also make additional grants for research and fellowships.

Increasingly, the department heads and other members of the faculty seek the advice and help of the Development Office in finding sources of support. This is a salutary trend; relatively, the amounts of money in most cases are not large and yet the grants provide a degree of flexibility that is not possible within the normal operating budget.

The Alumni Fund totaled $575,500, the largest total during the twenty-year history of the Fund and an increase of 29.3 per cent over 1958. There were 15,130 contributors to the Fund, the largest ever, and an increase of 13.5 per cent over the previous year. Close collaboration continued between the Fund operation and the other development activities.

Parents were not invited to contribute last year, as they had been in the two prior years, because of the announced increase in tuition. However, several parents volunteered contributions; and since the tuition still represents only a fraction of the cost, we should urge financial support through gifts from those parents who are in a position to help.

M.I.T. fares well in its support in comparison with other private universities of comparable size. This is no reason for complacency; the fact is that the opportunities of an institution like M.I.T. far outrun the resources available. Although the total annual gifts for operating purposes go far toward meeting the needs, there remains a substantial gap in available capital funds.

ROBERT M. KIMBALL

DEAN OF THE GRADUATE SCHOOL

The expansion of graduate schools throughout the United States has become an important national issue in which our own Graduate School must play its appropriate part. Two forces combine to urge a rapid growth of our graduate schools nationally. The first is the rapidly increasing sophistication of all professional activities. This is especially true of engineering and science, though in all fields the need is felt for increasing numbers of highly educated, able people to cope with the social, political, and economic as well as the scientific problems in a world of increasing tempo and complication. Our graduate schools are the primary source of well-educated people to fill these professional needs.

The second force for expansion of our graduate schools is the oncoming great increase in the numbers of college and university teachers required to meet the demands imposed by the bumper baby crop of the war and post-war years. This need has been well publicized, but more than publicity is required to provide even moderately well-prepared faculties in U. S. higher education during the next decade or two.

M.I.T. takes seriously its obligation in this near-crisis. We believe that we will make our greatest contribution by placing first emphasis on quality, and second (though important) emphasis on quantity. First emphasis on quality requires that growth in student numbers be limited to fit growth in resources of faculty and finances. Neither of these is subject to precise quantitative prediction. Nevertheless, general goals need to be set as a basis for planning. Careful consideration of our obligations, our resources, and our best use of these resources has led to the concept of an undergraduate school continuing at essentially its present size and a graduate school slowly growing at roughly the same rate as in the immediate post-war years.

It must be emphasized that such growth is sound only if the physical and financial resources, and especially the faculty resources, can be built up at least at a corresponding rate and if the pressure for graduate student admission is sufficient to provide us with graduate students at least as good as those we now have.

It must be emphasized that this concept expresses planning principles rather than production goals; it is a guide to help us emphasize our goal of quality in the face of strong pressures for increased enrollments — a goal which, if unchecked, would undoubtedly lead us to much greater rates of growth.

Resources for Financial Aid

Another resource has major significance in the growth of graduate school enrollments. This is the funds available for financing graduate students. Subsidy for graduate students is not solely a contemporary phenomenon. For well over a century significant critiques and studies of graduate work in this country almost monotonously repeat the idea that the price of attracting *good* graduate students to our universities is providing them with the cost of their living and tuition.

At the national level, two significant steps were taken this year in recognition of the necessity of providing more aid for the support of increased numbers of graduate students. The National Science Foundation has introduced its Cooperative and Summer Teaching Assistant Fellowships effective for the college year of 1959–60. Approximately one thousand Cooperative Fellowships are to be added to a like number of N.S.F. Predoctoral Fellowships presently being awarded, thus essentially doubling the graduate fellowship support from this source. By requiring students to apply for the Cooperative Fellowships through a given institution and setting quotas for the numbers of such applicants that any given institution may recommend, the Cooperative Fellowship Program counteracts the tendency toward high concentration in a few institutions and a few areas of the country that has occurred in the regular N.S.F. Predoctoral Fellowship Program, under which the recipient may attend the institution of his choice.

Another one thousand graduate fellowships in all fields also come into effect in the fall of 1959 under Title IV of the National Defense Education Act of 1958. These likewise will have a substantial influence on the build-up of graduate work, both by the support of more graduate students and by the particular terms of the Title IV Fellowship Program.

Under Title IV, fellowships are provided only for graduate students participating in new or expanded programs of graduate study; they are accompanied by cash support to the institution that may substantially exceed tuition. The stated intent of this Title is to increase the number and geographic distribution of institutional resources for graduate study. Administration of this Title for the first year has excluded mere increase in numbers in a given program as qualifying under the term "expansion." Very significant questions have been raised as to whether the graduate-education resources of the nation are more effectively augmented by exclusive attention to support of essentially new kinds of activities, or activities in new locations, as compared with the support of institutions and programs of known strength and standing that could readily be expanded in student numbers with the kind of support provided by Title IV. However, Title IV is the present law, and it establishes the principle of government subsidy of graduate education on a somewhat more generous basis than previous government fellowship programs. It is hoped that subsequent revision of the Act may benefit from the initial experience in a way to provide a broader base of support for graduate work.

What is the effect of these augmented national programs on M.I.T.? We have been second only to Harvard in number of National Science Foundation Predoctoral Fellows in recent years. We will have a large number of Cooperative N.S.F. Fellows this fall but fewer than will attend some of the very large state universities. Under Title IV of the National Defense Education Act our expanding program in political science qualified for four fellowships, a helpful but modest element of support. Title IV support tended to go more to the institutions striving to get new graduate work under way than to those having strong going programs.

These increased national fellowship programs emphasize rather than reduce the need for M.I.T. fellowship funds with which to attract outstandingly able new graduate students. Our industrial fellowships, together with teaching assistantships and research assistantships provided by sponsored research, go a long way toward providing support, especially after the first year of graduate study. But in engineering, especially, it is difficult to overemphasize the importance of adequate first-year fellowships. These are badly needed to attract more of the outstandingly able *new* engineering graduates whose natural inclination as an engineer is toward industrial employment. This spring, as an example, our engineering departments had 90 highly qualified new applicants for the Graduate School seeking M.I.T. fellowship aid. Aware of the limited funds available for such fellowships, these departments recommended 70. The Graduate Committee, impressed with the exceptional promise of the applicants, awarded 43 with the expectation based on past experience of 22 acceptances. Although current earnings provide support only for 17, actually 27 accepted, leaving the support of 10 to be drawn from dwindling wartime income reserve. These fellowships were offered exclusively to new Bachelor's men from other institutions whom we would like very much to see undertake graduate work — and undertake it at M.I.T.

A somewhat parallel situation exists in science, which although less critical as far as attracting new Bachelor's to *some* graduate school is more critical as far as M.I.T.'s competitive position is concerned because of the relatively larger number of good graduate schools of science throughout the country. We need more Institute funds for fellowships to attract those outstanding graduate students who, however much they want to come to M.I.T., feel they cannot come at the sacrifice of fellowship support available at other good schools.

In architecture and city planning, sponsored fellowship aid is far less plentiful than in the natural sciences and engineering — indeed less than is available in the social sciences. In our School of Architecture and Planning, where M.I.T. sources of student aid have to play the role that is played by various sources in the other fields, a modest amount of fellowship support not now available would pay handsome dividends.

More and more institutions nationally are able to offer attractive fellowships for the outstanding new graduates in all fields. We must augment our fellowship resources if the Institute is to continue to attract its fair share of these outstanding students. Our academic reputation is very high, but this alone is no more than a necessary condition for attracting students. The sufficient condition includes adequate fellowship offerings. Our fellowship resources are rapidly becoming inadequate to back up our great and growing academic resources.

Interdisciplinary Activities

Turning from finances to academic affairs, one of the notable developments is the growing interest in doctoral programs which range outside the bounds of any single department. The so-called "interdepartmental doctorate" is of increasing intellectual importance in terms of the number of students having such interests and in the number of newly evolving fields that call upon several of the traditionally allocated departmental disciplines. There is widespread concurrence among our faculty as to the validity and importance of such interdepartmental programs, and the feeling is that some of the important new advances are, and will be, occurring in just such interdiscipline areas.

Yet the administrative problems involved are not trivial. The departments are rightly jealous of their natural custodianship of academic standards. They feel that they provide an academic home and have a sense of responsibility for the well-being of their graduate students that no other existing agency can supply in comparable degree. Nevertheless, an increasing though modest number of individual students utilize our existing mechanism, in which a separate interdepartmental committee is selected to guide and administer each individual program and to take responsibility for the student's examinations and appropriate guidance of his research. This mechanism works well provided a central monitor, normally the Dean of the Graduate School, assures continuity of each interdepartmental committee, should committee members go on to other activities away from M.I.T. These individual cases can be, and are, handled satisfactorily.

However, when a more widespread interest results in numbers of students being attracted to a newly emerging field, we feel the need for a significant administrative invention. A case in point is the field of materials. With the recent growth of theoretical and applied knowledge in this field, and the increasing degree to which the sciences are able to contribute to what heretofore has been largely empirical knowledge and art, this field is rapidly becoming a legitimate separate discipline. A number of departments in the Schools of Engineering and Science are equally concerned. On the intellectual level, interdepartmental activity in materials has proceeded with verve and effectiveness; but formalized programs of doctoral work in materials having a broad interdepartmental character nearly floundered from inability to provide an academic administrative mechanism of persuasive merit and soundness. In this particular case the dilemma was resolved by the Committee on Graduate School Policy's request for authorization of the Corporation, through the faculty and on behalf of several departments, for a nonexclusive authorization to recommend graduate degrees at the Engineer and the doctoral levels. These degrees are to be granted for programs of graduate study and research administered by the individual departments, with guidance and advice on academic matters from a standing Interdepartmental Committee on Materials.

In the field of linguistics, we have a less well developed but perhaps even more exciting area which is beginning to pull together such diverse groups as the more adventurous of the conventional linguists, the digital computer people, the neurophysiologists, the electrical communication and acoustics people, and the students of comparative languages and history of languages. This is a diverse group, yet their combined resources, especially when leavened by imaginative and wide-reaching exploration, lead as an example to not-so-visionary visions of full machine translation.

In such an area we can proceed and are proceeding on an experimental interdepartmental basis, emphasizing the intellectual interactions and minimizing the formal academic administrative matters. However, should this field develop into a program involving considerable numbers of students, we should again, as in the case of materials, be faced head on with the necessity of providing some adequate administrative mechanism which will satisfy the departments that standards are adequately safeguarded and that students are adequately cared for. That our faculty is becoming increasingly aware of this dilemma and of the need for the means of resolving it is in itself encouraging. We are far from unique in experiencing such questions; answers are being sought in many institutions. Hope for an eventual reasonable solution therefore appears justified.

Graduate School Activities

The need for an adequate graduate center is becoming more and more pressing, and as a consequence more and more attention is being given to the best ways of achieving it. The fine work of the Ryer Committee on the location of a graduate center is proving to have been merely an initial effort in grappling with a very difficult and complex matter. As the subject is examined, it becomes apparent that no institution has more than touched the surface of determining the potentialities of such a center or of learning how to achieve them. This, therefore, is a subject calling for serious, deeper exploration and the exercise of exceptional imagination, analysis, and wise judgment. It is now under active exploration.

The Goodwin Medal, awarded when a candidate (a graduate student who is also a member of the staff) appears who justifies exceptional recognition for conspicuously effective teaching, was this year awarded to Harry Barney Lee, Jr. The Committee was genuinely enthusiastic in making this award; indeed it felt that a number of other graduate assistants merited more than nominal recognition. It is clear that at M.I.T., as at other graduate schools across the country, some of the really fine teaching is being done by graduate students — especially in the fields of the natural and engineering sciences, where high intellectual ability, sparked with imagination and personal interest in students, can provide an adequate basis for excellence in teaching.

The Committee on Graduate School Policy continues to function with notable effectiveness as a working group concerned with the Institute-wide operations of the Graduate School that involve common interests and common problems, and that require the ability to identify, evolve, and interpret significant matters of policy. Its members effectively and strongly represent departmental concerns and interests, yet place these in proper perspective when the welfare of the Graduate School as a whole, or indeed of the Institute, requires a broader outlook.

Some of the significant statistics on the Graduate School operation of the past year follow.

Advanced Degrees Conferred, 1958–59

	S.M.	*Engineer*	*Sc.D.*	*Ph.D.*	*Total*
September, 1958	157	10	17	26	210
February, 1959	129	9	25	24	187
June, 1959	438	53	35	65	591
	724	**72**	**77**	**115**	**988**

Fellowships, Scholarships, and Staff Awards, 1958–59

	Number of Awardees	*Amount*
Fellowships	210	$437,933
Scholarships	80	104,750
Staff awards	441	238,238
	731	**$780,921**

Graduate School Registration, 1958–59

	Summer, 1958	*Fall, 1959*	*Spring, 1959*
School of Engineering	665	1,550	1,439
School of Science	267	797	743
School of Architecture and Planning	32	72	76
School of Humanities and Social Science	11	84	82
School of Industrial Management	59	181	174
	1,034	**2,684**	**2,514**
U.S. or Canadian citizens	873	2,221	2,066
Others	161	463	448
	1,034	**2,684**	**2,514**
Regular students	946	2,239	2,146
Special students	88	445	368
	1,034	**2,684**	**2,514**
Civilian students	—	2,528	2,352
Military students	—	156	162
		2,684	**2,514**

Graduate Fellowships

The Institute gratefully acknowledges the important contribution to the work of its Graduate School provided by the sponsors of the following fellowships, which were awarded by M.I.T. for the year 1958–59 to the recipients named below. We are no less appreciative of the many fellowship awards made by outside agencies to graduate students electing to study at M.I.T.; we omit them only because of the unfair connotations of an unavoidably incomplete listing.

AC Spark Plug Fellowship

JAMES S. MILLER, in the Department of Aeronautics and Astronautics

Allegheny-Ludlum Fellowships

(Both in the Department of Metallurgy)

SHELDON H. MOLL

JOHN R. RAWLING

Allied Chemical and Dye Corporation Fellowship

JOHN W. MEADER, in the Department of Chemical Engineering

Aluminum Company of America Fellowships

(All in the Department of Metallurgy)

THOMAS H. ALDEN

PAUL E. BROWN

BARTON ROESSLER

American Brake Shoe Fellowship

RICHARD V. BARONE, in the Department of Metallurgy

American Chicle Company Fellowship

GERALD M. SAPERS, in the Department of Food Technology

American Cyanamid Company Fellowship
JERRY SILVERMAN, in the Department of Chemistry

American Cyanamid Company Practice School Fellowships
(All in the Department of Chemical Engineering)

WILLIAM H. DALZELL
RICHARD P. DE FILIPPI
MALCOLM P. FRIEDMAN
JOHN C. FULMER
PETER A. GLENSHAW
THEODORE KALINA
LEO F. KELLEY
PHATU R. MULCHANDANI
ROBERT S. SLOTT
JAMES F. TAO

American Society of Metals Fellowship
GEORGE W. PEARSALL, in the Department of Metallurgy

American Viscose Corporation Practice School Fellowship
DOUGLAS J. WARNER, in the Department of Chemical Engineering

Aviation Week Fellowship
LAURENCE R. BOEDEKER, in the Department of Aeronautics and Astronautics

Bendix Aviation Corporation Fellowship
PAUL PENFIELD, in the Department of Electrical Engineering

Boeing Airplane Company Fellowship
FRED E. C. CULICK, in the Department of Aeronautics and Astronautics

Vannevar Bush Fellowships
HARRY PARSONS, in the Department of City and Regional Planning
DAVID R. WONES, in the Department of Geology and Geophysics

Campbell Soup Company Fellowship
ALVAN W. PYNE, in the Department of Food Technology

Chandler Fellowship
E. JACK SCHOOP, in the Department of City and Regional Planning

Chemical Engineering Department Research Fellowship
DANIEL L. BROWN, in the Department of Chemical Engineering

Coats and Clark Fellowship
PETER G. POPPER, in the Department of Mechanical Engineering (Textile Division)

Coffin Fellowship
RICHARD H. HOLM, in the Department of Chemistry

Compton Fellowships
(Both in the Department of Biology)
GERALD W. CAMENIER
GERALD L. CARLSON

W. Danforth Compton Fellowship
PAUL R. DERMANIS, in the Department of Architecture

Continental Can Company Fellowship
JOHN H. HUTCHINS, in the Department of Metallurgy

Crane Company Fellowship in Foundry Research
CARL A. WESTON, in the Department of Metallurgy

Douglas Aircraft Company Fellowship
CHARLES W. HALDEMAN, in the Department of Aeronautics and Astronautics

Dow Chemical Company Fellowship
ROBERT S. TIMMINS, in the Department of Chemical Engineering

du Pont Company Fellowships
BERNARD M. GOODWIN, in the Department of Chemical Engineering
CHARLES T. HUGHES, in the Department of Chemical Engineering
PETER D. LENN, in the Department of Mechanical Engineering
ANTHONY TURANO, in the Department of Chemical Engineering

Richard C. du Pont Memorial Fellowships
(All in the Department of Aeronautics and Astronautics)
KENTON J. IDE
DONALD H. LEWIS
JAMES D. MC CLURE

Eastman Kodak Company Fellowships
EDWARD J. GRUBBS, in the Department of Chemistry
ARNOLD TUBIS, in the Department of Physics

Eastman Kodak Company SM Fellowship
PETER C. WAYNER, in the Department of Chemical Engineering

Economic Development Fellowship
LATTEE A. FAHM, in the Department of Economics and Social Science

Esso Standard Oil Practice School Fellowships
(All in the Department of Chemical Engineering)
EDWARD D. DE SA
HAROLD G. ERICHS
JOHN J. HERMAN
ALBERT W. KARNATH
BERTON M. LAPIDUS
ARTHUR W. MOORE
THOMAS F. SEAMANS
JOHN B. YANNAS
SHOU-CHEN YIH
JOHN P. ZAREMBA

Foundation for Instrumentation and Research Fellowship
LESTER M. SASLOW, in the Department of Mechanical Engineering

Fluor Foundation Fellowship
JOHN P. SCHEIDT in the Department of Chemical Engineering

Ford Foundation Fellowship
JOHN M. F. CRISPO, in the Department of Economics and Social Science

Foundry Fellowship
RICHARD V. BARONE, in the Department of Metallurgy

Lester D. Gardner Graduate Fellowship
BURTON D. FIGLER, in the Department of Aeronautics and Astronautics

General Dynamics Corporation Fellowships
JOHN T. MADELL, in the Department of Nuclear Engineering
KARL S. MENGER, in the Department of Electrical Engineering

General Electric Fellowships
LARRY D. BLACKBURN, in the Department of Metallurgy
LAWRENCE H. BOWEN, in the Department of Chemistry
ROBERT P. ELY, in the Department of Physics

General Motors Fellowship
ARTHUR C. NUNES, in the Department of Mechanical Engineering
GEORGE R. SCHNEIDER, in the Department of Chemical Engineering

Goodyear Tire and Rubber Company Fellowship
EDWARD J. KANE, in the Department of Economics and Social Science

Goodyear Tire and Rubber Company and Goodyear Aircraft Corporation Fellowship
ROBERT E. KELLY, in the Department of Aeronautics and Astronautics

Grunsfeld Scholarship
EIGIL NANSEN, in the Department of Architecture
Gulf Research and Development Company Fellowships
GEORGE JANSEN, JR., in the Department of Chemical Engineering
NORMAN F. NESS, in the Department of Geology and Geophysics
Hicks Fellowship
HERBERT A. CHESLER, in the Department of Economics and Social Science
Humble Oil and Refining Company Fellowship
WILLIAM C. BEHRMANN, in the Department of Chemical Engineering
Industrial Relations Fellowships
(All in the Department of Economics and Social Science)
DAVIS B. BOBROW
PHOEBUS J. DHRYMES
CARLOS F. DIAZ
JOHN E. DONER
EUGENE P. FELDMAN
HARRY GRUBERT
RUSSELL B. IRVINE
FRANCIS M. MC LAUGHLIN
HARVEY M. ROMOFF
BARTON SENSENIG
MARSHALL R. SINGER
VINCENT D. TAYLOR
International Business Machines Corporation Fellowships
RUDOLF W. BAUER, in the Department of Physics
IRVIN S. BERNSTEIN, in the Department of Mathematics
International Communications Fellowships
(Both in the Department of Economics and Social Science)
ROBERT E. JONES
MARGUERITE NUSSLE
Kennecott Copper Corporation Fellowship
PETER TARASOFF, in the Department of Metallurgy
Kimberly-Clark Fellowship
GERALD A. GORDON, in the Department of Chemical Engineering
Koskinen Fellowship
ARLON L. BASTIAN, in the Department of Mathematics
Arthur Dehon Little Fellowships
MOU-NENG LO, in the Department of Chemical Engineering
BETTY J. STEINBACH DUFFIELD, in the Department of Chemistry
Lockheed Leadership Fellowship
GEORGE K. BIENKOWSKI, in the Department of Aeronautics and Astronautics
McClintock Fellowship
REINALDO P. RICHARDSON, in the Department of Civil and Sanitary Engineering
Melpar, Incorporated Fellowship
ARTHUR D. HAUSE, in the Department of Electrical Engineering
Minneapolis-Honeywell Fellowship
ROBERT E. L. FARMER, in the Department of Electrical Engineering
Monsanto Chemical Company Fellowship
WALTER F. GANNON, in the Department of Chemistry
National Institutes of Health Fellowships
(All in the Department of Biology)
SUBIR K. BOSE
EMMA M. DUCHANE
CARROLL E. JOHNSON
KARL KORNACKER
ELIZABETH A. MAC LEAN
DANIEL J. PLOCKE
JOHN R. SHERMAN
ANTHONY O. W. STRETTON

National Steel Corporation Fellowship
STUART B. KEELER, in the Department of Metallurgy
Nichols Foundation Fellowship
PHILIP B. HERR, in the Department of City and Regional Planning
James Flack Norris Memorial Fellowship
ELLEN R. BRESSEL, in the Department of Chemistry
Owens-Corning Fiberglas Fellowships
JERRY V. GIBBONS, in the Department of Electrical Engineering
PETER GOTTLIEB, in the Department of Physics
Procter and Gamble Company Fellowships
FRANK W. BACHELOR, in the Department of Chemistry
ROBERT A. KRUGER, in the Department of Mechanical Engineering
ANDREW J. ROBELL, in the Department of Chemical Engineering
ARNOLD STANCELL, in the Department of Chemical Engineering
Ramo-Wooldridge Fellowships
JONATHAN ALLEN, in the Department of Electrical Engineering
PETER L. DUREN, in the Department of Mathematics
RICHARD D. SMALLWOOD, in the Department of Electrical Engineering
Research Laboratory of Electronics Fellowships
RONALD L. BARNDT, in the Department of Electrical Engineering
PHILLIP A. BELLO, in the School of Industrial Management
ROBERT L. BURKHOLDER, in the Department of Physics
JAY L. HIRSHFIELD, in the Department of Physics
ROBERT B. LEES, in the Department of Electrical Engineering
SEYMOUR N. LOTSOFF, in the Department of Electrical Engineering
Schlumberger Fellowship
ALBERT F. NIESSNER, in the Department of Electrical Engineering
School of Industrial Management Fellowships
(All in the School of Industrial Management)

MASSIMO BRIGHI
ALFRED I. CAMHI
MELVYN R. COPEN
RAYMOND W. CRAIG
HENRY R. HAMILTON
WILLIAM L. HOOPER
ARUN JOSHI
GARY C. KOGER
JOHN N. MAGUIRE
LE ROY G. MALOUF
JOHN J. MONTESI
ROBERT P. NICHOLSON
GERHARD R. PEDRAGLIO
JEAN-CLAUDE PETERSCHMITT
JOHN T. SELLDORFF

Scientific Design Fellowship
CHONG Y. YOON, in the Department of Chemical Engineering
Samuel Scott Fund
(Both in the Department of Architecture)
NEIL L. ASTLE
JOHN O. COTTON
Sears-Roebuck Foundation Fellowship
HENRY S. BRINKERS, in the Department of City and Regional Planning
Shell Fellowships
THOMAS H. DUPREE, in the Department of Physics
ROY F. SCHLENKER, in the Department of Mechanical Engineering

Sloan Fellowships
(All in the School of Industrial Management)

GEORGE W. ALLEN
DOUGLAS W. ANDERSON
KARL L. BOCKSTRUCK
LEWIS K. BROWNING
DANIEL P. CAMERON
EDWARD H. CARMAN
JOSEPH H. CHOATE
WILLIAM S. CROWLEY
LINCOLN A. DIVOLL
JOHN P. EBERHARD
JOHN H. EIDE
ROBERT C. ERNEST
JAMES L. EVERETT
CARL R. GLOSKEY
JAN O. GUTHE
HENRY F. HODGKINS
ROBERT B. JOHNSON
CHARLES J. KARRER
EUGENE R. KARRER
CHARLES W. KING
EDWARD R. KINSLEY
RAMCHAND T. KIRPALANI
WALTER C. KOTTEMANN
ROBERT L. LAND
EDWARD C. NEZBEDA
JOSEF J. PRIMAS
FRANCIS L. REES
WILLIAM E. RUDLOFF
ALAN W. SAMPSON
ARTHUR V. SOMMER
ROGER G. SWEET
FRANKLIN WALTER
RAYMOND F. WINCH

J. Waldo Smith Fellowship
WILLIAM W. TROUTMAN, in the Department of Civil Engineering

Solar Energy Fellowships
(All in the Department of Chemistry)
JOSEPH G. ATKINSON
ELLWOOD P. BLANCHARD
LOUIS A. KAMINSKI
GEORGE H. NAWN

Sperry Gyroscope Company Fellowships
(Both in the Department of Aeronautics and Astronautics)
THEODORE C. BLASCHKE
WALTER M. HOLLISTER

Standard Oil Foundation, Incorporated Fellowship
ALBERT L. MOORE, in the Department of Chemical Engineering

Standard Oil of California Fellowship
RICHARD H. MAEHL, in the Department of Geology and Geophysics

Steelmaking Fellowship
DANIEL DUTILLOY, in the Department of Metallurgy

Sun Oil Company Fellowship
LEONARD M. BAKER, in the Department of Chemistry

Swope Fellowships
ARTHUR C. BRUCE, in the Department of Aeronautics and Astronautics
JOHN S. HILL, in the Department of Electrical Engineering

Union Carbide Chemicals Company Fellowships
NOBLE M. NERHEIM, in the Department of Chemical Engineering
GEORGE A. PARKS, in the Department of Metallurgy
NORMAN L. PETERSON, in the Department of Metallurgy
JOHN PIPER, in the Department of Chemistry

Union Carbide Chemicals Company Practice School
KENNETH A. SMITH, in the Department of Chemical Engineering

United States Rubber Company Fellowship
A. THOMAS GUERTIN, in the Department of Chemistry
United States Steel Foundation Fellowship
GEORGE L. PERRY, in the Department of Economics and Social Science
Universal Cyclops Foundation Fellowship
BRUCE A. MAC DONALD, in the Department of Metallurgy
Visking Fellowship
WILLARD B. FRAIZE, in the Department of Mechanical Engineering
Voorhees, Walker, Smith and Smith Fellowship
EDWIN N. WILMSEN, in the Department of City and Regional Planning
Weirton Steel Fellowship
ZISIS A. FOROULIS, in the Department of Metallurgy
Westinghouse Fellowship
GEORGE E. DELEHANTY, in the Department of Economics and Social Science
Jonathan Whitney Fellowships
JOEL R. ALPER, in the Department of Civil and Sanitary Engineering
FRANK BELVIN, in the Department of Electrical Engineering
GARY L. BENTON, in the Department of Electrical Engineering
WILLIAM BLUMEN, in the Department of Meteorology
JOHN L. CUTCLIFFE, in the Department of Civil and Sanitary Engineering (Sanitary Engineering Division)
ROBERT R. DONALDSON, in the Department of Mechanical Engineering
MICHAEL FALCO, in the Department of Chemical Engineering
RONALD G. GRIFFIN, in the Department of Electrical Engineering
JOHN R. HEALY, in the School of Industrial Management
JOHN S. HILL, in the Department of Electrical Engineering
NORMAN A. JACOBS, in the Department of Chemical Engineering
THOMAS F. KLIMEK, in the Department of Electrical Engineering
HARRY C. S. LAM, in the Department of Physics
RAYMOND C. MASTER, in the Department of Electrical Engineering
GLENN MILES, in the Department of Chemical Engineering
THEODORE J. MUSHO, in the Department of Architecture
FIROOZ PARTOVI, in the Department of Physics
FRANCIS W. PASTERCZYK, in the Department of Chemical Engineering
ROBERT J. PAWLAK, in the Department of Mechanical Engineering
LAWRENCE A. RADER, in the School of Industrial Management
HENRY R. RADOSKI, in the Department of Physics
DAVID J. SAKRISON, in the Department of Electrical Engineering
ROBERT F. WEISS, in the Department of Aeronautics and Astronautics

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, 1959, 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	*For September, 1958*	*For September, 1959*
Total applications	6,858	6,630
Completed final applications	3,858	3,775
Admissions granted	1,814	1,685
Actual registration *	941	941
Registration as per cent of admissions	51.9%	56.0%
Number of secondary schools represented	712	682

* Includes former students returning (8) and college transfer students who entered the first year (10), the latter also included in the table below.

College transfers	*For the academic year 1957–1958*	*For the first term 1958–1959*
Total applications	862	745
Applications completed	349	331
Admissions granted	196	164
Actual registrations	145	132
Combined Plan (included above)	23	26
Registrations as per cent of admissions	74%	80%

Freshman Applications

After a seven-year period of successive annual increases in the number of freshman applications, the total of both preliminary and final applications went down slightly this year. At the same time, the applicant group as a whole continued to show improvement in intellectual qualifications, so that it has been possible to bring in an entering class of unprecedentedly high quality from a smaller applicant group. This desirable development clearly reflects improved guidance in the high schools, so that some weak or marginal applicants who might have applied in previous years have refrained from applying. A contributing factor in this better guidance has undoubtedly been the statistical data which we distribute yearly to the schools, showing the relationship of performance in entrance tests to probability of acceptance here. The net effect of all this has been to encourage the abler students and discourage those whose chances of acceptance are small.

For a number of years there has been a progressively higher rate of cancellations by applicants to whom admission was offered. Last year this trend showed a reversal, and the new downward trend has continued in effect this year. In other words, the yield of registered freshmen from a given number of admission offers has again increased. A number of other eastern colleges and universities have reported a similar trend. This suggests that we may have passed the peak of "multiple applications" as an inter-institutional admissions problem.

College Transfers

The college transfer data indicate a relatively constant number of preliminary applications and admissions in 1957–58 as compared with the preceding two years. Fewer applications were completed, but more of those acted upon were found to be acceptable. In parallel with the experience in first-year admissions, there was a decrease in the number of admissions refused, which may be an indication of a more careful consideration of the whole process and fuller knowledge of the Institute on the part of the applicant.

The data for the year 1957–58 include 39 transfer students who were foreign nationals and 106 citizens of the United States. Of this latter category, five withdrew during the year for various reasons, four were disqualified for academic failure, and 97 either took their degrees or are eligible to continue their studies here. It is believed that this loss represents a reasonable amount of risk in the admissions decisions. While those students who are not able to continue might not agree with this, there is another group of transfer students of about the same size whose prognostication for success was no greater but who performed well. A more cautious admissions policy designed to exclude the first group would also have denied an opportunity to the second.

Advanced Placement

Since 1954, 258 students have entered the freshman year having taken one or more courses of college freshman level while still in secondary school, followed by corresponding advanced placement examinations under the College Board Advanced Placement Program. Of these, 116 have been given advanced subject placement for a total of 208 semesters of credit. In 1959, 145 freshmen (16.2% of the class) had taken one or more advanced placement examinations. Mathematics continues to be the subject area in which the largest number of our entering freshmen seek advanced credit through this means. Chemistry, physics, English literature, American and European history are other subject areas in which credit has been granted. These students, on the whole, whether credit was given or not, have been above the average of the class in achievement.

The College Board sponsors each year a series of conferences on the Advanced Placement Program which include program administrators, school and college faculty members, subject-matter committee members, and examination readers. In June, 1959, Professor Hartley Rogers, Jr., attended the Mathematics Conference at Ripon College. Professors Charles R. Niehaus and Rowland L. Mitchell, Jr., attended, respectively, the conference on English at Hamilton College, and on history at Yale University. Eugene R. Chamberlain participated in the Administrators Conference at the University of Michigan.

The Educational Council

The admissions process has continued to benefit by the growth of the Educational Council and by the devoted efforts of this group of 740 alumni who have gained increased experience in the complex problems of educational guidance. The presence of these M.I.T. representatives at the "grass roots" in every section of the country provides an indispensable element in our program of contact with students and schools. The motive power which keeps this system in operation is, on one hand, the genuine need of high school students for contact with informed alumni, and, on the other, the profoundly rewarding experience which these perennial contacts with youth give to the alumni themselves. During the year, the Admissions Office referred 6,767 students to members of the Council in their respective areas (the Council member being simultaneously informed) suggesting a personal conference upon the initiative of the student. A total of 3,263 applicants followed up these invitations, and reports about them were in each case then forwarded to this office. In addition, 991 interviews held in the Admissions Office were reported on as a part of the applicant's record. We received 208 invitations to attend high school "college nights," "college conferences," or "career days." Since these can seldom be reached by persons dispatched from M.I.T. because of scheduling difficulties, we rely chiefly on members of the Educational Council to represent us at these events, of which 122 were covered during the year. In these conferences, which fulfill a significant guidance function, a total of 1,529 students, many of them accompanied by parents, were seen and had an opportunity to discuss their educational plans. Further details of the Educational Council's operations are included in the report of its Executive Secretary.

School Visits

The largest share of the Admissions Office effort went this year, as before, into our program of information, guidance, and public relations *vis-a-vis* the broad public of secondary school personnel, students, and parents. Most of the school visiting program was, as usual, completed during the fall months. This year a total of thirty members of the faculty and administrative staff and seven members of the Admissions Office staff participated in this activity for periods ranging from one day to five weeks. The typical arrangement for a member of the teaching faculty calls for a single week devoted to this work. During the year we visited 679 schools in 41 states and three Canadian provinces. A total of 6,151 students were conferred with, usually in small guidance seminars, the students being preselected by the schools for the purpose of meeting with the M.I.T. representatives.

As usual in these visits, the emphasis was on educational guidance in the broad sense, rather than on "recruiting." This emphasis brings us the confidence and cooperation of school counselors and teachers which is by far our greatest asset. We have consistently avoided the "selling" approach which characterizes many institutions and which has so often produced a defensive and hostile attitude in the secondary schools.

The enthusiasm and energy with which the arduous school visiting activity continues to be carried on each year reflects great credit on the faculty members participating. Special mention should be made of the week spent in the Chicago area by the late Professor Dudley A. Buck, whose contagious enthusiasm elicited a warm response from schools and alumni. The others participating, with interest and vigor, were: Professors Amar G. Bose, George A. Brown, James H. Brown, William H. Brown, William H. Dennen, Cecil G. Dunn, Peter S. Eagleson, John L. Enos, Donald R. F. Harleman, George N. Hatsopoulos, Delbar P. Keily, E. Eugene Larrabee, Philip Lewis, Robert W. Mann, William H. Pinson, Mahmoud Riaz, Maurice E. Shank, William M. Siebert, David A. Thomas, Wallace E. Vander Velde, Kenneth R. Wadleigh, George Wadsworth, Robert C. Wood; also the following: Willard W. Dickerson, James H. Eacker, Dean Robert J. Holden, J. Samuel Jones, Dean Thomas P. Pitrě, and John W. Sheetz.

Selection Policy

During the year the Faculty Committee on Admissions raised the question of criteria for the selection of freshmen in the present highly competitive situation. The Committee proposed that in dealing with cases at or near the margin, more relative weight should be given to high statistical probability of academic success and less to subjective evaluation of the candidate as a person. Since a question of this kind can be dealt with only in terms of actual, concrete cases, it was arranged that the Faculty Committee (essentially a policy committee) should study a selected group of applicants near the margin so as to compare their opinions with those of the Admissions Office staff who constitute, in effect, the working committee. This was an experiment of limited scope because of the severe time limits in the final selection process.

Accordingly, as the admissions staff neared the fulfillment of its quota of admitted students, 50 places were left unfilled. A group of 100 applicants was isolated as being on the borderline between being admitted and being placed on the waiting list. Which 50 of these 100 would be admitted would (within the limits of reliability in judgments) suggest the orientation of the borderline. The admissions staff made its sorting of the 100 into tentative admitted and tentative waiting list groups of 50 each. The Faculty Admissions Committee then read these same folders individually. In 83 of the cases read by more than one faculty member there was a majority vote expressing a Committee decision. The 83 decisions are compared to the admissions staff decisions in the following table.

Admissions Staff Decision	*Faculty Committee Decision*	
	Admissions	*Waiting List*
Admission	22	17
Waiting list	19	25
	—	—
	41	42

It appears that the decisions made by the two groups are almost independent of each other. In addition, analysis of all the possible two-way comparisons of decisions by individual faculty members of the committee show only 64 per cent in agreement. Clearly, the judgments involving these students are not reliably made. It should be borne in mind that these are borderline cases and more difficult to decide than most of those acted on. Divergent judgments are therefore to be expected. However, a comparison of the two groups on which the faculty and the admissions staff made judgments does indicate a difference of emphasis. The 19 cases in the table above, which the Faculty Committee accepted and the staff rejected, showed an average scholastic index of 73 and a personal estimate of 6.7, while the 17 cases which the staff preferred showed respectively 56 and 7.3 for these values. In other words, the Faculty Committee replaced those accepted by the staff with others having, on the average, scholastic indices 16 points higher but 0.6 less on the personal estimate.

Thus the Faculty Committee has proposed in general terms that fewer very bright applicants be rejected for nonacademic reasons. Further, the Committee has reinforced this expression of policy by making decisions on an actual group of borderline applicants independently of decisions made by the admissions staff under the present policies. This shift in policy affected only about 1 per cent of the admitted class, since the numbers in the experiment were limited. It is nevertheless a change in favor of admitting more students with high academic potential but lower personal promise, and correspondingly reducing those of more evenly balanced qualifications and those who, though outstanding on personal grounds, are nearer the margin academically.

Certain of the criteria presently employed in admissions (particularly those in the nonacademic realm) involve value judgments that have not been verified as valid by empirical study. Some can never be verified empirically by their very nature. A question does arise, however, as to whether a searching investigation into nonacademic factors and their relation to professional accomplishment in later years should be made. At present the Institute has only very fragmentary knowledge of the accomplishments of its alumni. How these accomplishments are related to student careers and to admissions policies should be made the subject of systematic and extensive investigation. The rationale behind any personal estimate implies that there are values relevant to selection whose validity cannot be tested by freshman marks or even by undergraduate academic performance over a period of four years. What we need to explore is the hypothesis that applicants who exhibit in high school qualities such as energy, responsibility, maturity, good judgment, and an ability to work effectively with others will, over the long pull, contribute more to the good of society than others in whom such qualities are not detected by teachers and counselors — or at least in whom they are not evident to as great an extent — but who show somewhat greater academic potential as judged both by school marks and test scores. At present these questions are the subject only of speculation and conjecture.

Guidance Conference

Our third annual conference for secondary school guidance counselors was held on October 8 to 10, 1958, attended by 106 people, of whom 36 were women. They came from 38 states, the District of Columbia, and Canada, and represented 88 public and 12 independent schools. Extensive participation in the events of the two-day program by members of the M.I.T. faculty and administration did much to impart to our visitors an appreciation of the nature and purposes of the Institute. This is peculiarly important because these secondary school people, educated almost exclusively in teachers' colleges or colleges of liberal arts, have little knowledge of what an institution such as this seeks to accomplish. The program, planned by Professor Paul M. Chalmers and Mr. Chamberlain, provided some systematic exposition of M.I.T.'s educational objectives and also encouraged critical discussion and interchange of opinion through small group meetings.

As has been the case for a number of years, the National Council of Independent Schools held here in June the two-day meeting of its central committee, numbering about seventy men and women. It is highly desirable that this rotating group of representative leaders in secondary education should have a close and continuing relationship with M.I.T.

The student guide system, under the direction of Mr. Chamberlain, employed fifteen students and escorted a total of 4,558 visitors on tours of the campus during the year. Credit is due to Peter H. Stadler '59, Captain of Student Guides, for the efficient conduct of this essential service.

J. Peter Anderson, Assistant to the Director of Admissions, resigned on July 24, 1959. Robert K. Weatherall continues in this capacity. Willard W. Dickerson, Jr., who spent the year just past as Assistant to the Dean of Students, has rejoined the Admissions Office as Assistant to the Director of Admissions.

B. ALDEN THRESHER

ADVISER TO FOREIGN STUDENTS

This report covers the calendar year beginning July 1, 1958; the statistics are for the academic year beginning in September, 1958.

Requests for admission were received from 2,578 foreign students from nearly every country in the world. The comparable figure for the previous year was 2,536. In spite of rising dollar costs of an M.I.T. education, the demand for places remains high. Roughly one-third of this demand is from high school graduates whose parents want them to receive their undergraduate education in the United States. The remaining inquiries come from potential graduate students. Many of these are supported by scholarship programs, some of which are sponsored by the American government, more by governmental or industrial grants of other countries.

Informational material was sent to these 2,578 inquiries. If further correspondence revealed a serious applicant and a reasonably good chance of admission, final application material was sent. These final applications were sent to about 1,600 of the original inquirers. Of these, 985 filed their applications with such a degree of completeness that action could be taken on them. The figure for 1957 was 866 — making the 1958 total a substantial increase. Of these 985, 392 were granted admission. Of those admitted, ninety (23 per cent) subsequently canceled, most of them for financial reasons.

Of the 302 foreign students who registered at M.I.T. for the first time in September, 1958, 45 were freshmen, 39 were undergraduate students with advanced standing, and 218 were graduate students. In 1957 there were 321 foreign student admissions as against 302 for 1958, so that selection became slightly more strict.

Each year the Institute of International Education, the largest private foundation concerned with student exchange, conducts a census, published under the title, *Open Doors*. The following table is excerpted from their report of the academic year, 1958–59:

U. S. Institutions with More than 500 Foreign Students

	Total enrollment	*Number of foreign students*	*Per cent of total enrollment*
University of California	41,598	1,693	4.0
New York University	31,068	1,670	2.2*
Columbia University	26,787	1,380	5.2
University of Michigan	26,370	1,139	4.3
University of Minnesota	35,852	1,136	3.2
University of Illinois	25,920	908	3.5
University of Southern California	17,950	814	4.5
Massachusetts Institute of Technology	6,137	762	12.4
Harvard University	13,131	716	5.5
University of Wisconsin	24,873	709	2.9
Cornell University	11,102	708	6.4
University of Texas	18,563	542	2.9

* *Sic.* According to the figures given here, however, this percentage should read 5.4. — Ed.

Professor Philip Franklin of the Department of Mathematics resigned his position as Fulbright Adviser during the year, and President Stratton appointed as his successor Professor Isadore Amdur of the Department of Chemistry. Professor Amdur reports that fifteen M.I.T. students have been granted awards for study abroad next year.

An outstanding contribution to the extracurricular program of the foreign student on the M.I.T. campus was made by the International Program Committee, the Chairman of which was Jaime de Sola '60, whose home is in Curacao, N.W.I. The committee organized and ran an interesting and stimulating series of meetings during International Week in April, 1959. For this activity the committee was cited for a Karl Taylor Compton Award, with a grant of $500 for its future work and a special commendation for Chairman de Sola.

The Foreign Student Committee of the Technology Matrons, as in the past, has contributed immeasurably to the comfort and happiness of the M.I.T. foreign students, their wives, and their families. Home hospitality, get-acquainted occasions on campus, help with housing — all have been provided with skill and friendliness. The committee has found new and imaginative ways to be of service under the leadership of Mrs. Houlder Hudgins. She has now been succeeded by Mrs. Milton C. Shaw.

A special subcommittee of this Foreign Student Committee has assisted newly arrived married foreign students in finding suitable apartments. This is a greatly needed and much appreciated service, in light of the perennial and severe housing shortage which Boston shares with most other American cities and of the difficulties inherent in the arrival of a young family in a strange city in a strange country. Mrs. Howard F. Taylor has made an especially valuable contribution in this area. She is succeeded by Mrs. J. Francis Reintjes.

Eugene R. Chamberlain and J. Peter Anderson, both of the Admissions Office staff, have continued to act as Associate Advisers to Foreign Students. Mr. Chamberlain was on the program of the annual conference of National Association of Foreign Student Advisers in April, 1958, and is chairman of one of its standing committees. The undersigned served on the Board and on the Executive Committee of NAFSA.

PAUL M. CHALMERS

EXECUTIVE VICE PRESIDENT OF THE ALUMNI ASSOCIATION

From the start of the Alumni Fund in 1940 up to June 30, 1959, total alumni benefactions to the Institute have amounted to $31,203,222, of which sum $4,312,453 represents contributions received directly through the Fund. For 1958–59, the corresponding totals are $4,755,905 and $575,499.

Progress is also to be noted in the number of alumni "participating" in the Alumni Fund's program for "annual giving"; *viz.*, for 1958–59 there were 15,131 alumni contributors to the Fund compared with 13,331 for 1957–58 and 12,001 for 1956–57.

During 1958–59, no new M.I.T. clubs were organized, and the present total of 94 such geographical groups continues to be subdivided as follows: 68 are within the continental United States, 14 are elsewhere in the Americas, and 12 are overseas in the other hemisphere.

Senior among the 94 is the M.I.T. club of Chicago, founded in 1887, and second is that of Denver which this year passes its seventieth birthday. Other notable decennial anniversaries of M.I.T. clubs during 1959 include: the sixtieth of Pittsburgh; the fiftieth of Milwaukee and Spokane; the fortieth of Portland, Maine; and the thirtieth of Monterrey. During 1960, four clubs will have their fiftieth: Providence, Rochester, Mexico City, and Manila.

During the twelve months ended last April, 72 members of the Institute staff and Alumni Council attended 108 meetings of 64 different M.I.T. clubs.

Two of these meetings were regional conferences, our thirteenth and fourteenth held, respectively, at Albuquerque on November 8 and Detroit on January 31. Each conference was an event highly rewarding to those attending, but because of the impending centennial celebration of 1961, further regional conferences will not be held until 1962.

In addition to the regional conferences, the record of notable alumni foregatherings during 1958–59 included:

On September 12–13, our second Alumni Fund Conference held at Cambridge; on November 17, the Silver Stein Dinner of the M.I.T. Club of New York; on December 22, the seventh annual pre-Christmas joint banquet of the M.I.T. Clubs of Dallas and Fort Worth.

On January 10, the dinner of the M.I.T. Club of Panama in celebration of its thirtieth anniversary; on March 10, the dinner of the M.I.T. Club of Monterrey in celebration of its thirtieth anniversary; on March 12–14, the eleventh annual fiesta of the M.I.T. Club of Mexico City; on March 18, the dinner of the M.I.T. Club of Central Massachusetts at Worcester to honor President Stratton.

On April 23, the dinner of the Rocky Mountain M.I.T. Club at Denver in celebration of its seventieth anniversary; on April 30, the dinner of the M.I.T. Club of Puget Sound at Seattle to honor President Stratton; on May 5, the dinner of the M.I.T. Club of Chicago honoring Professors Charles S. Draper and H. Guyford Stever.

On May 23, the sixty-second anniversary dinner of the M.I.T. Club of Philadelphia at Wilmington; and on June 15, the twenty-fifth Alumni Day, the program of which included the Inauguration of President Stratton and the eighty-fourth annual banquet of the Alumni Association.

A census of the Association's membership taken last March 31 showed a total of 63,596 names: 50,023, or 78.7 per cent, being carried in living status, and 13,573, or 21.3 per cent, as deceased. Four per cent of the 50,023 living alumni — that is, a total of 2,011 — 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 2,011 living alumni who were 50 or more years out, 80 were nonagenarians and 755 were octogenarians.

HAROLD E. LOBDELL

EXECUTIVE SECRETARY OF THE EDUCATIONAL COUNCIL

This is the eighth annual report on the Educational Council. As in previous years, the interest, enthusiasm, and energy of the alumni who make up the Council cannot be described adequately. At the present time, membership in the Council stands at 740, with 694 members in the United States and 46 in other countries. An active school assignment program, involving 1,147 secondary schools in 148 areas, is now carried on in the United States. Less direct relations are maintained with an additional 262 schools. Council members are available in an additional 35 areas, but there is not yet a school relations program in these.

A fundamental part of Council activity is guidance of students. Council members frequently visit secondary schools in their areas on an informal basis, in order to aid them in their programs of counseling. Aside from these many informal visits, Council members last year attended 122 college nights and conferences in their local high schools and reported 1,529 student counseling contacts. An integral part of the Institute's school relations and student counseling program are the annual visits of faculty and staff members to secondary schools throughout the country. In all, 679 schools were visited last year. In 244 of these, a valuable reinforcement of Institute and local activity was achieved by joint visits of Council members and faculty or staff members.

In addition to these important long-range guidance and counseling activities with schools and groups of students, the Council members continued to perform a valuable service to individual students and an immediately beneficial service to the Institute. This was accomplished by personal conferences with students specifically interested in M.I.T. and by reports on these students, which were most helpful in the selection process and in the determination of financial aid awards. Last year 6,767 students were referred to Council members, and 3,263 reports on interviews with students were recorded. As in previous years, almost 70 per cent of the class which enters in September will have been aided by members of the Council.

An important activity of the Council office is to aid Council members in keeping up-to-date on Institute affairs and developments. Mailings of varied and extensive printed materials to Council members have been continued. Of equal importance have been the many meetings and visits of faculty and staff members with Council members over the country. Between early October and mid-May, the Executive Secretary had the pleasure of visiting with 38 Council groups, and 3 visits were made to new areas needing Council representation.

Council members have continued the valuable service of representing the President of the Institute at local academic functions. During last year, 15 members of the Council attended centennial, inaugural, or convocation ceremonies at sister institutions.

Perhaps the most significant development of the past year, and one which clearly illustrates the vital and exciting nature of Council activity, has been the comprehensive revision in the school assignment program. The virtual explosion of suburban developments across the country, with the attendant development of new schools, requires constant adjustment and expansion in our school relations activity if our school assignment program is to be effective. An imaginative and enthusiastic attack on this problem has been made by Council members in many areas, and in many other areas plans are in hand for reorganization and expansion.

D. HUGH DARDEN

DIRECTOR OF THE INDUSTRIAL LIAISON OFFICE

The year 1958–59 began a new decade for the Industrial Liaison Program at M.I.T. This year, more than ever before, the Program has reflected the Institute's dynamic growth as an educational institution and industry's increased dependence upon M.I.T. as a center of basic research in science and technology. At the conclusion of its eleventh year of operation, the Liaison Program reached new levels of activity in all of its parts. The basic purpose of providing organized communication between M.I.T. and a select group of companies remained unchanged. But the utility of organized liaison at a time of greatly proliferated scientific knowledge stimulated renewed interest among participating companies.

The statistics of operation bear out this conclusion dramatically. Compared with the previous year, attendance by company representatives at Industrial Liaison symposia increased by 50 per cent; the volume of faculty visits to member company research laboratories more than doubled; 18 per cent more M.I.T. publications were put into company channels; campus visit activity rose by 15 per cent; and the demand for reference material on current research projects grew significantly. To some extent, these increases were due to general economic recovery and to improved services offered to participating companies. But the overriding influence has been a reawakening on the part of industry to the importance of basic research and to the advantages of a shortened time interval between discovery of fundamental knowledge and its application.

The slow recovery from the 1957–58 recession resulted in a leveling off in the number of participating companies and income associated with the Industrial Liaison Program. At year's end, there were eighty-nine companies distributed among the following industries:

Aviation	17%	Insurance	4%
Chemicals	13%	Manufacturing	20%
Electronics	19%	Metals	9%
Food	5%	Petroleum	13%

Four new companies joined the Program, replacing an equal number who found it necessary to withdraw for budgetary reasons. Income for the year totaled $1,185,209, or within 7 per cent of the pre-recession record of two years ago.

Conferences and Symposia

Several of this year's conferences sponsored exclusively for participating companies attracted national attention. Fourteen such meetings of one- and two-day duration were held on the following topics:

Metallurgical Applications of X-Ray and Neutron Diffraction Techniques
Reinforced Plastics and Adhesion
Building Materials as Integrated Systems
Direct Conversion of Heat to Electricity
Computer Simulation of Industrial and Economic Processes
Mass Transfer
Organization of Research and Development in Decentralized Companies
Analytical Chemistry
Information Processing and Coding in Biological Systems
Surface Chemistry and Surface Physics
Control of Aircraft and Spacecraft
High Temperature Metallurgy
Industrial Dynamics
Fluid Power Control

A total of 911 company representatives attended these symposia in groups ranging from 23 to 148; average attendance was 65, or 30 per cent larger than the preceding year. The meetings were informal in nature and designed to stimulate free interchange of ideas, concepts, and experimental results. Much of the research discussed represented work in progress, little of which had appeared in the professional press at the time of presentation. Attendance at the meeting on Research Organization in Decentralized Companies was limited by personal invitation to top research management; thirty-eight vice presidents and directors of research gathered at this symposium to hear the first results of a two-year study of this subject in the School of Industrial Management.

These conferences featured reports by 107 M.I.T. staff members and nine invited speakers from outside organizations. They continue to prove a most efficient method of exchanging research information, notably in indicating profitable areas for future study. Their value is often enhanced by the interdisciplinary coverage of research not normally available in professional society meetings. Faculty interest in these symposia was particularly gratifying; upwards of seventy members of the teaching staff attended to hear current reports on M.I.T. research in departments and laboratories other than their own. A number of graduate students also attended, at the suggestion of their thesis supervisors, to gain perspective about current developments in fields in which they are writing.

Member companies were invited to attend numerous M.I.T. seminars, conferences, and colloquia sponsored by various departments at the Institute or by professional societies. These included major conferences on physical electronics, beryllium disease, brittle fracture, astronautics, and nuclear science, as well as many shorter seminars and colloquia of current interest. The Industrial Liaison Office was asked to contribute its experience to the planning and conducting of several special conferences at M.I.T. during the year. Assistance was also given to Harvard University in planning a three-day conference on Scientific Creativity in an Organizational Setting as well as to three other institutions which have recently initiated industrial liaison programs of their own.

Publications

The distribution of M.I.T. publications to participating companies improved both in coverage and quality during the year. A total of 446 titles was sent, of which one-third were preprinted in advance of publication in the professional press. Two new progress reports were initiated by the Computer Components and Systems Group and by the Energy Conversion Group. Abstracts of graduate theses in earth sciences and nuclear engineering were added to last year's coverage of thesis reports in four engineering departments. Total documents mailed during 1958–59 increased to 102,200 from 86,700 in the preceding year.

Timeliness and relevance were stressed to a greater degree than ever before in selecting printed material for distribution. Preprinted articles on "Thermodynamics of Electron Engines," "Properties of Gases at Extremely High Temperature," "Micromechanism of Brittle Fracture in a Low Carbon Steel," and "The Total Synthesis of Penicillin" aroused particular interest. Three technical reports on "Study of Electrical Energy Conversion Systems for

Future Aircraft," "Optimal Flow Through Networks," and "Basic Data of Electrical Discharges" also attracted considerable attention.

Special requests for Institute publications continued to rise. For example, the four most active companies in this regard sent 145, 96, 73, and 61 separate letters requesting information on M.I.T. research projects or specific publications. An estimated 2,500 inquiries of this type were processed during the year; prompt and courteous service was keynoted throughout. At the close of the year, a new checklist survey was developed to re-establish member company interest in receiving M.I.T. publications on an automatic basis. This is but one example of several techniques being studied that should result in an improved flow of research information to participants.

Visiting Programs

Individual visits to the campus by key people from each company occupied a major share of the attention of the Industrial Liaison Office. The profile of this activity clearly indicates both an intensified and broadened interest in M.I.T. research. The 15 per cent increase in over-all volume was due partly to liberalized company travel policies and partly to the discovery of new fields of interest at the Institute, a principal motive for making these visits being the establishment of new areas of company research activity. The general broadening of company interest permitted a 16 per cent wider participation by Institute staff members, which greatly assisted the Industrial Liaison Office in moderating the demands placed on individual faculty members. A total of 427 M.I.T. staff members were consulted this year, as compared with 367 in the preceding year, the general pattern being fewer visits with more Institute personnel and wider coverage of M.I.T. fields of activity. In addition, forty-four planned visits were made by Institute staff members to company research laboratories under a new program of presenting progress reports on M.I.T. research in person. The enthusiastic response to these visits indicates a clear need to strengthen this phase of industrial liaison.

The professional value of this organized interchange can only partly be measured in terms of specific results obtained during the year. The more significant benefits are those which contribute to the long-term progress of research both at M.I.T. and within the laboratories of participating companies; these benefits are far more subtle and difficult to estimate, but they are believed to be substantial. This year's activity provided a number of younger Institute staff members with opportunities to widen their professional acquaintances in industry. From a company's point of view, establishing such associations early in a faculty member's career has obvious advantages beyond professional intercourse in a particular field of current interest. Personal contact with company research leaders added notably to the faculty's knowledge and appreciation of company research programs. In some instances this knowledge was useful in proposing financial support of related research at the Institute; the result was a number of grant-in-aid and sponsored research programs. Teaching aids, samples of company products, the loan or gift of laboratory equipment, and graduate thesis suggestions are further examples of specific benefits which accrued to the faculty during the year. In addition, several faculty members were presented attractive opportunities for private consulting relationships with member companies.

Other Developments

On November 19, 1958, the Faculty Committee on Industrial Liaison presented a progress report on the Industrial Liaison Program in the regular monthly faculty meeting. The Committee reviewed the Institute's philosophy and operating experience during the first ten years of the Liaison Program and later circulated a printed report. Continuation of the present outlines of the Program and wider faculty participation were the principal recommendations.

Merrill J. Baumann, Winston R. Hindle, Jr., Robert D. Haberstroh, Kendall B. Randolph, and Lamar Washington served as Industrial Liaison Officers throughout the year. The energy and imagination with which they have carried out their responsibilities stand behind the accomplishments described above. That it has been possible to bring about these results with a reduced office complement, without compromising the personal quality of their work, is impressive indeed. It speaks highly for their individual performance, as well as for their effectiveness as a group. Their duties have been lightened by the active support and genuine cooperation of the Institute faculty and staff. At the year's end, Merrill J. Baumann completed his tour of duty and left to accept a position in industry. On October 1, 1958, the undersigned succeeded William R. Weems, who resigned as Director of the Industrial Liaison Office to take a position with the International Cooperation Administration overseas.

VINCENT A. FULMER

JOINT CENTER FOR URBAN STUDIES

In the past academic year, Presidents Pusey and Stratton signed an agreement establishing a Joint Center for Urban Studies of the Massachusetts Institute of Technology and Harvard University. The chief aim of the Joint Center is to encourage a new level of interest in urban studies at both institutions. The offices of the Joint Center are at 66 Church Street in Cambridge. The Joint Center has already begun to bring together architects, engineers, urban planners, economists, sociologists, lawyers, political scientists, philosophers, scientists, and experts in business, public health, and other disciplines affecting urban life.

The principal studies under way are: Analysis of Future Manpower Needs of Urban Governments (Associate Professor Robert C. Wood, M.I.T. Department of Economics and Social Science); Attitudes Toward the City: A Philosophic History (Professor Morton G. White, Harvard Department of Philosophy); British Legislative Provisions Governing Compulsory Acquisition of Land (Professor Charles M. Haar, Harvard Law School); A Comparative Study of Politics in the Larger Metropolitan Areas of the United States (Professor Edward C. Banfield, Harvard Department of Government); Criteria for Urban Design (Associate Professor Eduard F. Sekler, Harvard Department of Architecture); Development Decisions in Early Suburbs of the Boston Metropolitan Area (Sam B. Warner, Jr., Research Associate in Urban Studies); Economic Implications of City Size (Robert S. Rodd, M.I.T. Department of Economics and Social Science; Research Fellow In Urban Studies); Evaluation of Differences in Development Patterns of French Cities (Professor Daniel Lerner, M.I.T. Department of Economics and Social Science); Issues of Race in Northern Cities (Professor Charles Abrams, M.I.T. Department of City and Regional Planning); Measurement of Urban Traffic (Aaron Fleisher, M.I.T. Division of Sponsored Research); Physical Capacities of Urban Passenger Transportation Media (Assistant Professor Albert S. Lang, M.I.T. Department of Civil and Sanitary Engineering); Potential Influence of Information Technologies upon Metropolitan Organization (Visiting Lecturer Richard L. Meier, Harvard Department of City and Regional Planning); Settlement Patterns: Cross-Cultural Analysis of Space Utilization (Professor John W. M. Whiting, Harvard Laboratory of Human Development); The Urban Family House: A Project in Design (Professor Serge Chermayeff, Harvard Department of Architecture); Utility of Boston's Metropolitan District Commission (Professor Charles R. Cherington, Harvard Department of Government); and The Visual Form of the Metropolis: Explorations in Perception (Associate Professor Kevin A. Lynch, M.I.T. Department of City and Regional Planning).

The Joint Center is responsible to an Administrative Committee consisting of three officials from each institution. The Harvard members of the Administrative Committee are: Dean McGeorge Bundy of the Faculty of Arts and Sciences; Dean Jose Luis Sert of the Graduate School of Design; and Dean Don K. Price of the School of Public Administration. The M.I.T. officials are Carl F. Floe, Vice President, Research Administration (Chairman of the Administrative Committee); Dean John E. Burchard, School of Humanities and Social Science; and Dean Pietro Belluschi of the School of Architecture and Planning.

The Faculty Committee, chaired by Professor Lloyd Rodwin (M.I.T.), is responsible for general policies for the Joint Center. The members of the Faculty Committee from M.I.T. are: Professor John T. Howard, Head of the Department of City and Regional Planning; Professor Max Millikan, Director of the Center for International Studies; Professor Sidney S. Alexander of the School of Industrial Management; and Professor John B. Wilbur, Head of the Department of Civil and Sanitary Engineering. The Harvard members are Professor John M. Gaus of the Department of Government; Professor Samuel A. Stouffer, Director of the Laboratory of Social Relations; Dean John Snyder of the Graduate School of Public Health; Professor Reginald R. Isaacs, Chairman of the Department of City and Regional Planning; and Professor Martin Meyerson, Williams Professor of City Planning and Urban Research, who is Director of the Joint Center.

MARTIN MEYERSON, LLOYD RODWIN

DIRECTOR OF LIBRARIES

The Libraries, in step with the rest of the Institute, are booming. Activity in every reading room is intense throughout the day, over the weekend, and this year further into the night than ever before. Traffic in and out the doors of the Libraries, the number of books in circulation, and demands upon the staff are increasing faster than the Institute population. This is a challenge to which the Library staff is responding with an enthusiasm most gratifying to the Director.

Administration

During the year several steps were taken to strengthen the administrative organization of the Libraries. On April 1, Ryburn M. Ross, Executive Officer of the Science Library, was promoted to Associate Director of Libraries. He will have primary responsibility for those departments which order, receive, exchange, bind, and catalog. In the last ten years the Libraries have tripled in staff and budget and increased by an even larger factor in space and number of users. For the most part, methods of acquiring and handling materials have remained unchanged. With the new head of the Acquisitions Department, Miss Paula Gibbons, Mr. Ross is undertaking to rationalize the flow of orders, records, and materials in this area, which is called Technical Services.

Reader Services, which include reading rooms, circulation desks, and information and reference services, now come under the direct supervision of Miss Natalie Nicholson, who shares with the librarians in charge the job of adapting the physical facilities and services to the ever-increasing number of students, teaching and research staff, and outsiders who come to our Libraries.

Aided by these two Associate Directors and by Professor Secor D. Browne, Vice Director for Slavic Materials, it is the duty of the Director to make certain that the Libraries are and remain responsive to the present and future needs of the Institute community. This entails not merely providing more and more journals and books, staff to organize them, and well-lighted and ventilated reading rooms. The major job is to anticipate new trends in education and research, adapting facilities and materials to future needs. If remarkable work in geology is being published in Chinese journals, we must subscribe to them now against the day when Chinese-reading geologists will ask for them.

Building Research Collections

Only by close cooperation with the faculty and the administration is it possible for the Libraries to fulfill their long-term mission. The year has been particularly fruitful from this point of view. The demand for Russian materials is increasing rapidly, with requests for titles coming in at the rate of over seventy a month from a new group of faculty members appointed by the department heads to advise the Libraries on Russian materials. Almost all of this group read Russian. Their assistance already has been of great value to Professor Browne and to Mrs. Elena Caffrey, Slavic and Exchange Librarian, who are handling these Slavic materials. This faculty group is spending a large amount of time looking over lists of Russian works, suggesting titles, and evaluating the books when they arrive. As representatives of their departments, the group is trying to insure that we get first-rate coverage of all areas of interest to the M.I.T. faculty. The Faculty Advisory Committee on the Libraries does the same job for non-Slavic materials, and the Faculty Executive Committee on the Libraries assists the Director in matters of general policy. The Director and staff are grateful to the more than fifty faculty members who are helping us build fine research collections.

Russian Publications

It is not easy to obtain worthwhile books and journals from the Russians. The accepted Western method of sending an order, receiving the material, and paying the bill when it comes simply doesn't work most of the time. To have a good chance of getting a copy of a Russian book, you have to order it before it is published. Editions are small, and important books sell out within a few days after publication. There are only one or two dealers in the world who are relatively successful in getting Russian works, and there are none in the United States. It does not seem possible to subscribe at all to many journals.

The most successful way of getting what we need from Russia is by exchanging our works for theirs. Their libraries, universities, institutes, and academies have difficulty in procuring American books because they cannot get dollars. So they are eager to set up exchange arrangements. In October, Professor Browne made a month-long trip to Moscow and Leningrad to negotiate exchange agreements with the Institute of Scientific Information of the Russian Academy of Sciences and with half a dozen of the largest libraries. It sometimes takes a month or more to get the particular item we want; sometimes we can't get it at all; but exchanges of this kind have been relatively successful so far. We have requests for nearly three hundred items outstanding. Long lists of desired American works keep arriving and we attempt to supply these, but we do careful bookkeeping on the operation, so as to keep in balance.

One thing the Russians want is reports from M.I.T. laboratories. The Institute seems to be widely known and its work respected. The rules of the Commerce Department regarding the export of technical data have now been modified so that all published material may be freely sent anywhere in the world. It would be of great value to the Institute in the long run if at least one and preferably two copies of every unclassified work published in any part of the Institute could automatically come to the Libraries to be a part of the permanent record. Our exchange program would be strengthened if we could have six copies for this purpose.

Two other activities of the M.I.T. Libraries have to do directly with Russian material. One is the Russian Journal Translation Project. A grant was obtained from the National Science Foundation two years ago to cover the cost of translation and production of English versions of three Russian electronics journals, beginning with the 1957 issues. When the first year's allocation of $70,000 proved more than adequate, a fourth journal, in the instrumentation field, was added. In the latter case the project was done jointly with the Instrument Society of America, which has now received a direct grant from the Foundation to continue the translation of that journal and add three others. The three electronics journals are in their second year and it is anticipated that the project will be continued, although the number of subscriptions has been disappointing.

Another step toward providing coverage of Russian literature at the Institute is the signing of an agreement with the Office of Technical Services of the Commerce Department. Under this we have become a depository library for translations collected by OTS from government, industry, and private translators. We joined the program on January 1 and are already getting a substantial quantity of material.

The OTS material is not getting as much use as we had expected. One obvious reason might be that there is already too much material in English for people to read, a fact which might also explain why the subscription lists for translated journals remain small.

Documentation Studies

The new science of documentation has come into being to organize and furnish specialized information. Punched cards and high-speed memories have been applied successfully to industrial information problems. The narrower the field, the better the success documentalists and information officers in industry have in providing up-to-date coverage through state-of-the-art summaries and abstracts. Large libraries covering numerous fields of interest, like our Science Library, and serving users whose needs may extend to anything in the life or physical sciences, present a communication problem of a complexity which documentalists have not been able to tackle.

Some hopeful avenues of research are being explored by Dr. Myer Kessler of the Lincoln Laboratory, in cooperation with others interested at Lincoln and with members of the Institute Library staff.

Two small studies have already been started at Lincoln. One is an attempt to describe a field of study in terms of the footnotes and references of papers in the field. According to whether these converge or diverge, the field would seem to be more or less closely knit, and by taking time into account one may learn whether the field is developing more or less rapidly. Once a field is defined in these terms, other books or articles may be described, again in terms of footnotes and references, as central or peripheral with respect to the field.

A second of Dr. Kessler's studies applies dimensions to a book, paper, or report. This is a new approach to subject headings, substituting numbers for the usual verbal descriptors. Several sets of numbers can be derived and used to locate each item in the multidimensional shape of human knowledge.

Like books and papers, the interests of an individual can be described in terms of a number of subjects, some central, some peripheral. The problem of supplying information of interest to the individual then becomes a simple one of matching. "Ideally," Dr. Kessler says, "a central information service might provide every scientist with all new papers of interest to him and only those." It is possible that such a service might be a more effective aid to the scientist in keeping current with his field than are the abstract services, which have grown so bulky that many find them no longer usable.

Libraries have never been able to provide anything approaching this type of service. At best they produce lists of new books or perhaps a monthly bibliography of articles of unusual interest such as the "For engineers — have you read these articles?" issued monthly by the staff of the Engineering Library for the faculty of the School of Engineering.

Not only the bulk but the time lag of abstract services is discouraging to those who are trying to keep up in their fields. New commercial "express" services have appeared at subscription rates in the hundreds-of-dollars-per-year bracket. University libraries can scarcely afford these. Yet here is an area where something might be done to make it easier for our people to keep up-to-date. More and more, books are taking second place as a source of current information. Significantly, all the books in the Science Library, except those on reserve for required reading, are kept on the mezzanine to make room on the main floor for journals. Much skilled labor is spent cataloging books. The techniques are thorough and effective. But libraries do almost nothing with journal articles, for we could not begin to enter them in the catalog by author, title, and subject as we do monographs. Yet a way needs to be found to make the content of journal articles more accessible.

Another research project at the Institute involves a pilot study of the possibility of storing in a large computer-type memory all of the information which would be in a conventional catalog, plus author, title, and subject headings for all the articles in journals received in the last year or two. To limit the size of the memory, references to journal articles could be erased after a predetermined length of time, making way for new ones. It is proposed also to put in this storage all the secondary information about the individual items in the collections, starting with the suggestion for purchase and continuing through the stages of ordering, acquisitioning, cataloging, shelving, and circulating (including overdue notices and fines) until the final withdrawal and discard. Title, author, and much other information is copied perhaps one hundred times in the life of each item and stored in dozens of files. It is possible that much of this clerical routine might be eliminated with resulting great financial savings and improved speed and efficiency of service to library users.

Journal Subscriptions

The emergence of the journal as the primary source of new scientific information poses another major unsolved problem for the Libraries. Although journals are far cheaper word for word than books, subscription rates have been going up. Between 1948 and 1958 subscription rates have approximately doubled. They have gone up an average of 10 per cent in the last year alone. The story is the same for book prices. But the pinch is most severely felt in the fact that new journals must be added while subscriptions to most of the old ones are continued. During the year we submitted lists of the journals currently received to the Faculty Advisory Committees with the request that they eliminate every journal which is no longer needed. Some 25 out of a total of 3,053 journals currently received have been dropped. Another 20 ceased publication during the year. Only 67 new ones were added, but this is far short of the minimum needs. There is hardly a field in which important new journals did not appear during the year, most of which we were unable to buy for budgetary reasons. This compounded inflation of the rising cost of everything we buy and of salaries, plus the need to keep up with an expanding world production of scientific literature, makes the Libraries' bite on the general Institute budget all too reminiscent of the camel in the Arab's tent.

Recognizing these difficulties, the Budget Committee has been generous with the Libraries. The budget has been increased an average of 12 per cent in each of the last three years. Thus we have been able to buy most of the books we need and some of the periodicals, and we have been able to pay salaries high enough to keep most of our best people. Yet the failure to buy important new journals is serious. We are taking 72 from Russia and other Iron Curtain countries where we should be getting several hundred. We are taking 3 Chinese journals and very likely should be getting 20 or 30. In the West we probably should have added between two and three hundred journals out of the "approximately 1,200 responsible new journals in science and engineering" which commenced publication in 1958, according to a report from the Library of Congress. Another source gives 2,000 as the figure for new technical journals in the one year. It does not seem possible for this rate of expansion of the journal literature to continue. Yet if we are to have first-rate libraries, we must subscribe to the important new journals and we must subscribe in the first year, for the early numbers usually go out of print quickly and it may be impossible to get a complete set if subscription is delayed for several years. Other works which are issued in series — collective works on particular subjects, monographs, certain types of reports — also are increasing in number and in cost. It is in these two areas of serials and journals that our resources have failed most seriously to meet the need.

A list of all of our holdings in Current Serials and Journals, published last year for the first time, proved so useful that a new edition was prepared this year by the Catalog Department and the staff of the Computation Center. The cost of printing has been paid for by sales to other libraries, particularly industrial libraries, in the region. The list not only helps them by letting them know which titles and which numbers we have, but it saves hundreds of telephone calls to the Reference Department.

Industrial Use of the Libraries

It is the Reference Department which acts as our central information service, and it is there that the impact of use of the M.I.T. Libraries by industry is most clearly felt. Only 433 Library Privilege Cards were issued to individuals not connected with M.I.T. during the year; but of the 15,260 inquiries received by the Department — mail, telephone, and personal calls — one-third were from outsiders, with nearly half the telephone calls from industry. The total is up sharply from last year, when it was 13,558.

Use of the Libraries by those connected with industry has been increasing, but it has been difficult to get figures. There is no control over those who enter the reading rooms and simply consult journals and books on the shelves. Only if someone asks to borrow a work for outside use must he produce a Library Card. Still, librarians from many neighboring companies use our facilities extensively to supplement their own. We have charged $10 a year for a Library Privilege Card, but on the recommendation of the Visiting Committee of the Corporation we have decided to increase the price to $25. At the same time, ways are being studied of permitting companies which use our resources to contribute to the cost of maintaining them.

In an attempt to get data on several aspects of the use of the Libraries, a Library Use Survey was conducted in the Dewey, Engineering, General and Humanities, and Science Libraries during the week of May 11. In all, 8,798 questionnaires were given to those entering the Libraries at certain hours during the week and over the weekend. Members of the Operations Research Center have helped in drawing up the questionnaires and in coding and processing the results. When these have been tabulated, significant patterns of library use will be available for future planning.

From a partial analysis of the questionnaires, a few interesting statistics are already available. Average use of the Libraries by outsiders is a little over 6 per cent of the total on weekdays and nearly 10 per cent on weekends. In both instances the Science Library shows the highest percentage of outside use, with an almost equal number coming to General and Humanities. Of the outside users, 24 per cent were from industry, 5 per cent from government, and 71 per cent were students from educational institutions. Fifty-six different educational institutions and 67 different companies were represented in the brief time of the survey.

Space and Facilities

Space for readers and new materials in several of the Libraries has reached the vanishing point. This was true last year in Dewey, but improvements were made during the summer: stacks were extended into empty spaces, portions of an adjoining room and of a hall were incorporated into the Library, and the circulation desk was extended to make room for more help, with the result that shelving was increased over 30 per cent and some thirty new chairs were provided. Number of readers and materials borrowed are still increasing at the rate of roughly 10 per cent a year not only in Dewey but also in Science, Engineering, and Aeronautics.

The addition of astronautics to the aeronautical engineering field, with new subjects and the necessary new books and journals, is causing that Library to burst at the seams. The number of books borrowed is up 18 per cent this year, to 11,778. The pressure can be relieved temporarily by moving some of the older materials to the Engineering Library—but at the cost of some inconvenience to the users. What is not so easy and no less inconvenient is to provide more tables and chairs, for there is almost no floor space. Probably six or eight more chairs and small tables can be fitted in, but it is only a year or two at most before more space will have to be provided.

The Engineering Library is the best off for shelf space. But it is becoming crowded. More chairs and tables can be added in the stacks on the upper floors. Circulation of books in the Engineering Library increased from 25,987 in 1957–58 to 31,280 in 1958–59. The increase is explained by Ralph McNay, Engineering Librarian, as resulting from changes in engineering curricula and corresponding changes in the students' study habits. It used to be said that engineers don't use libraries. If this was ever true, it is less so every day. The Faculty Advisory Committee on the Engineering Library has started requesting basic physics and mathematics journals, duplicating those in the Science Library. Numerous science and mathematics reference books have been added. Normally one would question the advisability of spending money to duplicate works already in another library, but in this case there is no choice. The Science Library is filled to overflowing.

The number of readers using the Science Library has gone over 1,400 on some weekdays this spring. The shelves are nearly full. There is room at the most for three years at the present rate of growth — less if we start to buy journals at the rate we should, and less if plans under consideration in the Mathematics Department for developing our mathematics collection into a really first-rate one should mature. The one factor on the other side of the board is the future move of geology and meteorology material to a new earth sciences building. Unfortunately, holdings in these fields are not very extensive, but if the move comes in two years it will help counteract the growth in other fields.

The function of the Science Library has been under discussion for the last two or three years, particularly since the Library has begun to approach its present crowded condition. Many of the faculty of the science departments consider that the Science Library should be a research library, a large, quiet room with all the current journals, where the individual may either keep up with new work or conduct literature searches. Today these activities have to be carried on under conditions all too similar to an airport terminal building. On the hour, fifty to one hundred students leave to go to class; a new group comes in, taking every available chair; and the late-comers are forced to go to the General and Humanities Library on the second floor, to the Reserve Book Reading Room, or to the Music Library.

An aggravating factor on weekends and evenings is that numbers of students from a hundred schools and colleges in the area use our Science Library. Some come with friends from our student body, others just come to use our books or because the Science Library is air conditioned or because the library of their own school is closed. We have started using the bookcheckers to ask students entering at these times for M.I.T. identification. If numbers of outsiders continue to increase, we might be forced to the unpleasant step of requiring M.I.T. identification of all comers. At present those turned away often go to one of our other libraries where there is no bookchecker.

When nuclear engineering and chemical engineering materials were added to the Science Library because of their close relation to chemistry, their collections were small. They have been growing and the need is now felt for a staff member in the Science Library who could take particular charge of chemistry and these other two fields.

Probably the best long-term solution to problems in this area is to separate the two functions of the Science Library, giving us a research library for faculty, graduate students, and research staff, as well as an Undergraduate Science Library. The locations of these libraries should be established on the basis of traffic patterns. Some information on where our users come from and where they are going when they leave will be found in the results of the Library Use Survey mentioned above.

Heavier use of the Libraries has brought about an increased interest on the part of student organizations. The Graduate Management Association and the Graduate Economics Association have both held meetings devoted to conditions in Dewey Library, urging that ways be found to curtail loss of books and to cut down on noise in the reading room.

Extension of Library Hours

Representatives of the undergraduate Committee on Educational Policy called on Miss Nicholson to urge that the Reserve Book Reading Room be kept open until 1:00 a.m. to provide late study hall space not available elsewhere in the Institute. It was decided to experiment with the idea during examination period from May 13 to June 4. The room was open from 8:00 a.m. to 1:00 a.m. on Sunday through Thursday nights. Hourly counts of the number of users showed the Sunday average to be the highest: 46.3 at 11:00 p.m., 30.3 at 12:00 p.m., and 15.6 at 1:00 a.m. Monday morning closing time. Monday night through Thursday night averages were 39.7 at 11:00 p.m., 23 at 12:00 p.m., and 8.8 at 1:00 a.m. Only one student attendant is required to keep the Reserve Book Reading Room open, so this amount of use would seem to justify trying the late closing hour in the fall. Numerous other university libraries have found it desirable to extend their hours to accommodate the students' night study habits. This question will receive continued attention, for longer hours might relieve some of the day-time pressure.

Some Student Research Projects

Not only do students use the Libraries, they also help to staff them. Sixty-five men under a student captain worked an average of 511.5 hours a week throughout the year.

Several research projects have also been undertaken this year by students. One in the Science Library is a continuation of the survey of the circulation of new books added to that Library, started in 1954 by the Operations Research Center. By studying the early history of these books, it is hoped that a means will be found for predicting their future demand, thus enabling a librarian to decide such questions as whether or not to order a duplicate copy and if so how many, or when the demand will be low enough to send a book to warehouse storage. A study of approximately 1,000 Science Library books shows that there are a few typical patterns which can be represented by a family of curves. If each new book is watched carefully for the first week or two, it may be possible to place it on one of the curves and thus predict its future. A research assistant, with help from the Science Library staff, has been tabulating the data, and a report on results is expected soon.

Microreproduction Service

Other research projects have been carried on by students in the Microreproduction Laboratory. Under the direction of Peter Scott, head of the Laboratory, two students in mechanical engineering designed portable microfilm readers; another worked out a page transport for automatically moving 8½" x 11" pages under the microfilm camera and tripping the shutter. George Luedeke, Jr. '59, won the DeFlorez award this year for his microfilm reader.

Other research in the Microreproduction Laboratory had as its goal the development of a new microfilm system to make it simpler to find material placed on roll microfilm. Up to the present the difficulty of finding a particular selection has resulted in the use of short reels, with consequent loss of much of the potential reduction of storage space which the medium promises.

The Laboratory has shown an increase this year in every type of operation. This is most striking in photoprints, black-on-white copies made with microfilm as an intermediate step. Production was up from 74,395 prints in 1957–58 to 103,703 in 1958–59. There seem to be two main causes for this rise. One is the resumption of large orders from industry after a slackening during last year's recession. The second is a service arrangement for processing microfilm and making prints for the Boston Public Library and the Library of Boston University.

During the spring it seemed desirable to have a consultant look into the organization of the Laboratory, to determine if its expansion over the last few years would justify more streamlined procedures. Frederic C. Wood, who has been retained by the Institute to perform several such investigations, prepared detailed recommendations, including simplification of forms, elimination of unnecessary steps, and moving the business office to a location adjacent to the Laboratory. While the new office will be less convenient to users within the building, it will be better for those coming from outside. Mr. Scott says that once the office is established in the basement it will be possible to set a new, shorter schedule for the handling of orders.

The Microreproduction Laboratory has had a particularly heavy number of visitors this year. Mr. Scott's research and published work on standards for microfilm and on the new Kalvar copy film have attracted widespread interest.

Map Room

Librarians and architects planning new buildings continue to come from all over the world to see the Hayden Building. But visitors to the Institute this spring have been deprived of one of the major attractions in the Libraries. That is the large revolving orographical globe in the Map Room. A new movement was designed last year by Wayne O'Neill, a graduate student in the Mechanical Engineering Department. It was installed this year, but when the globe was being shifted to a position near the window, a minor accident caused the reopening of a crack made when the globe was originally damaged in transit from England. Permanent repairs have now been made, and the globe will be kept rotating during the hours when the sun strikes it, in order to keep it from fading.

Gifts

Many gifts have come this year from friends of the Institute and its Libraries. Of 13,487 items added to the Library, 2,780 came as gifts. Many valuable things are received this way: out-of-print books, long runs of journals, even a manuscript in the hand of Isaac Newton, the gift of Dr. Sidney M. Edelstein '32. Some individuals and some Institute departments have given money for the purchase of books in special fields. The French Government gave the Department of Modern Languages $250 to encourage the study of French culture. This was spent on books which were turned over to the Library. Professor Antoine Gaudin gave a fine new geological map of Russia which was presented to him during a visit there; as far as is known this is the only copy available to the public in the United States. To all those who through their generosity have added so substantially to the resources of the Libraries, the Director expresses his thanks and those of the Institute community.

Personnel

In personnel, the Libraries have suffered an even heavier turnover than in the past few years. Matrimony and maternity account for the largest number of resignations; a few left us to take better positions, to continue their education, or to travel.

Miss Marguerite Chamberlain, Science Librarian, retired in June after twenty-seven years at the Institute, and the following resignations were accepted: Miss Eleanor Canty, Acquisitions Librarian; Miss Anne-Marie Hartmere, Earth Science Librarian; Miss Diana Jorjorian, Earth Science Librarian; Miss Regina Pichetti, Associate Dewey Librarian; Burton A. Robie, Humanities Librarian; and Mrs. Margaret F. Sax, Humanities Librarian.

One man was promoted from clerical to professional staff: William Presson, who started as stackman three years ago, became Associate Dewey Librarian. Miss Arlene Kupis, Assistant Engineering Librarian, became Humanities Librarian. Miss Natalie N. Nicholson, Executive Assistant to the Director, became Associate Director; and, as previously mentioned, Mr. Ryburn M. Ross, Executive Officer of the Science Library, also became Associate Director. Mrs. Margaret Sax, Assistant Reference Librarian, became Humanities Librarian.

New appointments were: Professor Secor D. Browne, Vice Director for Slavic Materials; Mrs. Elena A. Caffrey, Slavic and Exchange Librarian; Mrs. Rachel Corn, Assistant Engineering Librarian; Miss Paula J. Gibbons, Acquisitions Librarian; Miss Diana Jorjorian, Earth Science Librarian; and Miss Katherine Murphy, Assistant Reference Librarian.

It is appropriate that this report should end, as it began, with the entire library staff. They are responsible for transforming 647,000 books from a paper labyrinth to a living organism responsive to the needs of every member of the Institute community who comes in the door. Working with the faculty, the staff is striving toward the goal of making the Libraries as outstanding as are the teaching and other research facilities of the Institute.

WILLIAM N. LOCKE

MEDICAL DIRECTOR

The year 1958–59 marked a serious loss for the Medical Department in the death of Dr. LeMoyne White at the age of 44. His keen intelligence, his penetrating wit, his warm and boundless generosity and his unsparing devotion to his work made him a valued and much beloved member of the M.I.T. community.

Appointments

Dr. Benson R. Snyder, former Psychiatrist at Wellesley College, has accepted the appointment of Psychiatrist-in-Chief effective July 1, 1959. Dr. Snyder is particularly interested in carrying on a continuing systematic study of the interactions between the student and his environment at M.I.T.

Dr. John W. Chamberlain has been appointed Surgeon-in-Chief and has relinquished the title of Associate Medical Director.

Dr. Albert O. Seeler has been appointed Physician-in-Chief.

Dr. Samuel D. Clark has been appointed Associate Medical Director in recognition of his assumption of increased administrative responsibility.

Dr. Martin J. Bellinger has resigned as Assistant Surgeon, due to the press of private practice.

Medical Facilities

During the summer, extensive structural alterations were carried out on the second floor. Space formerly occupied by a kitchen and maids' dining room was converted into a suite of five examining rooms well suited for the routine examination of students and employees. Laboratories and offices formerly occupied by the Occupational Medical Service were converted into a dental clinic and offices for otolaryngology, ophthalmology, and psychiatry. These changes have released much-needed space for the general clinics on the first floor and relieved crowding in the main reception area.

The activity in the Ambulatory Clinic continued approximately the same as in the previous year.

The Dental Clinic

The Dental Clinic reports an active year. Approximately 4,780 students, faculty, and employees took advantage of services offered by this clinic, which functions on an operative and preventive basis. A total of 1,573 required dental examinations was made in connection with the annual routine medical examinations of students of the Institute. This number comprised newly enrolled members of the freshman class, transfer students, and new graduate students. As part of the routine freshman dental examinations, bite wing dental x-rays were taken and checked, and patients were informed of findings.

Follow-up is an essential phase of the dental health program, and students are encouraged to consult with their family dentists or, upon their request, are referred to dentists on the Institute's approved list. The services of the clinic (dental prophylaxis, dental x-ray, examination, and consultation) are extended to students, staff members, and employees of M.I.T. It has been shown that dental complications are a widespread problem in prenatal care; therefore, the dental clinic is examining and making recommendations to those who are being seen in the prenatal clinic at M.I.T. Possible changes in teeth and bone structure are also being evaluated as part of a D.S.R. study of late effects of exposure to radium.

The operation of the Dental Clinic with a single dental hygienist has not proved entirely satisfactory. During the fall, when the incoming students were being examined, the load was such that dental prophylaxis had to be virtually abandoned for an extensive period. We plan to take on an extra dental hygienist on a temporary basis next fall to cover this rush period.

Dental research projects will be initiated in September, 1959, and will be incorporated with the dental examinations of incoming first-year students. Studies regarding the prevalence of dental disease will be supported with an oral hygiene index. This will be accomplished in conjunction with the Dental Division, Massachusetts Department of Public Health.

Prenatal Clinic

The Prenatal Clinic, operated in conjunction with the Boston Lying-In Hospital for wives of students who cannot afford private obstetrical care, has now been in operation for two years. Seventeen babies were born under this program in the first year, and forty-five in the second. In the second year fourteen wives who returned to their home towns for delivery were followed in the Prenatal Clinic. There have been three miscarriages since the program started, and six patients have transferred to private obstetricians. The average number of prenatal visits has been ten per patient.

We estimate that the net cost to M.I.T. has averaged about $2.20 per patient, while the Lying-In Hospital figures its net loss on each patient has been about $5.00. The service has been entirely satisfactory, and the fact that the fee of $250 is a *maximum* for covering contingencies and complications which might otherwise add considerably to the expense has proved to be a valuable insurance feature.

Otolaryngology

Dr. Lyman G. Richards reports on the value of early recognition and treatment of conditions in his field. Although he has fewer infections of the upper respiratory tract to deal with than formerly, he is treating a larger number of patients with allergy.

Dermatology

Dr. Robert F. Tilley, who has just completed ten years of service as dermatologist at M.I.T., reports that in this period it has never been necessary to send a patient into a hospital for a skin condition. He attributes this in part to early treatment made possible by holding daily clinics. Another valuable result has been a virtual absence of workmen's compensation claims based on occupational dermatitis.

Surgical Service

There was a marked increase in the number of minor surgical procedures carried out in the operating room during the year (167 as compared to 94 the previous year). Most of this was elective surgery. In addition, 123 lacerations were sutured after 5 p.m. and during weekends and holidays.

Sports accidents have shown an apparent sharp drop from 308 last year to 165. We are not sure enough of the reporting to interpret this literally; but the records on the more serious injuries such as fractures and dislocations, on which our reporting is quite accurate, dropped by one half, and there were no really serious injuries. We believe credit for this must be given to preventive measures taken by the Athletic Department — in particular to close supervision and refereeing of informal touch foot-ball contests.

Clinic Visits, 1957–59

	1957–58	*1958–59*
Medical	7,980	7,893
Surgical	9,101[1]	12,128[1]
Psychiatric	2,605	2,134
Eye	1,228	1,158
Ear, nose, and throat	1,353	1,197
Skin	1,523	1,457
Dental	5,465	4,780

Infirmary

There was a drop in the number of patients treated in the Infirmary from 1,081 to 762. Last year's high figure reflects the influenza epidemic of 1957–58, whereas this year's figure is more comparable to the total of 743 patients in 1956–57.

The infirmary kitchen, a costly operation, was abandoned late last year, and meals have been delivered in a heated cart from the Graduate House across the street. The service has been more than satisfactory, thanks particularly to the interest of Robert Wheeler, Director of Dining Services, and Miss English, the dietitian. The change has made possible the elimination of three positions — cook, assistant cook, and maid — with considerable saving to the Institute.

[1]These figures include visits to the surgical clinic for shots of various sorts, including vaccines and allergy treatments. Much of the increase in surgical visits may have been for immunizations.

Patients Admitted to the Infirmary, 1957–59

	1957–58	1958–59
Staff	37	44
Graduate students	196	147
Undergraduate students	802	528
Employees	40	38
Others	6	5
Total patients	**1,081**	**762**
Total patient days	**3,653**	**2,842**

Faculty Health Survey

A total of 359 members of the faculty and administration received a complete medical checkup. Several cases of hypertension were turned up and, in cooperation with the family physicians, appropriate therapy was instituted. This annual examination has again afforded a valuable opportunity for an unhurried discussion of medical problems, for laying out reasonable programs of individual personal hygiene, and for flagging the earliest signs of impending trouble.

Physical Examination of Students

A total of 1,694 students had an admission physical examination in the fall. In addition, 389 upperclassmen were re-examined to evaluate their eligibility for participation in athletics. Of these, 131 were asked to return for further evaluation of physical or psychiatric findings. Little in the way of previously unrecognized disease was found in this group. However, two cases of unsuspected heart trouble were picked up.

During the coming year, studies are planned to see if our medical screening process cannot be streamlined to bring in economies without sacrifice of effectiveness. We also plan to introduce the tuberculin test in the place of the chest x-ray as part of the routine examination on admission.

Pre-employment Physical Examinations

During the year the Department gave 1,532 pre-employment examinations. Abnormalities of sufficient importance to justify review of the problem with the prospective employee were found in about ten per cent of the group. Twelve applicants showed chest x-ray changes suggesting inactive tuberculosis, and one was found to have active tuberculosis. One applicant was found to have carcinoma of the lung. Three individuals were epileptic. Surprisingly, there was only one diabetic. The health of seven applicants was such that we felt that they should not be employed by M.I.T. Seven other individuals were found to have health defects that limited their employment to light work.

In addition to the pre-employment examination and the ambulatory medical care of employees offered by the clinic, the Medical Department is endeavoring to serve the Institute community by establishing a program for the periodic evaluation of personnel who have been found to have chronic illness. The purpose of this program is to assist the patient in obtaining proper medical care and to make sure that his work requirements are appropriate for his medical condition.

Lincoln Laboratory

The following is a resumé of the activities of the Medical Department at Lincoln Laboratory for the academic year 1958–1959 as reported by the physician in charge of the Lincoln Clinic, Dr. Gordon Winchell.

"The Medical Department at Lincoln Laboratory consists of a full-time registered nurse, Miss Mary Callahan, a full-time secretary, Mrs. Phyllis Bryant, and myself acting as Medical Consultant. We have worked in close cooperation with the Personnel Department in all matters relative to employee health, as well as with Dr. Harriet L. Hardy and Thomas Wilkinson in relation to the industrial medicine aspects of the Lincoln Laboratory. The physical plant is considered very adequate, with four adjacent rooms centrally located.

"During the period covered by this report, a total of 12,051 patient visits were attended at the first-aid room. In addition to this, 945 employees received injections of polio vaccine during this period. The physician consultant's role has been that of a daily visit to Lincoln Laboratory to interview all cases in which the patient's complaint or situation required a physician's evaluation. From July, 1958, through June, 1959, 1,178 patients were interviewed by the physician. The largest percentage of these were referred for further care to their family physicians when follow-up treatment and studies were indicated. We have continued to render services to the newly formed Mitre Corporation until such time as their medical program is more adequate for complete coverage. In the last four months, over 600 Mitre employees received treatment at our first-aid station.

"Our relationship with Dr. Chamberlain and Dr. Seeler, as well as with the other consultants at the Homberg Infirmary, has remained very satisfactory and has been a great asset to good medical care. For geographic reasons the communications between ourselves and Homberg Infirmary meet with some difficulty, but this is entirely amenable to improvement, which I think can be initiated largely from our side of the relationship.

"In the coming year my services at Lincoln Laboratory will be supplemented by those of Dr. Charles Keevil, who is associated with me in the practice of internal medicine, and I hope that this will allow us to devote more time to the larger and more basic problems of policy and patient care. I hope this fall that we will be able to offer tetanus toxoid immunizations to all those willing to have them. We should participate in an over-all disaster plan for Lincoln Laboratory; this has already been initiated and is in the early stages of organization by Mr. Wilkinson. I am very happy with the general medical program and anticipate that it will be able to grow with the needs of the Lincoln Laboratory."

Occupational Medical Service

During the year the broadening of the scope of the activities of the staff and, in particular, the increase in the use of radioactive materials has been reflected in new appointments. Robert J. Allen, as Industrial Hygiene Chemist, replaces Miss Janet Walkley, who resigned. Paul Magno, as Radiochemist, and Francis X. Masse, as Assistant Radiological Safety Officer, represent new positions.

Samuel Levin, Radiological Safety Officer, has been appointed lecturer in the Department of Nuclear Engineering and will give nine hours in Nuclear Reactor Physics Laboratory (subject 22.41).

Under the sponsorship of the Industrial Liaison Office and the Medical Department, a symposium on beryllium disease and its control was held from September 30 through October 1 in the Kresge Auditorium. Approximately 210 people attended, representing industry, government agencies, and insurance companies, as well as individual physicians and research workers. The proceedings were published in a separate issue of the *Archives of Industrial Health* in February, 1959.

Dr. Hardy arranged a field trip to certain M.I.T. laboratories for the American Academy of Occupational Medicine in February, 1959. In April she participated in an international conference in Prague to establish maximum allowable limits of concentration of various toxic or potentially toxic substances in the industrial environment. In June she was off to Bogota to participate, at the request of the International Cooperation Administration, in the teaching seminar for industrial physicians in the mining area of Colombia.

Four members of the Institute staff — Professors Francis Bitter, Robley D. Evans, and John G. Trump and Dr. Peter T. Demos — have agreed to serve as advisers to the Medical Department on radiation protection problems. It is a great comfort to be able to turn to a group of this caliber when important matters of policy or procedure come up for decision.

It is a source of gratification that Professor John W. Irvine, Jr., has accepted the chairmanship of the M.I.T. Radioisotope Committee, a committee required by the Atomic Energy Commission in order that the Institute may procure radioisotopes. The function of the Occupational Medical Service is to recommend safe practice, but implementation of such recommendations must depend upon faculty cooperation and support.

Frederick J. Viles, Jr., has, in addition to his service responsibilities as Industrial Hygiene Engineer, been engaged in a research project supported by the National Institutes of Health under the title, "Application of Membrane Filters for Aerosol Assays."

Dr. Lloyd Tepper, Research Fellow in Occupational Medicine at Harvard Medical School, has been getting on-the-job training in the Department. This arrangement appears to have worked well.

Hazard memoranda on the following subjects were distributed during the year throughout the Institute: benzene, carbon tetrachloride, toluene diocyanate, and ultra-high-frequency radiation.

Psychiatric Service

The following table summarizes Psychiatric Service activity.

	1957–58	*1958–59*
Students		
New students	359	193
Continued student patients	49	33
Reopened student patients	64	33
Total students	**472**	**259**
Faculty	22	3
Staff	30	24
Employees	26	16
Others	66	
Total	**616**	**302**

There was a 46 per cent drop in both the number of new students and in the total number of students seen in psychiatric consultation last year compared with the previous year. These percentages are a reasonable indication of the extent of the reduction in the case load. The drop in number of students coming for consultation corresponds roughly with the 35 per cent cut in available time following Dr. White's tragic death last fall.

It is significant that approximately 75 per cent of the students this year were self-referred, compared to 53 per cent last year. This shift is the result of a marked reduction in the number of students referred from the Medical Department, the Dean's office, and the faculty. The students' continuing use of the psychiatric service is an important index of their confidence.

Sanitary Report

Monthly sanitary inspections of the Institute dining services, including bacteriological tests of utensils and dairy products, have been carried on by Fred E. Smith, Sanitary Engineer. The reports of the bacterial cultures on utensils indicate that 91.7 per cent of the tests yielded results within the desired standards, as compared to 87.7 per cent the previous year. No outbreak of foodborne infection occurred during the year.

JAMES M. FAULKNER

AIR, MILITARY, AND NAVAL SCIENCE

On Military Day, on May 5, 1959, the combined Army, Navy, and Air Force cadets were reviewed by Vice Admiral Edward L. Cochrane, Vice President for Industrial and Governmental Relations, Emeritus, of the Institute. Among the guests in the reviewing party were representatives of Army, Naval, and Air Force installations in the vicinity and of local chapters of military and patriotic societies. At a ceremony following the review 16 Army R.O.T.C. cadets were presented awards by the Professor of Military Science and the visiting dignitaries. At the review the precision and snap of the cadets was vastly improved over that of previous years. The state of discipline achieved is possible only under a completely voluntary program.

Naval Science

With the completion of the third year of operation of the Naval Science Department, the first senior class of N.R.O.T.C. students has arrived with a count of 26. Total unit strength is 86, with 30 each in the N.R.O.T.C. classes of 1961 and 1962. Academic attrition during the year has accounted for the loss of three members of each group. Fourteen students have resigned from the program for various reasons. Three have been dropped due to physical disqualifications, and one junior was disenrolled for getting married while still in the program.

A highlight during the year was the voluntary participation of 9 sophomores and 11 juniors in a six-day field trip to the U. S. Naval Air Station in Pensacola, Florida. Transportation to and from Pensacola was effected by Navy R5D aircraft. At the Air Station they received indoctrination in naval aviation training, tours of the overhaul and repair facilities, and a one-day trip at sea on an aircraft carrier, where they witnessed a demonstration of carrier landings and take-offs for student aviators.

Other field trips included a tour of the Boston Naval Shipyard by over half of the unit and a day aboard the USS Wasp (CVS 18), one of our carriers engaged in hunter-killer, antisubmarine warfare.

This summer will mark the second time that the Department has sponsored a summer employment program for the N.R.O.T.C. students. Approximately one-fifth of the unit will participate in various types of work and training at such places as the Boston and New York Naval Shipyards, the Bureaus of Ordnance and Ships in Washington, D. C., and the Naval Research Laboratory. It is believed that this program not only helps in the gainful employment of the students during the summer, but in addition gives them further insight into the locations and functions of their possible future assignments as engineering duty officers.

This summer also marks the first time M.I.T. midshipmen will embark on a summer training cruise afloat. Scheduled to join hundreds of other contract N.R.O.T.C. students from all over the country, they will board the USS Oriskany (CVA 34) on July 11, will participate in training exercises in the eastern Pacific, and will complete their cruise on August 8. Inasmuch as they are the only students in the entire N.R.O.T.C. program who are specifically destined for "engineering duty only" assignments upon commissioning, they will be trained together as a group. Their cruise curriculum will emphasize engineering and technical assignments, studies, and watches.

On the lighter side of the department's program, it is reported with pleasure that the Unit Rifle Team won the First Naval District Small Bore Meet in competition with N.R.O.T.C. units from Harvard, Tufts, Brown, Dartmouth, and Holy Cross.

As noted in last year's report, the military administration of all Navy-sponsored postgraduate students this past year has been under the Professor of Naval Science. This has involved some

59 Navy officers, 19 Coast Guard officers, 2 Marine officers, and 17 foreign naval officers. Of these, 36 were granted Master's degrees at the end of the academic year.

This fall will mark the commencement of a new graduate program, specifically designed for the purpose of training unrestricted line officers, with the doctorate as the ultimate goal and the ultimate assignment of graduates to unrestricted line billets throughout the naval establishment. The program supplements the regular Advanced Science Postgraduate Educational Program and is called the Junior Line Officer Advanced Scientific Educational Program. One student is scheduled to enter the Graduate School at M.I.T. this fall in connection with the new program.

Of interest this past year at the undergraduate level has been the initiation of the Navy's new program, designed to give an opportunity to its most talented young enlisted personnel to pursue a course of study in the engineering, scientific, and allied fields at government expense. This program, called the Navy Enlisted Scientific and Engineering Program, was started at M.I.T. with the matriculation last fall of four Navy and one Marine enlisted personnel, class of 1962. It is anticipated that there will be a similar input this fall.

There have been extensive staff personnel changes during the past year. In December, 1958, Commander Alfred C. Edwards relieved Commander Robert A. Weatherup as Executive Officer and Associate Professor of Naval Science. Captain Joseph S. Lewis completed his tour of duty in June as Professor of Naval Science and Commanding Officer of the combined N.R.O.T.C. and Naval Administrative Units. His relief, Captain George L. Street, will report in the latter part of the summer. Also detached from duty at the Institute were Commander Joe W. Thornbury, Associate Professor of Naval Architecture, and Lieutenant Herbert O. Burton, Assistant Professor of Naval Science. Their replacements, respectively, are Lieutenant Commander John K. Baylis and Lieutenant Basil F. Gray, Jr. In conclusion, the department was brought to full strength with the arrival of Commander Robert B. Giblin, Assistant Professor of Naval Science, who will teach the seniors a newly and locally formulated subject in Naval Industrial Management and Leadership. In connection with this, it is to be noted that outstanding cooperation has been received from the School of Industrial Management.

COMMANDER ALFRED C. EDWARDS

Military Science

With the beginning of this academic year, the Army R.O.T.C. Program at M.I.T. entered a new phase. As a result of the faculty vote on January 15, 1958, all military training at the Institute became voluntary. As predicted, Army R.O.T.C. enrollment took a very considerable drop. Last year the corps started with 863 cadets, while the initial strength this year was only 429. The true drop, however, is better measured by considering only the freshmen class, where the initial enrollment dropped from 358 under the last compulsory year to 127 in the first voluntary year.

A major problem under the voluntary program is that of adequately informing the incoming freshmen of the nature of R.O.T.C. training at the Institute, the advantages and disadvantages of enrolling in the program, and the consequences of deciding not to enroll. To this end, the Institute sent to each entering freshman a pamphlet describing the three R.O.T.C. programs offered and pointing out the importance of making a decision on whether or not to take R.O.T.C. training. This was supplemented by a letter from the Professor of Military Science and an Army pamphlet describing the Army program in detail. During freshman week, prior to the beginning of the fall term, the Army R.O.T.C. staff was available for consultation with interested freshmen. These measures, however, are not adequate. Many freshmen fail to read the literature sent them and very few take advantage of the consultations offered. As the decision to take or not take R.O.T.C. training in college is one of the most important that any young man must make, he should have all the facts at hand. This might be done by requiring each freshman to have an interview with a member of the Army, Naval, or Air Force R.O.T.C. staffs, or with a faculty adviser who has been properly oriented on the R.O.T.C. programs.

The voluntary program has produced a much smaller but decidedly more enthusiastic corps of cadets. Classes were smaller this year in the Basic Course, and the cadets received a great deal more individual attention by the staff. This will eventually produce better oriented and trained reserve officers and may very likely motivate more of the outstanding cadets to seek Regular Army commissions under the Distinguished Military Student Program. The only disadvantage of the voluntary program is that the military services will lose those individuals who did not take R.O.T.C. training of their own volition, but who, once enrolled in it under a compulsory program, found that they liked it. A poll of this year's senior cadets indicates that almost half are in this category.

There were no significant changes in the curriculum during this year. However, because of the rather widespread dissatisfaction with portions of it, both a faculty *ad hoc* committee and the Department of the Army are studying ways to improve it. While nothing definite has materialized to date, I look for changes which will decrease the total number of on-campus hours; increase the length of summer camp; delete those subjects which can better be taught at summer camp or in a service school after commissioning; add subjects in the fields of personnel psychology and industrial management; and increase the participation in teaching R.O.T.C. subjects by members of the faculty outside the military departments.

Among the highlights of the year were our rifle firing at Fort Devens; the weekends for selected students at the United States Military Academy and at Fort Devens; the pre-camp orientation program held at Fort Devens; the visit to Fort Bragg, North Carolina, by 20 cadets to witness the airborne demonstrations by the 82nd U. S. Army Airborne Division on Armed Forces Day; and the Annual Military Day.

The rifle firing, which was instituted last year for freshmen, was expanded this year to include all classes of cadets and interested members of the faculty. Again, as last year, a highly interesting and instructive Sunday was spent on the rifle ranges of Fort Devens. Four Advanced Course students were invited to spend three days living with the cadets of the U.S.M.A. and entering into all their activities, while several Basic Course students learned how the Army lives, works, and plays during a weekend at Fort Devens. In order to orient our third-year cadets to the problems of living on an Army post at summer camp, most of the juniors spent a weekend at Fort Devens. The results of this year's summer camps have demonstrated the value of this training.

The cadets who went to Fort Bragg for the airborne demonstrations traveled by military aircraft arranged for by the Air Force R.O.T.C. Staff. The trip was highly successful and created more enthusiasm for the armed services than has been seen around M.I.T. in many a day.

This year the M.I.T. Company of Scabbard and Blade, the honorary military society, came to life. While in the past their chief function has been to run the Military Ball, this year they not only did this very well but also demonstrated the qualities of leadership their members possess by assisting the staff in many ways with orienting and teaching the cadet corps. For instance, the summer camp orientation visit to Fort Devens was run almost entirely by

Scabbard and Blade members with only a minimum of supervision by the staff.

On June 11, 1959, 63 cadet officers were commissioned second lieutenants in the following branches of the U. S. Army Reserve:

Corps of Engineers, 5; Signal Corps, 13; Ordnance Corps, 23; Chemical Corps, 15; and Quartermaster Corps, 7.

At the conclusion of summer camp, 13 additional cadets were commissioned.

Of the new second lieutenants, 15 will enter on six months of active duty for training, 18 will enter on active duty for two years' service, and 43 will attend graduate schools, with their active duty delayed.

Among those commissioned were twelve Distinguished Military Graduates, so designated because of their over-all excellence in military science. Of these, two were commissioned in the Regular Army in the Chemical Corps.

Lieutenant Colonel LaMonte A. Tucker, Chief of the Chemical Corps Unit, and Major Joseph M. Walters, Jr., Chief of the Ordnance Corps Unit, have completed their tours of duty at the Institute and have been reassigned. They will be replaced by Major Charles M. Shadle and Major Robert A. Ireland, Jr., respectively.

GILBERT G. BRINCKERHOFF, JR.

Air Science

This Department continued to place major emphasis on leadership training during the past year. As expected, the small size of classes allowed more individual attention and produced a better attitude on the part of the students; we had a smaller but a very fine cadet corps. Of the twenty-six students eligible for the Advanced Course, twenty-four have applied as of this writing.

Throughout the year we continued to work with the faculty *ad hoc* committee in the development of a suitable elective A.F.R.O.T.C. curriculum. This first year's work has resulted in a tentative course pattern and curricula outlines. The results have gone to other members of the M.I.T. faculty and to A.F.R.O.T.C. headquarters for comments. We expect that the several aspects of the problem of developing a suitable elective will be sufficiently refined by February, 1960, for presentation to the faculty, and we hope that the new program can be initiated in September, 1960. During the year Professor Milton C. Shaw became a member of the *ad hoc* committee.

The reorganization of our standard Air Force R.O.T.C. curricula (as distinct from the new proposed curricula discussed above), which was announced in last year's report, is proceeding on schedule. This new Air Force curriculum continues the philosophy of a generalized rather than a specialized course. The new freshman curriculum was an improvement. We expect the same of the sophomore and junior programs, which will be implemented this fall. The senior program is scheduled for implementation in September, 1960.

This September, at the beginning of the term, we will convert to the commutation system for Basic Course uniforms. This is a system whereby the government pays the Institute a flat rate for each cadet enrolled, and the Institute purchases the necessary uniforms. This system is currently being used at M.I.T. to acquire uniforms for the Advanced Course (juniors and seniors). We believe that the broadening of this system to include Basic Cadets will provide more flexibility of operation and a better appearing cadet corps. The system has already been successfully used in most schools participating in the A.F.R.O.T.C. Program.

At commissioning ceremonies on June 11, 1959, we commissioned nine M.I.T. students as officers in the Reserves of the Air Force. Eleven will be commissioned at the completion of summer training. Among these officers were three Distinguished Air Force R.O.T.C. Graduates, so designated because of their outstanding leadership abilities and academic achievements.

Six members of the Department will be leaving this summer. Lt. Colonel John A. Vanderpoel is transferring to A.D.S.I.D. at L. G. Hanscom Field; Captain Norman A. Jolie to Tufts University; Captain Alan D. Wheeler to Holloman A.F.B. in New Mexico; M/Sgt. Victor C. Minich to Spangdalen, Germany; S/Sgt. Jere S. McCarthy to Kelly A.F.B., Texas; and S/Sgt. Harrison L. Donovant to Griffiss A.F.B., New York. M/Sgt. William C. Madden will rejoin the Department this summer. He reports to us from Stoney Brook Air Force Station in Massachusetts.

COLONEL FREDERIC H. FAIRCHILD

PLACEMENT OFFICER

Since the beginning of the Korean War many thousands of words have been written about the shortage of technically trained personnel. Some of what has been written has been true, a bit has been untrue, and a great deal has been exaggerated. As Dr. Killian has so often stated, our real shortage is in terms of *qualified* technically trained men and women; the solution to the problem will not be found in training masses of poorly qualified personnel.

As one source of well-trained young men and women, the Institute is besieged annually by employers from all parts of the country. It is the function of the Placement Bureau to provide a well-organized meeting ground for students and alumni who are seeking employment and for those organizations that seek them.

The Placement Bureau is in two parts, Student Placement and Alumni Placement. Student Placement tends to be a more mass operation than does its alumni counterpart. We attempt to provide sufficient interviewing space so that any organization wishing to interview at the Institute may do so. There are usually some four hundred organizations interviewing each year. Alumni Placement is a more hand tailored operation, wherein specific openings are known to exist for a chief engineer, a metallurgist with ten years' experience, or a director of research. Active files are kept of alumni who desire to change position either in the immediate future or when the right opportunity comes along.

Student Placement

As with so much at the Institute, the Placement Bureau leaves as much to the initiative of the individual as possible. We feel that the student's search for the right job may be an education itself, but it will be of educational benefit only if it is achieved through his own initiative, drive, and ambition. We try in the Placement Bureau to provide an atmosphere within which the student may educate himself concerning the employment opportunities available. This atmosphere includes counseling for those who seek it. This counseling is not of the hand-holding variety, but is an attempt to give the student who needs it a frame of reference within which to make his own decisions.

On the employer's side, we are conscious at the Institute of the Placement Bureau's public relations function. In many cases the sole contact between an industrial concern and M.I.T. is the Placement Bureau. We are as concerned with counseling employers who seek advice as with counseling students, but, just as with the student body, the initiative to seek advice must rest with the employer.

The business of recruiting college graduates each year has become a well-organized, highly skilled one and is beginning to show a few earmarks of a profession. The market for the college graduate fluctuates quite markedly from year to year, but each year finds more employers better organized and better able to assess correctly their needs for college graduates. From the beginning of the Korean War up through the class of 1957, there existed a panic-stricken search in industry for men with technical degrees. Many companies were trying to relieve their own engineering shortages.

With the recession of 1957–58, however, the class of 1958 (and to a lesser extent 1959) noticed a marked change in emphasis and attitude on the part of companies seeking graduates. A year ago there were 404 employers visiting the Institute, as compared with an all-time high of 448 in 1956–57. Of the 404 that visited in 1957–58, many did so in the name of public relations and "keeping up contacts." There was a great deal of "going through the motions of interviewing"; and although we had no way of knowing at the time, there were many cases in which very few, if any, jobs actually existed in companies which were conducting active recruiting campaigns. A few employers had the foresight, however, to take full advantage of the situation during the recession and hired when others did not, as a hedge against the future.

By comparison, during the current year only 335 employers came to M.I.T., but all 335 were dead serious about recruiting. During the recession of last year, many employers overemphasized seeking the top 25 per cent of the country's collective graduating class and assumed erroneously that the top 25 per cent was the same at all institutions. This past year, this emphasis was shifted, probably appropriately, so that it was assumed that this top 25 per cent might well include many of the graduates of one institution and few of the graduates of others.

What changes have taken place in the student's approach to the job search? Whereas three or four years ago the M.I.T. senior was confronted with innumerable companies, all of whom sought him at any cost, and whereas many seniors took the unfortunate attitude of "What do you have to offer me?" this all changed for the class of 1958. The average number of job offers per man in 1957 had been four. Last year it was a little better than one, and for many seniors that one job did not materialize until very late in the year. Many seniors expressed disappointment but not resentment that they had missed some of the wining and dining fun of the years previous. As usual among undergraduates, however, last year's seniors bounced back well, appraised the situation, and took steps accordingly. The class of '59 approached this year's recruiting season with the same attitude, and a healthy one it is. This year's senior has been well prepared for the interviewing he has taken, and for the most part had a sincere reason for interviewing employers. He not only used the facilities in the Placement Bureau, but more often than not did some extra research in one of the Institute libraries. Many times I have been confronted by a dazzled interviewer who has had his company's annual report figuratively torn to shreds before him. The senior is not as swayed by glamor as he was in recent years past. He is more interested in long-range opportunity as well as the immediate future, rather than in the immediate future alone as he was a few years ago. The top men in the class, who in many cases are not the top men in academic standing, are receiving as many offers as ever. The highest number of offers this year was fifteen. The bottom men always have a difficult time, and the middle of the class "runs a little bit scared" but on the whole has been well placed. This is perhaps as it should be.

Graduate students are in extremely heavy demand, particularly in mechanical, electrical, and aeronautical engineering and in physics and mathematics. The Ph.D. is in extremely short supply and has made the most surprising change in attitude toward recruiting. Ph.D. recruiting traditionally was carried on in the various departments and by a relatively small number of companies. As the demand for Ph.D.'s has increased, however, the departments have been unable to accommodate all the companies wishing to interview them. The Ph.D. has, therefore, begun to use the Placement Bureau, a function he all but ignored only a few years ago.

What sort of salaries has this year's graduate been offered? For the past five or six years the median starting salary offered to the M.I.T. senior has increased steadily, at the rate of $25 per month, each year. This year's Bachelor's candidates have had a median starting salary of $515; Master's candidates, $600; and the doctoral candidates, $760. The high offers for each degree are somewhat startling: $675 per month to a Bachelor, $785 to a Master, and $1,225 to a Ph.D.

How well have we done? Many placement offices at other schools figure success in terms of placements and are unhappy with anything short of 100 per cent. To me, however, the word "placement" is a misnomer, since I doubt if we have ever "placed" anyone in a job. Our statistics, thus far, indicate that only 1.8 per cent of the S.B. candidates are unplaced — that is, without jobs, graduate school, or military service to look forward to. We would seem, therefore, to have nearly fulfilled our function as a service if it were measured in terms of placements.

What is the relationship between the change in outlook on the part of employers and the "engineering shortage"? We must look at the question of shortage in its parts. In certain industries, notably those heavily supported by government funds, there was apparently little shortage during the recession, but companies that laid off thousands of men two years ago have now reversed themselves and claim that they need thousands more. In some fields less glamorous to the student, drastic shortages exist. There are shortages, which may become disastrous, of trained people in many small companies, certainly in teaching at all levels, and in some of the old line, nonglamorous companies.

In the years to come, in this ever-accelerating technological age, the shortage will grow more acute. I had occasion recently to talk with the placement officers of some of the other top schools in the country, and at none of them is there any intention of increasing the quantity of technically trained men at the expense of quality. Our great challenge lies in developing techniques for the appropriate utilization of qualified talent available, not in producing masses of poorly trained personnel merely to satisfy personnel requisitions.

Alumni Placement

An analysis of the activities in Alumni Placement emphasizes the need of both schools and industry to settle down to this same challenge to make most effective use of the talent available.

In the last six months of this fiscal year we received so many specific requests for electrical engineers, at all degree levels, that to fill the demand would have taken every electrical engineer who has graduated from M.I.T. during the past ten years. The requests in this six-month period in one field of engineering put us in the unhappy position of having 122 jobs for every electrical engineer who was, to our knowledge, interested in a new position.

Further analysis of the half-year requirements of industry for electrical engineers shows that while more and more companies are looking for executives specifically trained in electrical engineering (we had sixty-two requests for such men at salaries up to $40,000 a year, plus benefits), they are still finding it difficult to fit into their engineering, or even their manufacturing and sales divisions, men of high ability unless these men bring with them a very specialized skill.

The outstanding demands for the graduates of only one particular course dramatize and underline the problem which industry and education face, but almost the same result would be found for mechanical engineers, metallurgists, or physicists.

General demand for men increased 59 per cent this year over 1957–58 and 40 per cent over the pre-recession year of 1956–57.

While fewer men registered with the office this year than during our brief recession, we had an increase of 15 per cent in registration over 1956–57. Obviously, a 15 per cent increase in available manpower does not balance our increase of 40 per cent in jobs during the same period and is simply another indication of an extremely tight market for all kinds of technically trained personnel. Another very real indication of the tight market is the increase in suggested salaries for experienced men. This year the highest quoted salary we received for a nonsupervisory engineer with less than ten years of experience was $16,000, and the average salary for a nonsupervisory man with less than ten years experience was $11,217, an all-time high.

THOMAS W. HARRINGTON, JR.

DIRECTOR OF PUBLIC RELATIONS

Varied activities in public information during the past year included special efforts in connection with major M.I.T. accomplishments. Nationwide publicity resulted from press conferences concerned with the completion of the nuclear reactor, the disclosure that Lincoln Laboratory had reached Venus by radar, the announcement that the APT System had been developed under the leadership of the Electronic Systems Laboratory, and the opening of the Special Test Facility of the Instrumentation Laboratory at Hanscom Field. Our informational services were extended to cover student activities and those of the Educational Council.

An event which we believe to have been of long-term value was the three-day Science Writers' Seminar held in collaboration with Harvard University. In the previous year such a seminar had been held for New England science writers. The 1959 seminar attracted representatives from some of the country's leading magazines and newspapers, who were most enthusiastic about the success with which faculty members conducted background sessions in science.

The resignation of Volta W. Torrey to become editor of *The Technology Review* meant a serious loss, for as director of television, as host of "The Science Reporter," and as a science writer he had been a valuable member of our staff. Our television activities for Channel 2 were curtailed when Professor Norman N. Holland found it impossible to continue his "Film Critic" program, and WGBH decided it would have to cancel "Weather for You," in which Miss Elizabeth A. Kelley had proved a faithful performer.

William T. Struble, who had just completed special training at Columbia University in science writing, joined the staff as assistant director and assumed responsibility for our educational television activities. Nelson W. Lees, an M.I.T. alumnus who became assistant to the director, also proved his capabilities in television. Vacancies caused by the resignation of Miss Margaret Williamson, who had been editor of *The Observer*, and Miss Margaret Richardson, who had been editor of *Tech Talk*, have been filled by Mr. Lees and Miss Maude Agnalt, respectively.

Office of Publications

The leadership of M.I.T. publications under the able direction of John I. Mattill was further demonstrated during the past year. "A Family Guide to M.I.T." received a first prize in the annual American College Public Relations Association competition, and three other publications received citations. Six publications were selected for the 1959 show of the Art Directors Club of Boston, and two received first-place citations. Ralph Coburn's design for the 1958 Special Summer Program on Random Vibration was selected for the national exhibitions of both the American Institute of Graphic Arts and the Type Directors Club of New York.

The Office of Publications has had full or partial responsibility for the production of more than two hundred items of printed matter during the past year, fifteen of them for the first time or in new format. Two books and six jackets have been done for The Technology Press. Mrs. Jacqueline Casey and Mr. Coburn have a constant backlog of design assignments awaiting them. They were joined for three months this year by Miss Therese Moll from Basel, Switzerland, who brought new concepts to the department as well as contributing her own skill.

Through the able assistance of Frederic W. Fenerty, Purchasing Agent for printing and paper, economies have been achieved without sacrificing quality in our publications.

FRANCIS E. WYLIE

REPORT OF THE REGISTRAR FOR THE YEAR 1958–1959

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	1958–59	6,259
1895–96	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
			1958	1,650	1,752

* 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

	1949	*1950*	*1951*	*1952*	*1953*	*1954*	*1955*	*1956*	*1957*	*1958*
Faculty members of the staff:										
Professors	131	132	136	144	152	158	169	190	201	209
Associate Professors	141	137	144	149	157	155	167	169	169	171
Assistant Professors	138	144	154	166	170	178	175	199	206	211
Ex-Officio	10	8	11	10	12	14	15	16	15	16
Professors Emeriti (Lecturers)	13	13	10	9	10	9	7	7	15	17
Technical Instructors	..	..	..	..	..	..	..	..	..	..
Research Associates	2	2	2	2	2	1	1	1	1	1
Library Fellows	..	..	..	..	..	..	..	..	..	..
Total Faculty	**435**	**436**	**457**	**480**	**503**	**515**	**534**	**582**	**607**	**625**
Other members of the staff:										
Instructors	151	145	139	141	144	129	146	134	145	136
Technical Instructors	15	13	12	13	12	13	11	12	12	12
†Administrative Assistants	..	2	2	2	2	2	4	2	5	..
Teaching Assistants	..	..	186	208	222	214	249	273	261	286
Teaching Fellows	91	98	..	..	..	..	..	..	..	..
Fellows in Applied Math.	..	..	..	..	..	..	..	..	..	..
Assistants	124	122	..	..	..	..	..	..	..	..
Consultant	1	..	..	..	..	..	..	..	..	..
Lecturers	11	22	32	25	25	28	33	42	40	51
Research Associates	120	105	86	100	97	93	86	92	118	140
Research Assistants	348	433	474	517	542	529	536	586	621	647
Technical Assistants	..	..	46	45	48	39	40	36	47	52
Carnegie Fellows	..	..	2	..	..	..	..	..	..	..
Fellows	..	..	20	..	..	..	..	..	..	..
Total of other staff	**861**	**940**	**999**	**1,051**	**1,092**	**1,047**	**1,105**	**1,177**	**1,249**	**1,324**
Total staff	**1,296**	**1,376**	**1,456**	**1,531**	**1,595**	**1,562**	**1,639**	**1,759**	**1,856**	**1,949**
Other members of the faculty:										
Faculty and administrative officers, Emeriti (not Lecturers)	49	53	54	52	57	55	58	60	60	58
Non-Resident Professor	1	1	1	1	1	..	..	..	..	..
Total of other faculty	**50**	**54**	**55**	**53**	**58**	**55**	**58**	**60**	**60**	**58**

† Not included beginning in 1958–59.

Table 3. Classification of Students since 1956

Course	*1956–57*						*1957–58*						*1958–59*					
	1	*2*	*3*	*4*	*G*	*Total*	*1*	*2*	*3*	*4*	*G*	*Total*	*1*	*2*	*3*	*4*	*G*	*Total*
Aeronautical Engineering (XVI)	82	56	37	25	132	332	65	86	41	41	153	386	64	35	58	39	178	374
Aeronautical Engineering (Cooperative) (XVI-B)	..	..	12	15	..	27	..	..	11	13	..	24	..	..	11	11	..	22
Architecture (IV-A)	14	32	26	32	28	132	15	23	28	28	35	129	10	24	26	30	30	120
Fifth year	..	..	..	38	..	38	..	..	..	27	..	27	..	..	..	35	..	35
Biology (VII)	4	10	13	14	33	74	8	8	13	11	50	90	11	25	17	14	49	116
Building Engineering and Construction (XVII)	..	..	..	10	21	31	..	..	..	..	19	19	..	..	..	..	16	16
†Chemical Engineering (X)	135	101	109	67	186	598	112	103	77	93	234	619	91	81	86	73	169	500
Chemical Engineering Practice (X-A, X-B)	..	..	..	10	48	58	..	..	..	7	17	24	..	..	..	1	25	26
Chemistry (V)	29	27	27	17	214	314	56	21	23	28	192	320	37	39	17	25	207	325
City and Regional Planning (IV-B)	..	..	..	..	31	31	..	..	..	..	39	39	..	..	..	..	42	42
Civil Engineering (I)	37	37	51	48	76	249	18	31	42	50	105	246	32	23	34	42	107	238
Army Engineer	..	..	..	..	9	9	..	..	..	..	9	9	..	..	..	..	6	6
Economics, Politics, and Engineering or Science (XIV)	4	5	10	21	83	123	1	12	14	16	82	125	3	9	17	18	83	130
Electrical Engineering (VI, VI-B)	229	242	151	130	353	1,105	233	236	149	144	400	1,162	217	204	151	137	373	1,082
Electrical Engineering (Cooperative) (VI-A)	..	..	73	62	54	189	..	..	48	76	51	175	..	..	40	60	62	162
Food Technology (XX, XX-A, XX-B)	..	1	11	9	38	59	1	4	3	9	40	57	1	6	4	4	55	70
General Engineering (IX-B)	25	2	6	13	..	46	..	..	1	5	..	6	..	..	..	..	..	..
General Science (IX-A)	4	1	1	7	..	13	..	..	1	6	..	7	..	..	..	1	..	1
Geology and Geophysics (XII, XII-A)	2	14	22	13	49	100	3	10	17	18	63	111	6	14	13	20	55	108
Humanities and Engineering (XXI-A) or Science (XXI-B)	7	8	18	..	..	33	11	25	31	12	..	79	12	18	23	26	..	79
Industrial Management (XV)	21	70	78	98	143	410	26	64	86	95	172	443	25	44	81	93	179	422
Mathematics (XVIII)	28	33	22	20	105	208	45	35	33	22	115	250	76	57	45	39	147	364
Mechanical Engineering (II)	74	107	90	103	207	581	78	72	106	91	211	558	72	96	69	106	239	582
Mechanical Engineering (Cooperative) (II-B)	..	..	21	29	..	50	..	..	4	24	..	28	..	..	8	7	..	15
Metallurgy (III)	9	42	36	30	138	255	10	27	46	35	137	255	11	26	37	43	129	246
Ceramics	..	..	..	..	11	11	..	..	..	..	17	17	..	..	..	..	17	17
Meteorology (XIX)	1	3	2	4	53	63	..	..	3	3	49	55	..	..	..	3	51	54
Naval Architecture & Marine Engineering (XIII, XIII-B)	6	6	10	13	21	56	5	10	8	17	23	63	4	6	8	9	24	51
Naval Construction and Engineering (XIII-A)	..	..	..	..	70	70	..	..	..	..	73	73	..	..	..	..	79	79
Nuclear Engineering (XXII)	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	101	101
Physics (VIII)	223	129	93	68	180	693	222	137	115	79	205	758	268	146	101	104	227	846
Sanitary Engineering (XI)	..	..	..	..	26	26	..	..	..	..	23	23	..	..	..	..	20	20
Sci. Teaching (IX-C) or Sci. and Math. Teaching (XXI-C)	2	5	4	2	3	16	..	..	..	1	1	2	1	2	3	3	1	10
Totals	**936**	**931**	**923**	**898***	**2,312**	**6,000**	**909**	**904**	**900**	**951***	**2,515**	**6,179**	**941**	**855**	**849**	**943***	**2,671**	**6,259**

* These totals include the fifth year in Architecture (IV-A).
† Prior to 1958–59 Nuclear Engineering was included in Chemical Engineering.

Table 4-A. Students Classified by Schools, Courses, and Years, 1958–59

Course	*Year* 1	2	3	4	G	*Total*
School of Architecture and Planning:						
Architecture (IV-A)	10	24	26	30	30	120
Fifth year	..	..	..	35	..	35
City and Regional Planning (IV-B)	..	..	..	..	42	42
Total	**10**	**24**	**26**	**65**	**72**	**197**
School of Engineering:						
Aeronautical Engineering (XVI)	64	35	58	39	178	374
Aeronautical Engineering (XVI-B) (Cooperative)	..	..	11	11	..	22
Building Engineering and Construction (XVII)	..	..	..	..	16	16
Chemical Engineering (X)	91	81	86	73	169	500
Chemical Engineering Practice (X-A) (Graduate)	..	..	..	..	25	25
Chemical Engineering Practice (X-B) (Undergraduate)	..	..	..	1	..	1
Civil Engineering (I)	32	23	34	42	107	244
Army Engineer	..	..	..	..	6	
Electrical Engineering (VI)	212	173	132	114	373	1004
Electrical Engineering (VI-A) (Cooperative Course)	..	..	40	60	62	162
Electrical Science and Engineering (VI-B)	5	31	19	23	..	78
General Engineering (IX-B)	..	..	..	..	..	..
Mechanical Engineering (II)	72	96	69	106	229	582
Textile Engineering	..	..	..	..	10	
Mechanical Engineering (II-B) a. At Plant	..	..	2	..	..	
(Cooperative Course) b. At M.I.T.	..	..	6	7	..	15
Metallurgy (III)	11	26	37	43	124	
Mineral Engineering	..	..	..	..	5	263
Ceramics	..	..	..	..	17	
Naval Architecture and Marine Engineering (XIII)	4	6	8	8	23	49
Naval Construction and Engineering (XIII-A)	..	..	..	..	79*	79
Nuclear Engineering (XXII)	..	..	..	..	101	101
Sanitary Engineering (XI)	..	..	..	..	20	20
Shipping and Shipbuilding Management (XIII-B)	..	..	..	1	1	2
Total	**491**	**471**	**502**	**528**	**1,545**	**3,537**
School of Humanities and Social Studies:						
Economics, Politics, and Engineering (XIV-A)	1	7	11	8	83	130
Economics, Politics, and Science (XIV-B)	2	2	6	10	..	..
Humanities and Engineering (XXI-A)	9	4	5	13	..	..
Humanities and Science (XXI-B)	3	14	18	13	..	88
Science and Mathematics Teaching (XXI-C)	1	2	3	3	..	..
Science Teaching (IX-C)	..	..	..	..	1	1
Total	**16**	**29**	**43**	**47**	**84**	**219**

Table 4-A — continued

School of Industrial Management:						
Industrial Management (xv)	25	44	81	93	179	422
Total	**25**	**44**	**81**	**93**	**179**	**422**
School of Science:						
Biochemical Engineering (xx-B)	..	1	1	1	2	5
Chemistry (v)	37	39	17	25	207	325
Food Technology (xx, xx-A)	1	5	3	3	53	65
Geology and Geophysics (xii)	6	14	13	20	52	105
Geology and Geophysics (xii-A)	..	..	..	..	3	3
General Science (ix-A)	..	..	..	1	..	1
Mathematics (xviii)	76	57	45	39	147	364
Meteorology (xix)	..	..	..	3	51	54
Physics (viii)	268	146	101	104	227	846
Quantitative Biology (vii)	11	25	17	14	49	116
Total	**399**	**287**	**197**	**210**	**791**	**1,884**
Grand total	**941**	**855**	**849**	**943**†	**2,671**	**6,259**

* First graduate year, 24; second graduate year, 32; and third graduate year, 23.
† This total includes the fifth year in Architecture (iv-A).

Table 4-B. Special Students Classified by Courses and Years, 1958–59*

Course	*Year* 1	2	3	4	G	*Total*
School of Architecture and Planning:						
Architecture (iv-A)	..	2	..	1	1	4
Fifth Year	..	..	..	..	..	..
City and Regional Planning (iv-B)	..	..	..	..	4	4
School of Engineering:						
Aeronautical Engineering (xvi)	..	..	..	..	61	61
Building Engineering and Construction (xvii)	..	..	..	..	2	2
Chemical Engineering (x, x-A, x-B)	..	..	..	1	14	15
Civil Engineering (i)	..	..	..	1	8	9
Electrical Engineering (vi, vi-A, vi-B)	1	1	3	2	112	119
Mechanical Engineering (ii, iii)	..	..	..	3	40	43
Metallurgy (iii)	..	1	1	3	26	31
Naval Architecture and Marine Engineering (xiii, xiii-A, xiii-B)	..	..	..	..	13	13
Nuclear Engineering (xxii)	..	..	..	..	6	6
School of Humanities and Social Studies:						
Economics, Politics, and Engineering or Science (xiv-A, xiv-B)	..	..	1	..	10	11
Humanities and Engineering or Science (xxi-A, xxi-B)	..	..	..	3	1	4
School of Industrial Management:						
Business and Engineering Administration (xv)	..	1	1	1	16	19

* These students are included in Table 4-A.

continued

Table 4-B — continued

School of Science:						
Chemistry (v)	..	..	..	1	8	9
Food Technology (xx, xx-A, xx-B)	1	..	..	..	6	7
Geology and Geophysics (xii, xii-A)	..	..	1	..	2	3
Mathematics (xviii)	1	1	..	1	48	51
Meteorology (xix)	..	..	..	..	23	23
Physics (viii)	..	1	1	2	27	31
Quantitative Biology (vii)	..	..	..	1	12	13
Total	3	7	8	20	440	478

*Table 4-C. Classification of Former Students Who Returned in 1958–59**

Course	*Year* 1	2	3	4	G	*Total*
School of Architecture and Planning:						
Architecture (iv-A)	..	..	2	2	4	8
Fifth Year	..	..	..	5	..	5
City and Regional Planning (iv-B)	..	..	..	..	3	3
School of Engineering:						
Aeronautical Engineering (xvi, xvi-B)	..	1	1	3	6	11
Chemical Engineering (x, x-A, x-B)	..	2	1	3	8	14
Civil Engineering (i)	..	..	4	1	2	7
Electrical Engineering (vi, vi-A, vi-B)	2	7	7	10	9	35
Mechanical Engineering (ii, ii-B)	..	3	6	7	9	25
Metallurgy (iii)	..	2	1	1	1	5
Naval Architecture and Marine Engineering (xiii, xiii-B)	..	..	1	..	2	3
Nuclear Engineering	..	..	..	..	5	5
Sanitary Engineering (xi)	..	..	..	..	1	1
School of Humanities and Social Studies:						
Economics, Politics, and Engineering or Science (xiv-A, xiv-B)	..	..	3	..	4	7
Humanities and Engineering or Science (xxi-A, xxi-B)	..	1	3	1	..	5
School of Industrial Management:						
Business and Engineering Administration (xv)	1	3	10	8	11	33
School of Science:						
Chemistry (v)	..	..	..	2	2	4
Food Technology (xx, xx-A, xx-B)	..	1	..	..	3	4
Geology and Geophysics (xii, xii-A)	..	1	..	2	1	4
Mathematics (xviii)	..	1	2	2	3	8
Meteorology (xix)	..	..	..	..	7	7
Physics (viii)	..	5	5	..	4	14
Quantitative Biology (vii)	..	..	2	..	2	4
Total	3	27	48	47	87	212

* These students are included in Table 4-A; this listing excludes 74 special students.

Table 5. Geographical Classification of Students since 1954

	1954	*1955*	*1956*	*1957*	*1958*
United States:					
Alabama	13	15	19	22	20
Arizona	9	10	17	20	23
Arkansas	7	11	16	11	8
California	121	145	172	186	204
Colorado	22	30	35	32	39
Connecticut	162	172	212	180	169
Delaware	16	15	11	15	15
District of Columbia	39	44	48	40	34
Florida	72	90	97	113	118
Georgia	26	31	35	34	29
Idaho	8	11	8	10	10
Illinois	196	202	217	230	235
Indiana	29	46	41	52	56
Iowa	20	21	30	33	36
Kansas	22	24	30	31	41
Kentucky	22	26	24	28	32
Louisiana	17	19	27	25	33
Maine	43	54	47	38	34
Maryland	53	54	79	92	74
Massachusetts	1,447	1,241	1,121	1,387	1,459
Michigan	103	107	129	142	125
Minnesota	42	52	51	48	57
Mississippi	12	11	14	10	6
Missouri	53	54	61	70	60
Montana	11	16	16	13	13
Nebraska	15	18	20	19	29
Nevada	3	3	3	2	3
New Hampshire	46	42	57	47	50
New Jersey	331	346	358	358	352
New Mexico	13	9	10	12	15
New York	987	1,088	1,162	1,051	997
North Carolina	20	17	17	16	29
North Dakota	8	10	13	13	12
Ohio	140	170	201	195	195
Oklahoma	23	32	36	38	45
Oregon	15	21	21	20	22
Pennsylvania	238	287	316	315	312
Rhode Island	43	51	57	50	40
South Carolina	12	16	15	14	13
South Dakota	6	6	11	5	7
Tennessee	28	31	32	42	47
Texas	79	97	106	106	108
Utah	10	9	11	10	13
Vermont	16	17	18	18	25
Virginia	66	73	83	73	70
Washington	47	56	61	53	62
West Virginia	14	15	22	30	23
Wisconsin	40	52	62	57	56
Wyoming	5	6	8	7	4

continued

Table 5 — continued

U.S. Territories and Dependencies:					
Alaska	1	2	2	1	4
Canal Zone	2	2	1	3	2
Hawaii	16	15	21	17	16
Puerto Rico	8	11	14	11	12
Virgin Islands	..	..	..	1	1
Total, United States	**4,797**	**5,003**	**5,295**	**5,446**	**5,494**
Foreign countries:					
Algeria	..	..	1	..	1
Argentina	17	20	20	20	20
Australia	2	5	8	5	3
Austria	..	2	2	2	2
Bahamas	1	..	2	1	2
Belgian Congo	1	..	..	..	..
Belgium	3	12	9	8	7
Bermuda	..	..	1	1	1
Bolivia	1	..	1	1	1
Brazil	19	35	38	33	27
British Honduras	..	..	1	..	..
British North Borneo	1	1	..	..	..
British West Indies	5	5	4	5	5
Burma	15	11	8	8	5
Cambodia	..	..	..	1	..
Canada	78	93	116	118	103
Channel Isles	..	..	1	..	..
Chile	3	3	7	7	6
China	6	17	12	9	..
Colombia	17	24	23	26	28
Costa Rica	..	1	2	2	4
Cuba	17	18	17	17	24
Cyprus	1	2	2	..	1
Czechoslovakia	..	..	1	..	..
Denmark	1	1	..	3	1
Dominican Republic	2	1	1	1	3
Ecuador	2	3	..	3	2
Egypt	5	7	7	12	15
England	19	6	18	24	25
Ethiopia	1	..	..	1	1
Finland	5	5	3	2	3
Formosa	2	6	14	11	25
France	19	25	26	28	37
Germany	6	7	10	9	9
Ghana	..	..	1	2	3
Greece	21	24	27	33	19
Guatemala	5	8	8	7	3
Haiti	1	1	..	..	..
Honduras	2	2	2	2	3
Hong Kong	6	4	9	15	25
Hungary	..	1	..	9	8
Iceland	..	2	..	1	2
India	44	36	35	40	55
Indonesia	2	3	1	4	3

Table 5 — continued

Iran	4	5	6	10	15
Iraq	4	2	3	7	8
Ireland	1	1	1	..	2
Israel	12	16	24	19	24
Italy	7	8	6	11	15
Japan	16	15	19	18	31
Jordan	..	..	1	1	1
Korea	6	17	27	29	31
Lebanon	..	1	1	2	5
Liberia	1	..	..	..	..
Luxembourg	2	2	1	..	..
Malaya	2	2	2	2	1
Mauritius	1	1	2	2	..
Mexico	26	29	32	26	18
Morocco	1	1	1	1	..
Mozambique	1	1	1	..	..
Netherlands	4	4	4	7	3
Netherlands West Indies	1	1	2	2	3
New Zealand	..	3	2	3	1
Nicaragua	1	2	1	1	2
Nigeria	2	2	1	1	1
Northern Ireland	..	..	..	2	1
Norway	16	16	14	12	16
Pakistan	2	2	1	3	5
Panama	2	2	2	2	..
Peru	4	4	6	10	7
Philippines	16	15	14	14	9
Poland	..	..	..	..	3
Portugal	..	..	..	..	1
Portuguese India	..	..	..	..	1
Rhodesia	..	..	..	..	1
Salvador	3	2	3	1	1
Saudi Arabia	1	2	4	2	2
Scotland	2	3	2	7	6
Singapore	..	..	2	1	2
Spain	2	4	4	3	6
Sweden	9	6	4	3	3
Switzerland	5	6	8	7	7
Syria	4	4	2	2	2
Tanganyika	..	1	..	..	..
Thailand	5	10	11	10	9
Timor	1	..	..	..	..
Transjordan	2	2	1	..	..
Turkey	4	6	8	7	9
Union of South Africa	7	11	9	8	6
U.S.S.R.	..	..	1	1	..
Uruguay	4	6	6	6	5
Venezuela	35	36	22	16	14
Vietnam	1	2	3	2	3
Wales	4	1	1	..	1
Yugoslavia	..	..	2	1	2
Total, foreign	**551**	**645**	**705**	**733**	**765**
Grand total, U.S. and foreign	**5,348**	**5,648**	**6,000**	**6,179**	**6,259**

Table 6. New Students Entering from Other Colleges as Candidates for Degrees, 1958–59

Class joined at the Institute	*Calendar years spent at college*				
	One	*Two*	*Three*	*Four or more*	*Total*
First year	13	2	..	1	16
Second year	27	16	9	14	66
Third year	..	9	25	19	53
Fourth year	..	..	1	6	7
Graduate year	..	..	57	624	681
Total	**40**	**27**	**92**	**664**	**823**

Table 7. Women Students Classified by Courses and Years, 1958–59

Course	*Year*					*Total*
	1	*2*	*3*	*4*	*G*	
Aeronautical Engineering (XVI)	1	..	1	..	..	2
Architecture (IV-A)	2	..	3	..	..	5
Fifth year	..	..	..	2	..	2
Biology (VII)	..	2	..	1	11	14
Business and Engineering Administration (XV)	..	..	2	..	..	2
Chemical Engineering (X)	1	..	..	..	..	1
Chemistry (V)	1	..	..	1	14	16
City and Regional Planning (IV-B)	..	..	..	..	3	3
Civil Engineering (I)	..	..	..	..	1	1
Economics, Politics, and Engineering or Science (XIV-A, XIV-B)	..	..	..	..	7	7
Electrical Engineering (VI)	..	1	1	1	1	4
Food Technology (XX, XX-A, XX-B)	1	..	1	..	5	7
Geology and Geophysics (XII, XII-A)	..	..	1	..	..	1
Humanities and Engineering or Science (XXI-A, XXI-B)	..	..	2	4	..	6
Mathematics (XVIII)	7	2	4	3	10	26
Metallurgy (III)	..	..	1	..	3	4
Meteorology (XIX)	..	..	..	..	1	1
Naval Architecture and Marine Engineering (XIII)	..	..	..	..	1	1
Physics (VIII)	5	6	2	2	6	21
Science and Mathematics Teaching (XXI-C)	..	1	..	..	..	1
Total	**18**	**12**	**18**	**14**	**63**	**125**

Table 8. Continued, Former, and New Students

	1953–54	1954–55	1955–56	1956–57	1957–58	1958–59
Students registered at the end of the last academic year (including specials)	3,361	3,395	3,621	3,870	3,996	4,020
Students who have previously attended the Institute but were not registered at the end of the last academic year (including specials)	212	218	244	255	302	286
New students who entered by examination	803	955	913	906	883	917
New students who entered from other colleges as candidates for degrees	677	639	724	753	750	823
New students who entered as specials, not candidates for degrees	130	141	146	216	248	213
Total	**5,183**	**5,348**	**5,648**	**6,000**	**6,179**	**6,259**

Table 9. List of American Colleges and Universities with Number of Graduates Attending the Institute, 1958–59

Adelphi College	2
Alabama Polytechnic Inst.	2
Alabama, University of	3
Alaska, University of	1
Alfred University	6
Allegheny College	3
Amherst College	25
Antioch College	4
Arizona, University of	5
Arkansas, University of	1
Baldwin-Wallace College	1
Barnard College	1
Bennington College	1
Berea College	1
Bethany College	1
Boston College	20
Boston University	22
Bowdoin College	11
Bradford Durfee Tech. Inst.	1
Brandeis University	2
Brigham Young University	2
Brooklyn College	10
Brown University	11
Bryn Mawr College	1
Bucknell University	3
Buffalo, University of	2
Butler University	1
California Institute of Tech.	14
California State Poly. Coll.	1
California University at Berkeley	32
California University at Davis	2
California University at Los Angeles	6
California University at Santa Barbara	1
Canisius College	1
Carleton College	2
Carnegie Institute of Tech.	8
Case Institute of Tech.	9
Catholic Univ. of America	2
Central Y.M.C.A. College	1
Chicago, University of	16
Cincinnati, University of	12
Citadel, The	1
City College, The N.Y.	47
Claremont Men's College	2
Clark University	5
Clarkson College of Tech.	2
Clemson Agricultural Coll.	2
Colby College	4
Colgate University	4
College Agric. & Mech. Arts (Puerto Rico)	2
College of the Pacific	1
College of Wooster	4
Colorado Agric. & Mech. Coll.	1
Colorado School of Mines	5
Colorado, University of	5
Columbia College	19
Columbia University (N.Y.)	12
Connecticut, University of	9
Cooper Union, The	14
Cornell University	43
Creighton University	1
Dartmouth College	14
Davidson College	1
Davis and Elkins College	1
Dayton, University of	1
Delaware, University of	6
Denver, University of	2
DePauw University	2
Detroit, University of	3
Doane College	1
Drew University	2
Drexel Institute of Tech.	5
Duke University	3
Duquesne University	1
Eastern Kentucky College	1
Eastern Nazarene College	1
Eastern Washington Coll. of Education	1
Evansville College	1
Fenn College	2
Fisk University	1
Florida Southern College	1
Florida State University	1
Florida, University of	4
Fordham University	1
Franklin and Marshall Coll.	2

continued

Table 9 — continued

General Motors Institute	10
Georgetown University	2
George Washington Univ.	3
Georgia Institute of Tech.	22
Georgia, University of	3
Gettysburg College	1
Grinnel College	4
Gustavus Adolphus College	1
Hamilton College	2
Harvard University	79
Haverford College	4
Hawaii, University of	3
Heidelberg College	1
Hiram College	1
Hobart College	2
Holy Cross, College of	5
Houghton College	1
Howard University	2
Idaho, University of	4
Illinois Institute of Tech.	11
Illinois, University of	34
Indiana Teachers College	1
Indiana University	1
Iona College	1
Iowa State University	12
Johns Hopkins University	4
Juniata College	1
Kansas State Coll. of Agric. and Applied Science	4
Kansas State Teachers College	1
Kansas, University of	7
Kentucky, University of	2
Kenyon College	3
King's College	2
Lafayette College	2
Lamar State College of Technology	2
Lasalle College	2
Lebanon Valley College	1
Lehigh University	16
LeMoyne College	1
Lincoln University	1
Long Island University	1
Loras College	1
Louisiana Polytechnic Inst.	2
Louisiana State Univ. and Agric. and Mech. Coll.	1
Louisville, University of	4
Lowell Technological Inst.	6
Luther College	1
Lycoming College	1
Macalester College	1
Maine Maritime Academy	1
Maine, University of	8
Manhattan College	6
Marietta College	1
Marshall College	1
Maryland, University of	4
Mass. Institute of Tech.	809
Mass. Maritime Academy	3
Massachusetts, Univ. of	18
Merrimack College	3
Miami, University of	5
Miami University (Ohio)	3
Michigan College of Mining and Technology	5
Michigan State University	4
Michigan, University of	26
Middlebury College	14
Midwestern University	1
Milwaukee School of Eng.	1
Minnesota, University of	18
Mississippi State College	3
Missouri School of Mines and Metals	2
Missouri, University of	2
Montana School of Mines	2
Montana State University	1
Morehouse College	2
Mount Holyoke College	2
Muhlenberg College	2
Nebraska, University of	3
Newark College of Eng.	5
New Bedford Institute of Textiles and Technology	1
New Hampshire, Univ. of	10
New Jersey State Teachers College	1
New Mexico Coll. of Agric. and Mechanical Arts	1
New Mexico Institute of Mining and Tech.	1
New Mexico, University of	5
New School of Social Res.	1
New York University	26
North Carolina State Coll.	7
North Carolina, Univ. of	1
North Dakota Agric. Coll.	6
North Dakota State Teachers College	1
North East Missouri State Teachers College	6
Northeastern University	45
Northwest Nazarene Coll.	1
Northwestern University	13
Norwich University	2
Notre Dame, Univ. of	10
Oberlin College	4
Occidental College	2
Ohio Northern University	1
Ohio State University	11
Ohio University	4
Ohio Wesleyan University	3
Oklahoma Agric. and Mechanical College	2
Oklahoma Baptist Univ.	1
Oklahoma State Univ.	4
Oklahoma, University of	2
Oregon State College	5
Oregon, University of	2
Parks College	3
Pembroke College	1
Pennsylvania State Coll.	1
Pennsylvania State Univ.	22
Pennsylvania, Univ. of	15
Philadelphia College of Pharmacy and Science	1
Philadelphia Textile Inst.	2
Pittsburgh, University of	7
Poly. Institute of Brooklyn	22
Pomona College	9
Pratt Institute	2
Princeton University	42
Principia College	6
Providence College	2
Puerto Rico, University of	4
Purdue University	28
Queen's College (N.Y.)	2
Radcliffe College	2
Reed College	9
Rensselaer Poly. Inst.	57
Rhode Island School of Design	5
Rhode Island, Univ. of	4
Rice Institute	3
Ripon College	4
Rochester, University of	11
Rockhurst College	1
Rose Polytechnic Institute	3
Rutgers University	14
St. Anselm's College	1
St. Elizabeth College	1
St. Francis Xavier Univ.	1
St. John's University (N.Y.)	2
St. Joseph's College	3
St. Lawrence University	3
St. Louis University	4
St. Mary's University	1
St. Olaf College	3
San Jose State College	1
Santa Clara, University of	2
Sarah Lawrence College	1
Seattle Pacific College	1
Simmons College	7
Smith College	1
South, University of the	1
South Carolina, Univ. of	1
South Dakota School of Mines and Technology	2
South Dakota, University of	1
Southern California, University of	4
Southern Illinois Univ.	1
Southwestern at Memphis	2
Southwestern Louisiana Institute	1
Spring Hill College	1
Stanford University	17
State Teachers College (Bridgewater, Mass.)	2
State Teachers College at Boston	1
State University of Iowa	3
State Univ. of New York	1
Stetson University	1
Stevens Institute of Tech.	11
Suffolk University	1
Swarthmore College	8
Syracuse University	13
Temple University	1
Tennessee Agric. & Indust. State University	1
Tennessee, University of	2
Texas Agric. & Mech. Coll.	8
Texas Christian University	3
Texas Technological Coll.	3
Texas, University of	18
Texas Western College of the Univ. of Texas	1
Trinity College	5
Trinity University	2
Tri-State College	1
Tufts University	40
Tulane Univ. of Louisiana	2
Tulsa, University of	1
Union College (N.Y.)	3
U.S.A.F. Inst. of Tech.	1
U.S.C.G. Academy	20
U.S.M.M. Academy	3
U.S. Military Academy	15
U.S. Naval Academy	72
U.S.N. Postgrad. School	13
Utah, University of	10
Valparaiso University	1
Vanderbilt University	5
Vassar College	1
Vermont, University of	7
Villanova University	8
Virginia Military Inst.	7
Virginia Polytechnic Inst.	9
Virginia, University of	3

Table 9 — continued

Washington & Jefferson College	5
Washington & Lee Univ.	1
Washington, State Coll. of	2
Washington University	5
Washington, University of	19
Wayne University	6
Webb Inst. of Naval Arch.	4
Wellesley College	2
Wesleyan University	13
West Texas State College	2
Western Reserve University	2
Weston College	2
West Virginia, Univ. of	3
Wichita, University of	1
William Jewell College	1
William & Mary, College of	2
Williams College	18
Wilson College	1
Wisconsin, University of	18
Worcester Poly. Institute	12
Worcester State Teachers College	1
Wyoming, University of	1
Yale University	38
Yeshiva University	10
Total	2,723

In all, 309 American colleges and universities were represented. In addition, graduates of 195 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, 1958–59

	No previous degree			*Graduates of other colleges*					*Graduates of M.I.T. taking graduate work*		
	Entered:			*Entered in Sept., 1958*		*Entered in previous years*					
Course	*Sept., 1958*	*Previous years*	*Total*	*Under-grad.*	*Grad.*	*Under-grad.*	*Grad.*	*Total*	*S.B. degree, 1958*	*Other grad-uates*	*Total*
Aero. Eng. (XVI)	5	6	11	2	50	2	36	90	14	17	31
Architecture (IV-A)	8	20	28	11	20	17	6	54	..	3	3
Biology (VII)	2	1	3	..	9	..	20	29	2	6	8
Bldg. Eng. & Con. (XVII)	..	..	..	..	8	..	3	11	2	1	3
Bus. & Eng. Adm. (XV)	7	13	20	..	79	4	59	142	7	18	25
Chem. Eng. (X, X-A, X-B)	11	5	16	1	53	2	70	126	27	30	57
Chemistry (V)	2	4	6	..	53	..	141	194	..	5	5
City & Reg. Plan. (IV-B)	..	..	..	..	17	..	20	37	..	1	1
Civil Engineering (I)	1	11	12	3	39	2	38	82	6	22	28
Economics (XIV-A, XIV-B)	..	1	1	..	24	..	44	68	3	2	5
Elec. Eng. (VI, VI-A, VI-B)	29	50	79	8	73	6	125	212	79	46	125
Food Tech. (XX, XX-A, XX-B)	1	..	1	..	10	..	30	40	1	8	9
Geol. & Geophys. (XII, XII-A)	..	1	1	..	8	..	24	32	4	17	21
Humanities (XXI-A, XXI-B)	1	1	2	..	..	1	..	1	..	..	..
Mathematics (XVIII)	4	9	13	..	31	..	50	81	3	15	18
Mechanical Engineering (II)	23	28	51	5	64	7	80	156	23	32	55
Metallurgy (III)	1	2	3	1	24	1	58	84	6	32	38
Meteorology (XIX)	..	..	..	..	6	..	9	15	3	10	13
Nav. Arch. & Mar. Eng. (XIII)	2	4	6	1	2	5	9	17	1	1	2
Nav. Con. & Eng. (XIII-A)	..	..	..	..	27	..	49	76	..	..	..
Nuclear Engineering (XXII)	..	..	..	..	33	..	47	80	1	14	15
Physics (VIII)	11	22	33	2	42	3	100	147	14	44	58
Sanitary Engineering (XI)	..	..	..	..	8	..	..	8	2	10	12
Science Teaching (IX-C)	..	..	..	..	..	..	..	..	1	..	1
Ship. & Spbldg. Man. (XIII-B)	..	..	..	..	1	..	..	1	..	..	..
Total	**108**	**178**	**286**	**34**	**681**	**50**	**1,018**	**1,783**	**199**	**334**	**533**

Table 11. Number of Degrees Awarded in September, 1958, February, 1959,

Name of Degree	*S.B.*			*B.Arch. and B.C.P.*			*S.M.*			*M. Arch. and M.C.P.*		
	Sept. 1958	*Feb. 1959*	*June 1959*	*Sept. 1958*	*Feb. 1959*	*June 1959*	*Sept. 1958*	*Feb. 1959*	*June 1959*	*Sept. 1958*	*Feb. 1959*	*June 1959*
Aeronautical Engineering	6	..	37	..	..	..	8	4	37	..	..	..
Architecture	..	..	..	4	3	14	..	..	..	19	2	4
Biochemical Engineering	..	..	..	..	..	..	1	1	1	..	..	..
Biochemistry	..	..	..	..	..	..	..	1	..	..	..	..
Biology	..	..	..	..	..	..	..	..	1	..	..	..
Biophysics	..	..	..	..	..	..	..	..	1	..	..	..
Building Eng. and Con.	..	..	..	..	..	..	1	..	5	..	..	..
Business and Eng. Admin.	9	..	..	..	..	..	..	..	..	..	..	..
Ceramics	..	..	..	..	..	..	1	1	1	..	..	..
Chemical Engineering	5	4	52	..	..	..	6	12	27	..	..	..
Chemical Engineering Prac.	..	..	8	..	..	..	3	12	18	..	..	..
Chemistry	1	1	21	..	..	..	1	2	4	..	..	..
City Planning	..	..	..	..	..	..	..	..	..	5	1	13
Civil Engineering	2	2	38	..	..	..	10	8	35	..	..	..
Economics and Eng.	..	..	..	..	..	..	1	..	..	..	..	..
Economics and Science	..	..	..	..	..	..	..	..	1	..	..	..
Economics, Pol., and Eng.	1	..	7	..	..	..	..	..	..	..	..	..
Economics, Pol., and Science	1	..	10	..	..	..	..	..	..	..	..	..
Electrical Engineering	24	16	135	..	..	..	37	28	70	..	..	..
Food Technology	2	1	2	..	..	..	..	3	2	..	..	..
General Engineering	..	..	..	..	..	..	..	..	..	..	..	..
General Science	1	..	2	..	..	..	..	..	..	..	..	..
Geology and Geophysics	3	2	13	..	..	..	4	..	4	..	..	..
Humanities and Engineering	..	1	7	..	..	..	..	..	..	..	..	..
Humanities and Science	..	..	3	..	..	..	..	..	..	..	..	..
Industrial Economics	..	..	..	..	..	..	..	..	..	..	..	..
Industrial Management	..	9	71	..	..	..	9	9	73	..	..	..
Mathematics	2	2	29	..	..	..	1	2	9	..	..	..
Mechanical Engineering	11	9	80	..	..	..	14	13	38	..	..	..
Metallurgy	2	3	35	..	..	..	8	6	7	..	..	..
Meteorology	..	..	..	..	..	..	3	1	3	..	..	..
Naval Arch. & Marine Eng.	1	..	7	..	..	..	1	4	28	..	..	..
Nuclear Engineering	..	..	..	..	..	..	17	13	14	..	..	..
Physics	3	2	81	..	..	..	2	1	6	..	..	..
Quantitative Biology	..	..	9	..	..	..	..	..	..	..	..	..
Sanitary Engineering	..	..	..	..	..	..	1	1	9	..	..	..
Shipping and Shipbldg. Man.	..	..	..	..	..	..	..	..	..	..	..	..
Textile Technology	..	..	..	..	..	..	1	1	..	..	..	..
Without course classification	..	..	..	..	..	..	3	3	27	..	..	..
Total	**74**	**52**	**647**	**4**	**3**	**14**	**133**	**126**	**421**	**24**	**3**	**17**

and June, 1959

Engineer Sept. 1958	Engineer Feb. 1959	Engineer June 1959	Ph.D. Sept. 1958	Ph.D. Feb. 1959	Ph.D. June 1959	Sc.D. Sept. 1958	Sc.D. Feb. 1959	Sc.D. June 1959	Total Sept. 1958	Total Feb. 1959	Total June 1959	
1	..	3	..	..	3	..	..	2	15	4	82	Aeronautical Engineering
..	..	..	..	..	..	..	..	..	23	5	18	Architecture
..	..	..	..	..	..	..	..	..	1	1	1	Biochemical Engineering
..	..	..	..	..	..	..	..	..	..	1	..	Biochemistry
..	..	..	1	..	1	..	..	..	1	..	2	Biology
..	..	..	..	..	..	..	..	..	..	..	1	Biophysics
..	..	..	..	..	..	..	..	..	1	..	5	Building Eng. and Con.
..	..	..	..	..	..	..	..	..	9	..	..	Business and Eng. Admin.
..	..	..	..	..	..	..	1	1	1	2	2	Ceramics
1	..	1	..	..	..	3	7	6	15	23	86	Chemical Engineering
..	..	..	..	..	..	..	..	..	3	12	26	Chemical Engineering Prac.
..	..	..	14	11	15	..	..	..	16	14	40	Chemistry
..	..	..	..	..	..	..	..	..	5	1	13	City Planning
..	..	..	..	..	..	..	3	2	12	13	75	Civil Engineering
..	..	..	..	..	..	..	..	..	1	..	..	Economics and Eng.
..	..	..	..	..	..	..	..	..	..	..	1	Economics and Science
..	..	..	..	..	..	..	..	..	1	..	7	Economics, Pol., and Eng.
..	..	..	..	..	..	..	..	..	1	..	10	Economics, Pol., and Science
4	6	13	..	..	1	2	3	7	67	53	226	Electrical Engineering
..	..	..	..	..	1	..	..	..	2	4	5	Food Technology
..	..	..	..	..	..	..	..	..	..	..	..	General Engineering
..	..	..	..	..	..	..	..	..	1	..	2	General Science
..	..	..	2	..	6	..	..	..	9	2	23	Geology and Geophysics
..	..	..	..	..	..	..	..	..	..	1	7	Humanities and Engineering
..	..	..	..	..	..	..	..	..	..	..	3	Humanities and Science
..	..	..	..	6	6	..	..	..	..	6	6	Industrial Economics
..	..	..	..	..	..	..	..	..	9	18	144	Industrial Management
..	..	..	3	2	5	..	..	..	6	6	43	Mathematics
3	2	6	..	..	..	3	7	6	31	31	130	Mechanical Engineering
..	..	4	1	..	1	8	2	7	19	11	54	Metallurgy
..	..	..	..	..	1	..	..	..	3	1	4	Meteorology
1	..	26	..	..	..	..	..	..	3	4	61	Naval Arch. & Marine Eng.
..	..	..	..	..	2	..	2	3	17	15	19	Nuclear Engineering
..	..	..	5	5	22	1	..	..	11	8	109	Physics
..	..	..	..	..	..	..	..	..	..	..	9	Quantitative Biology
..	1	..	..	..	1	..	..	1	1	2	11	Sanitary Engineering
..	..	..	..	..	..	..	..	..	..	..	..	Shipping and Shipbldg. Man.
..	..	..	..	..	..	..	..	..	1	1	..	Textile Technology
..	..	..	..	..	..	..	..	..	3	3	27	Without course classification
10	**9**	**53**	**26**	**24**	**65**	**17**	**25**	**35**	**288**	**242**	**1,252**	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	Industrial Management ¶	Mathematics	Mechanical Eng. (including II-A)	Metallurgy**	Meteorology	Military Engineering	Mining Eng. & Metallurgy	Naval Arch. & Marine Eng.	Physics	Sanitary Engineering	Total	Total by decades
1868	..	..	..	..	..	..	..	..	..	6	..	..	..	..	..	1	..	..	..	..	1	..	..	..	6	..	..	..	14	
1869	..	..	..	..	..	..	..	..	1	2	..	..	..	..	..	..	..	..	..	..	2	..	..	..	..	..	..	..	5	
1870	..	..	..	..	..	..	..	..	1	4	..	..	..	..	..	1	..	..	..	..	2	..	..	..	2	..	..	..	10	29
1871	..	..	..	..	..	..	..	..	2	8	..	..	..	..	..	..	..	..	..	..	2	..	..	..	5	..	..	..	17	
1872	..	..	..	..	..	..	..	..	3	3	..	..	..	..	..	..	..	..	..	..	1	..	..	..	5	..	..	..	12	
1873	..	..	1	..	..	..	..	..	7	12	..	..	..	..	..	1	..	..	..	..	2	..	..	..	3	..	..	..	26	
1874	..	..	1	..	..	..	..	..	..	10	..	..	..	..	..	2	..	..	..	..	4	..	..	..	1	..	..	..	18	
1875	..	..	1	..	..	..	..	..	1	10	..	..	..	..	..	2	..	..	..	..	7	..	..	..	6	..	1	..	28	
1876	..	..	1	2	..	..	..	..	5	12	..	..	..	..	..	4	..	..	..	..	8	..	..	..	8	..	3	..	43	
1877	..	..	4	..	..	..	..	..	2	12	..	..	..	..	..	..	..	..	..	..	6	..	..	..	8	..	..	..	32	
1878	..	..	3	..	..	..	..	..	3	8	..	..	..	..	..	1	..	..	..	..	2	..	..	..	2	..	..	..	19	
1879	..	..	1	1	..	..	..	..	3	6	..	..	..	..	..	..	..	..	..	..	8	..	..	..	3	..	1	..	23	
1880	..	..	..	..	..	..	..	..	1	3	..	..	..	..	..	1	..	..	..	..	..	..	..	..	3	..	..	..	8	226
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	3	..	..	7	..	11	18	..	23	..	..	..	1	1	..	..	..	26	..	..	..	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	3	138	
1895	..	..	15	..	..	..	11	..	14	25	..	33	..	..	..	4	..	..	..	..	30	..	..	..	3	5	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	..	..	..	6	..	..	..	..	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	..	..	1	1	..	..	..	37	..	..	..	27	12	3	4	190	
1904	..	..	24	3	..	..	7	..	15	34	..	34	8	..	..	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.
¶ Prior to 1959 these degrees were included in Business and Engineering Administration.

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
1946	84	..	..	..	5	33	59	..	9	13	..	91	..	1	12
1947	84	..	..	4	9	154	114	..	23	45	..	189	..	6	28
1948	64	..	..	13	29	225	163	..	35	31	10	262	..	3	37
1949	51	..	..	3	23	157	72	12	28	49	16	176	..	12	33
1950	51	..	..	16	29	121	92	33	37	55	35	180	..	13	39
1951	50	..	..	14	32	119	92	27	26	55	23	150	..	10	26
1952	34	..	..	9	30	98	65	11	26	52	14	130	..	8	14
1953	40	..	..	12	18	77	59	12	23	55	12	126	..	5	21
1954	19	..	..	12	12	91	58	13	18	43	12	106	..	4	24
1955	36	..	..	9	7	87	62	8	12	41	9	147	..	3	21
1956	45	..	..	15	21	77	102	6	20	55	13	133	..	10	12
1957	33	..	..	11	10	97	64	9	18	38	19	167	..	8	11
1958	43	..	..	8	1	86	85	8	26	47	16	187	..	7	4
§1959	37	..	..	9	..	..	56	8	22	40	17	151	..	3	..
Total	**1218**	**172**	**865**	**474**	**376**	**3,296**	**2,974**	**386**	**1,255**	**2,984**	**196**	**5,458**	**301**	**93**	**817**

Class (calendar year)	General Science or General Course	Geology and Geophysics	Humanities and Eng. or Science***	Industrial Management¶	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	2	1	..	..	4	93	7	24	..	..	29	12	..	479	
1947	3	..	..	..	7	170	20	12	..	..	30	35	..	933	
1948	8	1	..	..	12	186	16	6	..	..	12	60	..	1,173	
1949	7	3	..	..	5	114	17	5	..	..	16	40	..	839	
1950	6	11	..	..	21	185	36	9	..	..	17	61	..	1,047	6,626
1951	7	18	..	..	13	139	40	7	..	..	23	53	..	924	
1952	7	18	..	..	21	117	38	9	..	..	26	67	..	794	
1953	10	18	..	..	17	81	27	5	..	..	10	58	..	686	
1954	4	11	..	..	12	93	31	7	..	..	15	51	..	636	
1955	6	13	..	..	13	88	22	1	..	..	11	47	..	643	
1956	11	15	..	..	23	119	26	2	..	..	15	39	..	759	
1957	9	6	..	..	15	123	24	3	..	..	7	63	..	735	
1958	6	16	10	..	18	114	32	2	..	..	14	73	..	803	
§1959	2	15	11	80	31	89	38	..	..	..	7	83	..	699	
Total	**335**	**237**	**21**	**80**	**302**	**5,172**	**524**	**92**	**5**	**880**	**880**	**1,134**	**264**	**30,791**	

§ Includes only February and June degrees.

*** Prior to 1958 these degrees were included in General Engineering and General Science or General Course.

¶ Prior to 1959 these degrees were included in Business and Engineering Administration.

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*	*Mathematics*	*Mechanical Eng.*	*Metallurgy*	*Meteorology*	*Naval Arch. & Marine Eng.*	*Naval Construction and Engineering*	*Nuclear Engineering*	*Petroleum Engineering*	*Physics*	*Sanitary Engineering*	*Without Course classification*	*Total*
1886	..	..	..	..	..	..	..	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	Economics & Eng. or Science	Electrical Eng. (including VI-A)	Food Technology & Biochemical Eng.	Geology and Geophysics	Industrial Management	Mathematics	Mechanical Eng. (including II-A)	Metallurgy	Meteorology	Naval Arch. & Marine Eng.	Naval Construction† and Engineering	Nuclear Engineering	Petroleum Engineering	Physics	Sanitary Engineering	Without Course classification	Total
1909	..	6	..	..	..	1	..	1	2	..	1	..	1	..	..	1	..	..	..	3	..	..	1	..	..	17
1910	..	6	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	..	..	..	..	..	..	3	4	..	4	..	..	..	1	1	..	..	..	..	..	..	..	..	..	15
1920	..	..	1	..	..	3	..	2	4	..	7	..	3	..	1	5	..	..	..	19	..	..	1	..	4	50
1921	3	..	..	..	..	29	..	6	2	..	4	..	2	..	..	10	..	..	..	20	..	..	..	..	17	93
1922	5	..	..	..	..	6	32	4	5	..	37	..	2	..	2	4	..	..	..	10	..	..	1	..	18	126
1923	10	..	..	..	..	3	34	1	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	237
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	30	..	1	6	1	72	21	3	43	4	132	4	7	89	10	64	20	9	27	..	..	..	10	11	37	601
*1959	41	..	3	5	2	39	30	6	43	1	98	7	4	82	11	52	13	4	32	..	27	..	7	10	30	547
Total	**762**	**84**	**89**	**78**	**15**	**940**	**1,002**	**211**	**763**	**44**	**2,520**	**49**	**95**	**664**	**161**	**1,171**	**329**	**238**	**216**	**478**	**27**	**5**	**216**	**168**	**1,033**	**11,358**
																									See note below	126
																										11,484

* Includes only February and June degrees.
† Beginning 1949, see Naval Engineer, Table 17.

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 11,484.

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	19	..	25	16
*1959	17	..	6	14
Total	498	31	380	195

* 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	3	..	4	2	20	1	10	3	..	2	22	1	68
*1959	3	..	1	..	19	1	8	4	..	2	23	1	62
Total	**33**	**4**	**10**	**11**	**108**	**5**	**89**	**21**	**2**	**10**	**304**	**9**	**606**

* Includes only February and June degrees.
† Discontinued in June, 1956.

Table 17. Degrees of Doctor of Philosophy Awarded

Class (calendar year)	*Aeronautical Engineering*	*Biology*	*Chemistry*	*Electrical Engineering*	*Food Technology*	*Geology*	*Industrial Economics*	*Mathematics*	*Metallurgy*	*Meteorology*	*Nuclear Engineering*	*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
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	..	2	36	..	1	6	9	6	1	2	..	25	..	1	89
*1959	3	1	26	1	1	6	12	7	1	1	2	27	..	1	89
Total	**3**	**81**	**694**	**3**	**23**	**118**	**96**	**129**	**2**	**11**	**2**	**474**	**9**	**2**	**1,647**

† 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	Nuclear Engineering	Petroleum Engineering	Physics	Sanitary Engineering	Total
1911	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	1
1912	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
1913	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
1914	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
1915	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	1
1916	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1
1917	..	..	..	..	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	1
1918	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
1919	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
1920	1	..	..	..	..	..	..	..	1	..	..	..	..	1	..	..	..	..	..	3
1921	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..
1922	1	..	..	1	..	1	..	..	..	..	..	..	..	..	..	..	..	..	..	3
1923	1	..	..	..	..	..	..	..	1	..	..	1	..	..	..	..	..	2	..	5
1924	..	..	2	..	..	1	..	..	1	..	..	1	..	..	..	..	..	1	..	6
1925	1	..	3	..	..	..	..	..	..	..	..	3	..	..	..	..	..	..	..	7
1926	..	..	1	1	1	1	1	..	..	..	..	4	..	..	..	..	..	..	..	9
1927	..	..	..	..	..	1	..	..	..	1	1	2	..	..	..	..	..	1	..	6
1928	1	..	5	..	1	2	..	..	..	..	..	1	..	..	..	..	..	..	..	10
1929	..	..	3	..	..	..	..	..	..	..	..	1	..	..	1	..	..	1	..	6
1930	..	..	9	..	..	6	..	..	..	1	3	1	..	..	..	..	..	..	..	20
1931	..	..	3	2	..	3	..	..	..	..	..	1	..	..	..	..	..	..	..	9
1932	..	..	5	..	1	2	..	..	1	..	2	1	..	..	..	..	..	2	..	14
1933	..	..	10	1	2	3	..	..	..	1	..	6	..	1	..	..	..	..	..	24
1934	..	..	3	..	..	2	1	..	1	..	3	2	1	..	..	..	..	..	..	13
1935	..	1	2	1	..	4	..	..	..	2	..	1	1	..	..	..	..	1	1	14
1936	2	1	12	..	..	1	..	..	..	..	2	3	..	1	..	..	..	2	..	24

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	11	..	4	16	..	..	..	..	12	23	..	..	..	..	..	1	..	70
*1959	2	2	13	..	5	10	..	..	..	..	13	9	..	..	..	5	..	..	1	60
Total	**57**	**45**	**315**	**13**	**76**	**198**	**2**	**11**	**14**	**6**	**161**	**266**	**47**	**5**	**2**	**5**	**1**	**44**	**22**	**1,290**

* 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 (1868–1959)

Bachelor of Science	30,791
Bachelor in Architecture	498
Bachelor in City Planning	31
Master of Science	11,484
Master in Architecture	380
Master in City Planning	195
Master in Public Health (discontinued after 1944)	104
Advanced Engineering	606
Doctor of Philosophy	1,647
Doctor of Science	1,290
Doctor of Public Health (discontinued after 1944)	9
Doctor of Engineering (discontinued after 1918)	4
Grand total	47,039

ROBERT E. HEWES

DIRECTOR OF THE REGISTRY OF GUESTS

During the second year of the stewardship of the undersigned, the Registry of Guests enjoyed a marked increase in its volume of traffic. The number of foreign visitors rose from some four hundred during the previous year to roughly five hundred and fifty this year.

As in the past, a flow of letters of gratitude from many parts of the world continues to attest to the sincere and heartfelt appreciation which our foreign visitors feel toward the faculty and staff of M.I.T. for their generous reception.

Reflecting the new reciprocal arrangements concluded by the Department of State and the Russian Foreign Office was the number of Soviet visitors to the Institute. Hitherto a rarity in these parts, both their numbers and positions were not insignificant.

Such dignitaries as the following were among those received: the Minister of Labor of Yugoslavia; the Yugoslav Permanent Representative to the United Nations; the Pakistani Ambassador to the United States; the First Deputy Chairman of the State Planning Commission of the U.S.S.R. and Minister of the U.S.S.R.; the French High Commissioner for Atomic Energy; and the Presidents and Rectors of over a dozen outstanding foreign universities.

Perhaps the most colorful group of distinguished foreign visitors consisted of a party of Buddhist monks from Rangoon, Burma, attired in their saffron robes.

The countries represented this year numbered fifty-two and include the following:

Afghanistan, Argentina, Australia, Austria, Belgium, Bolivia, Brazil, Burma, Canada, Ceylon, Chile, China (Taiwan), Costa Rica, Denmark, Ecuador, Eire, Finland, France, Germany, Ghana, Great Britain, Greece, Guatemala, Honduras, India, Indonesia, Iran, Israel, Italy, Japan, Korea, Malaya, Mexico, Netherlands, Norway, Pakistan, Peru, Philippines, Poland, Portugal, Southern Rhodesia, Spain, Sweden, Switzerland, Thailand, Turkey, Uruguay, U.S.S.R., Union of South Africa, Venezuela, and Yugoslavia.

THOMAS H. D. MAHONEY

DIRECTOR OF THE SCHOOL FOR ADVANCED STUDY

The Fellows of the School for Advanced Study are appointed from nominations made by individual members of the M.I.T. faculty. There are two sources of nominees. Holders of recognized postdoctoral fellowships and certain other qualified postdoctoral scholars already in attendance at the Institute may, as a mark of distinction, be nominated Fellows of the School for Advanced Study. During the academic year 1958–59, twelve Fellows were appointed from this group. These scholars represented eight countries: Argentina, England (2), France (2), Germany, India, Poland, Sweden, and the United States (3). They worked in the Departments of Biology, Chemistry (2), Geology, Physics (2), Aeronautics and Astronautics, Electrical Engineering (2), and Economics and Social Science (3).

In addition, other scholars are invited to come to M.I.T. as Alfred P. Sloan Foreign Postdoctoral Fellows of the School for Advanced Study, in a program made possible by the generous support of the Alfred P. Sloan Foundation, Inc. Nominations for these fellowships are submitted to the School for Advanced Study by faculty members and carefully studied by a selection committee, and the most promising nominees are invited to come to M.I.T. for a year of study and research. These Sloan Foreign Postdoctoral Fellows receive grants covering both traveling and living expenses.

In this first year of the Sloan Foreign Postdoctoral Fellowship program, the seven invited Fellows came from England (3), Holland, Israel, Japan, and Yugoslavia; they worked in the Departments of Biology, Chemistry, Mathematics (2), Physics, and Mechanical Engineering (2). As the year's stay draws to a close for these Fellows, all but one have elected to extend their stay in the United States for further study and research. Four of the six are remaining for further study at M.I.T. This is strong evidence of the success of the program. Meanwhile, the selection committee has invited a new group of seven Fellows for the year 1959–60.

A program matching the Sloan Foreign Postdoctoral Fellowship program, but designed for American scholars, is needed to round out the fellowship plans of the School for Advanced Study.

MARTIN J. BUERGER

MANAGER OF STUDENT PERSONNEL

The number of working students during the past year was 1,328. The total amount earned by these students, including income from jobs outside the Institute, was $701,478; this is an average of $528 per student. Of this total, $610,000 was earned exclusively from M.I.T. funds, for an average of $459 per student employed. Of the total earned from M.I.T. funds, $602,000 was earned by 1,308 undergraduates. The amount paid for work for laboratories, for Division of Sponsored Research projects, and for departments and administrative offices came to $414,000; this latter figure represents 68 per cent of the total M.I.T. funds paid to students for services performed on the M.I.T. campus. These figures do not include fellowships, research assistantships, and staff appointments to graduate students.

There were 1,584 new job assignments made during the past year. Adding the long-term jobs carried over from the preceding year, a total of 1,683 jobs were filled during 1958–59.

A survey of project supervisors and laboratory directors completed during the spring shows 145 possible new jobs available to students beginning in the fall term 1959–60. The prospective increase in tuition and the constantly increasing costs of living make such new job opportunities of special importance.

The Student Personnel Office conducted over 6,500 interviews during the year. Many students come to learn the requirements for part-time work on the campus and to find out the qualifications expected for work in various assignments.

The active files in the Student Personnel Office now contain 2,250 personnel records of young men and women who are interested in part-time work.

Our alumni files contain more than 6,000 records of graduates who have worked at M.I.T. as students during recent years. We frequently have reference to this information at the request of prospective employers.

WILLIAM H. CARLISLE, JR.

DIRECTOR OF THE SUMMER SESSION

The 1958 Summer Session was similar to those of recent years, with its three principal components consisting of (1) a series of Special Summer 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

For the ninth consecutive year the Institute offered a series of Special Summer Programs designed for professional people in business, industry, and government. This year 29 of the 37 programs extended through two weeks, while the remaining 8 were of one week's duration. These specialized programs, covering a wide variety of professional areas, are often developed by faculty members from two or more departments. Consequently, the following breakdown of the 37 programs by schools is somewhat arbitrary:

Architecture and Planning	2
Engineering	24
Humanities and Social Science	2
Industrial Management	3
Science	6

In practically every instance one or more distinguished guest lecturers participated.

The total registration in the 37 programs was 1,894, compared with 2,000 in 33 programs in 1957. The 1,894 registrants were drawn from 2,366 applicants, and there was no significant change in the general background of those who attended. The following table gives some statistics on the registrants, expressed as percentages of the total registration in the respective years:

	1958	*1957*	*1956*
Professional Origin:			
Business and industry	58	64	61
Government (federal and state)	34	33	31
Educational institutions	8	8	8
Geographical Origin:			
East of the Mississippi River	73	79	80
West of the Mississippi River	19	15	16
Foreign	8	6	4
Academic Background:			
Doctor's degree	12	7	11
Master's degree	28	23	25
Bachelor's degree	54	57	55
No degree	6	13	10
Average age (in years)	35	36	36

Included among the foreign students were 25 European nationals who attended one or both of the programs in the operations research field.

There is no set pattern for a program, except that each one is intended to offer professional training in an area of particular interest to one or more of the Institute faculty. Some are conducted with small groups on a seminar basis, others offer considerable laboratory demonstration, and some follow the familiar pattern of lectures with discussion periods. Likewise, the course content varies depending upon whether the program is an emerging technological area or whether it is intended primarily to refresh and enlarge the outsider's mastery of an established professional field. Some of the most popular programs are those which have been offered by the same faculty members many times in the past, thereby demonstrating that our series has earned widespread acceptance outside the Institute.

Conferences

During the summer, this office provided auxiliary support for two conferences. The American Mathematical Society conducted a national meeting at the Institute during the week of August 25 to 29. The attendance was approximately 1,000, and as many as possible were housed in the Institute's dormitories. The Cryogenic Engineering Conference was held at M.I.T. from September 3 to 5. Professor Samuel C. Collins made the arrangements for this meeting.

In addition, a number of smaller groups conducted meetings here or at Endicott House.

Regular Subjects

The total number of subjects (excluding Special Problems and Thesis) and the registration in recent years follows:

	1958	*1957*	*1956*	*1955*
Number of subjects	70	72	80	111
Registration	1,650	1,536	1,553	1,542

A marked increase (from 922 to 1,069) in the graduate enrollment entirely accounts for the significant change in the total registration.

Series in the Arts

The cooperative plan with Harvard University to present a series in the arts was modified this year so that the M.I.T. functions would coincide with the periods of high enrollment. The principal functions in Kresge Auditorium were a concert by the M.I.T. Choral Society (June 25), character sketches by Cornelia Otis Skinner (July 10), and an organ recital by E. Power Biggs (August 7). The latter two programs were M.I.T.'s contribution to the joint series with Harvard University. All three events were very well attended; it was necessary to close the doors for the Skinner performance.

In addition, the M.I.T. Community Players gave two performances of Christopher Fry's play, "A Phoenix too Frequent." This event drew full houses in the Little Theater on August 11 and 12.

JAMES M. AUSTIN

DIRECTOR OF THE TECHNOLOGY PRESS

During the year the Technology Press published the following books:

Coding for the IBM-704 Computer, edited by FRANK C. HELWIG, with nine contributors. Third edition. August, 1958.

* *The Scanlon Plan*, edited by FREDERICK G. LESIEUR, with seven contributors. October, 1958.

Selected Books and Journals in Science and Engineering, compiled by IRMA Y. JOHNSON. October, 1958.

* *The Physical Chemistry of Steelmaking*, edited by JOHN F. ELLIOTT, with thirty-eight contributors. November, 1958.

* *Nonlinear Problems in Random Theory*, by NORBERT WIENER. December, 1958.

History of the Gear-Cutting Machine, by ROBERT S. WOODBURY. December, 1958.

* *Noise in Electron Devices*, edited by LOUIS D. SMULLIN and HERMANN A. HAUS, with five contributors. February, 1959.

* *Molecular Science and Molecular Engineering*, by ARTHUR R. VON HIPPEL, in collaboration with twenty-two contributors. April, 1959.

* *Circuit Theory of Linear Noisy Networks*, by HERMANN A. HAUS and RICHARD B. ADLER. May, 1959.

* *Mathematical Programming and Electrical Networks*, by JACK B. DENNIS. June, 1959.

* *The Location of the Synthetic-Fiber Industry*, by JOSEPH AIROV. June, 1959.

Notes on Operations Research 1959, assembled by the Operations Research Center, M.I.T. June, 1959.

* Published jointly with John Wiley and Sons, Inc., New York.

Fourteen more books were in production at the end of the school year.

A new series of publications has been established under the name Technology Press Research Monographs in order to make more readily available the significant results of research that for one reason or another may not be suitable for more conventional modes of publication. A report that is too long for an article and not long enough, or perhaps not finished or definitive enough, for a book may still represent work that ought to be made available to the profession. A piece of work may not find its proper place in the literature of a field because it appears as a technical report of one of our laboratories. The Press has begun to experiment with ways of making this sort of material available more quickly, more informally, and perhaps more economically than is possible through ordinary book publishing methods.

The Press has joined the Association of American University Presses. This membership will make possible a more effective distribution of books with a small market. The more important technical books we will continue to distribute through a commercial publishing house.

LYNWOOD S. BRYANT

Principal Honors and Awards to the Staff

ADMINISTRATION

HAROLD L. HAZEN
Chairman of the Committee on Development of Engineering Faculties, American Society for Engineering Education.

JAMES R. KILLIAN, JR.
Honorary Degrees of Doctor of Laws, New York University and Johns Hopkins University.
Honorary Degree of Doctor of Science, University of Akron.
Gold Medal Award of the National Institute of Social Sciences.
World Brotherhood Award of the National Conference of Christians and Jews.
Award of Merit of the American Institute of Consulting Engineers.
Washington Award of the Western Society of Engineers.

JOHN I. MATTILL
Chairman of the Public Information Committee, American Society for Engineering Education.

G. EDWARD NEALAND
Associate Vice President of the National Association of Educational Buyers.

MALCOLM D. RIVKIN
Member of the Board of Directors and Corporation, Cambridge Center for Adult Education.

JULIUS A. STRATTON
Honorary Degree of Doctor of Laws, Harvard University.

B. ALDEN THRESHER
Chairman of the College Entrance Examination Board.

Medical Department

JAMES M. FAULKNER
Honorary Degree of Doctor of Science, Boston University.
Member of the Boards of Directors of the National Fund for Medical Education, of the United Funds and Councils of America, of the Unitarian Service Committee, and of the Boston University—Massachusetts Memorial Hospital Medical Center.

SAMUEL LEVIN
Commissioner of the Massachusetts Commission on Atomic Energy.

JOHN L. ROWBOTHAM
Fellow of the American College of Surgeons.

Library

IRMA Y. JOHNSON
Chairman of the Science-Technology Division, Boston Chapter, Special Libraries Association.

NATALIE N. NICHOLSON
Consultation Officer of the Boston Chapter, Special Libraries Association.

SCHOOL FOR ADVANCED STUDY

MARTIN J. BUERGER
Honorary Degree of Doctor of Philosophy, University of Berne, Switzerland.
Roebling Medal of the Mineralogical Society of America.

FRANCIS O. SCHMITT
Honorary Degree of Doctor of Science, Valparaiso University (Chile).
Member of the National Advisory Health Council, United States Public Health Service.

SCHOOL OF ARCHITECTURE AND PLANNING

PIETRO BELLUSCHI
Commencement Addresses at the Rhode Island School of Design and the School of the Museum of Fine Arts, Boston.

Department of Architecture

HERBERT L. BECKWITH
Fellow of the American Institute of Architects.
Vice Chairman of the National Committee on Education, American Institute of Architects.

ALBERT BUSH-BROWN
Editor of the *Journal of Architectural Education.*
Editor for Architecture, *Encyclopaedia Britannica.*

Department of City and Regional Planning

JOHN T. HOWARD
Yale Medal Award for Distinction in the Arts.

SCHOOL OF ENGINEERING

JOHN C. FISHER
H. W. Gillett Memorial Lecture sponsored by the American Society for Testing Materials and Battelle Memorial Institute.

C. RICHARD SODERBERG
Honorary Degree of Doctor of Engineering, Tufts University.
Royal Order of the North Star Medal bestowed by His Majesty King Gustav VI of Sweden.

H. GUYFORD STEVER
T. A. Boyd Lecture at the College of Engineering, Ohio State University.
Vice Chairman of the Scientific Advisory Board, United States Air Force.
Chairman of the Special Committee on Space Technology, National Advisory Committee for Aeronautics.
Chairman of the Research Advisory Committee on Missile and Spacecraft Aerodynamics, National Aeronautics and Space Administration.
Council Member of the Institute of the Aeronautical Sciences.

Department of Aeronautics and Astronautics

HOLT ASHLEY
Fellow of the American Academy of Arts and Sciences.

RAYMOND L. BISPLINGHOFF
Fellow of the Royal Aeronautical Society, London.

CHARLES S. DRAPER
Blandy Medal of the American Ordnance Association.
Godfrey L. Cabot Award of the Aero Club of New England.
American Honorary Fellowship of the Institute of the Aeronautical Sciences.

RENE H. MILLER
Technical Director of the American Helicopter Society.
Editor of the *Journal of the American Helicopter Society.*

PAUL E. SANDORFF
Chairman of the Education Committee, American Rocket Society.

GEORGE P. SUTTON
Consultant to the Advisory Panel on Aeronautics, Office of the Director of Defense Research and Engineering.
Chief Scientist of the Advanced Research Projects Agency, United States Department of Defense.

LEON TRILLING
Member of the United States Engineering Education Mission to the Union of Soviet Socialist Republics, American Society for Engineering Education.

Department of Chemical Engineering

EDWIN R. GILLILAND
Award in Industrial and Engineering Chemistry of the American Chemical Society.

WILLIAM H. MC ADAMS
Gold Medal of the Institut Français des Combustibles et de l'Energie.

ROBERT P. MORGAN
Nuclear Science and Engineering Fellowship, United States Atomic Energy Commission.

THOMAS K. SHERWOOD
Priestley Lecturer, Pennsylvania State University.

Department of Civil and Sanitary Engineering

JOHN M. BIGGS
Director of the Boston Society of Civil Engineers.

DONALD R. F. HARLEMAN
Chairman of the Committee on Mechanics of Stratified Flow, Engineering Mechanics Division, American Society of Civil Engineers.
Chairman of the Awards Committee, New England Water Works Association.

ARTHUR T. IPPEN
Vice President of the Boston Society of Civil Engineers.

FREDERICK J. MC GARRY
Member of the Executive Committee, Eastern Division, Society of Aircraft Materials and Process Engineers.

CHARLES L. MILLER
National Director of the American Society of Photogrammetry.

CHARLES H. NORRIS
Vice Chairman of the Massachusetts Section, American Society of Civil Engineers.

VINCENT J. ROGGEVEEN
Chairman of the Committee on Transportation, Civil Engineering Division, American Society for Engineering Education.

JOHN B. WILBUR
Member of the Steering Committee, National Transportation Policy Panel, Engineers Joint Council.

MARTIN WOHL
Past President's Award of the Institute of Traffic Engineers.

Department of Electrical Engineering

ELIE J. BAGHDADY
Gold Medal of Distinction of the Government of Lebanon.
First Prize, Papers Award of the Professional Group on Vehicular Communications, Institute of Radio Engineers.

LEO L. BERANEK
Chairman of the Acoustical Standards Board, American Standards Association.
Chairman of the Promotion and Development Committee, Acoustical Society of America.
Associate Editor of the *Journal of the Acoustical Society of America.*
Thomas Hawksley Lecturer of the Institution of Mechanical Engineers, London, Bristol, and Oxford, England.

ABRAHAM BERS
Television Shares Management Corporation Award.

JOSE M. BORREGO-LARRALDE
Sprague Electric Company Award.

MARY AGNES B. BRAZIER
Affiliate of the Royal Society of Medicine (Honorary), London.

GORDON S. BROWN
Lamme Medal of the American Society for Engineering Education.

DUDLEY A. BUCK
Honorable Mention, Outstanding Young Electrical Engineer Award of Eta Kappa Nu.

HAROLD E. EDGERTON
Outstanding New England Engineer Award of the Engineering Societies of New England, Inc.

PETER ELIAS
Fellow of the Institute of Radio Engineers.

ROBERT M. FANO
Fellow of the American Academy of Arts and Sciences.
Chairman of the Editorial Advisory Committee, Institute of Radio Engineers.
Lecturer at the Summer School on Information Theory, Varenna, Italy.

MOISE H. GOLDSTEIN, JR.
National Science Foundation Science Faculty Fellowship for study in Pisa, Italy.

ROBERT GOLUB
National Science Foundation Fellowship.

JOHN GRANLUND
Director of the Arlington Community Chest, Inc.

TRUMAN S. GRAY
Chairman of the Subcommittee on Organization, Instrumentation Division Committee, American Institute of Electrical Engineers.

HERMANN A. HAUS
Fellowship, John Simon Guggenheim Memorial Foundation.

RONALD A. HOWARD
Member of the Faculty of the Institute of Basic Mathematics for Application to Business, Ford Foundation.

JOHN W. IRWIN
Chairman of the Microcirculatory Conference.

HARRY B. LEE
The Goodwin Medal.

ARTHUR L. LOEB
Chairman of the Boston-Cambridge Section, Society for Industrial and Applied Mathematics.

SAMUEL J. MASON
Fellow of the Institute of Radio Engineers.

RONALD J. MASSA
Television Shares Management Corporation Award.

JOHN P. PENHUNE
Television Shares Management Corporation Award.
Fellowship to the Summer School on Theoretical Physics, University of Grenoble, France.

WILLIAM H. RADFORD
Member of the Scientific Advisory Board, United States Air Force.
Chairman of the *ad hoc* Voice of America Panel, President's Scientific Advisory Committee.

J. FRANCIS REINTJES
Member of the Board of Governors, The Belmont Forum.
Chairman of the Education Subcommittee, Region I, Institute of Radio Engineers.

WALTER A. ROSENBLITH
Chairman of the Organizing Committee, International Symposium on Principles of Sensory Communication.
Associate Editor of *Daedalus*, American Academy of Arts and Sciences.
Member of the Council and of the Executive Board, Biophysical Society.
Chairman of the Committee on Publicity and Editorial Policy, Biophysical Society.
Member of the Society of Experimental Psychologists.

JACK L. ROSENFELD
Television Shares Management Corporation Award.
Secretary of the Boston Alumni Chapter, Eta Kappa Nu.

CAMPBELL L. SEARLE
Fellowship, The Danforth Foundation.

MAGNUS I. SMEDAL
Member of the Executive Committee, New England Roentgen Ray Society.

LOUIS D. SMULLIN
Member of the United States Delegation, International Scientific Radio Union Commission VII.

KENNETH N. STEVENS
Associate Editor of the *Journal of the Acoustical Society of America.*
Chairman of the Working Group on Community Noise Problems, National Research Council Committee on Hearing and Bio-acoustics.

RICHARD D. THORNTON
W. R. G. Baker Award of the Institute of Radio Engineers.

JOHN G. TRUMP
Fellow of the American Institute of Electrical Engineers.

JOHN A. TUCKER
Member of the National Board of Directors, Eta Kappa Nu.
Member of the Executive Committee, Boston Section, American Institute of Electrical Engineers.

DAVID C. WHITE
Commissioner of the Concord (Massachusetts) Electric Light Board.

JEROME B. WIESNER
Member of the United States Delegation to the Geneva Conference on Safeguards Against Surprise Attack.

KARL L. WILDES
Chairman of the Members for Life Fund, American Institute of Electrical Engineers.

Department of Mechanical Engineering

DEAN C. KARNOPP
Fellowship, the National Science Foundation.

WILLIAM M. MURRAY
Secretary-Treasurer of the Society for Experimental Stress Analysis.

MILTON C. SHAW
Vice President of the College International pour l'Etude Scientifique des Techniques de Production Mecanique, Paris, France.

Department of Metallurgy

BENJAMIN L. AVERBACH
Chairman of the International Conference on the Atomic Mechanisms of Fracture.

JOHN CHIPMAN
President of the Metallurgical Society, American Institute of Mining, Metallurgical, and Petroleum Engineers.

MORRIS COHEN

Carnegie Memorial Lecture at the Pittsburgh Chapter, American Society for Metals.

Sauveur Memorial Lecture at the Philadelphia Chapter, American Society for Metals.

Expert to the American Delegation, International Institute of Welding, Vienna, Austria.

GEORGE ECONOMOS

Treasurer of the New England Section and Chairman of the Research Committee, American Ceramic Society.

Chairman of the Ferrites Task Group, American Society for Testing Materials.

JOHN F. ELLIOTT

Technical Chairman of the Third International Symposium on the Physical Chemistry of Process Metallurgy.

Chairman of the Boston Section, American Institute of Metallurgical Engineers.

Technical Chairman of the Meeting on Quality Requirements of Super-Duty Steels, American Institute of Metallurgical Engineers.

ANTOINE M. GAUDIN

Member of the Board, Engineering Foundation.

Chairman of the Research Procedure Committee, Engineering Foundation.

W. DAVID KINGERY

Chairman of the Basic Science Division, American Ceramic Society.

THOMAS P. MELOY

Graduate Cooperative Fellowship, National Science Foundation.

Citation, American Rocket Society.

Department of Naval Architecture and Marine Engineering

J. HARVEY EVANS

Chairman of the Panels on Hull Structure Design and Buckling Strength of Hull Structures, Society of Naval Architects and Marine Engineers.

S. CURTIS POWELL

Member of the Executive Committee, Society of Naval Architects and Marine Engineers.

LAURENS TROOST

Medal of Merit of the Federal Council of Engineering and Architecture, Brazil.

Department of Nuclear Engineering

IRVING KAPLAN

Director of the American Nuclear Society.

JOHN C. PEAK

Nuclear Science and Engineering Fellowship, Oak Ridge Institute of Nuclear Studies.

SCHOOL OF HUMANITIES AND SOCIAL SCIENCE

Center for International Studies

ALFRED BONNE

Corresponding Member of the International Institute of Arts and Letters.

ERIK H. ERIKSON
Fellow of the American Academy of Arts and Sciences.
ARNOLD RIVKIN
Meritorious Service Citation of the International Cooperation Administration.
ANTHONY J. WIENER
Fellowship, Society for the Investigation of Human Ecology.

Department of Economics and Social Science

MORRIS A. ADELMAN
United States Editor of *The Journal of Industrial Economics.*
FRANCIS M. BATOR
Fellowship, John Simon Guggenheim Memorial Foundation.
E. CARY BROWN
Acting Editor, *The National Tax Journal.*
ROGER W. BROWN
Program Chairman for Personality and Social Psychology, 1959 meetings of the American Psychological Association.
Visiting Lecturer in Psychology, Harvard University.
ALFRED D. CHANDLER, JR.
Fellowship, John Simon Guggenheim Memorial Foundation.
Secretary of the Humanistic-Social Division, American Society for Engineering Education.
Chairman of the Beveridge Award Committee, American Historical Association.
Trustee of the Business History Foundation.
EVSEY D. DOMAR
Fellowship, Committee on Inter-University Travel Grants.
DANIEL LERNER
Chairman of the Committee on International Policy, World Association of Public Opinion Research.
MAX F. MILLIKAN
President of the World Peace Foundation.
Member of the Science Advisory Board, U. S. Air Force.
NORMAN J. PADELFORD
Honorary Fellow of the American-Scandinavian Society.
ITHIEL D. POOL
Member of the Executive Council, American Association for Public Opinion Research.
LUCIAN W. PYE
Auxiliary Research Award of the Social Science Research Council.
ROBERT M. SOLOW
Associate Editor of *Econometrica.*
Auxiliary Research Award of the Social Science Research Council.
ROBERT H. STROTZ
Managing Editor of *Econometrica.*

Department of Humanities

CARVEL COLLINS
Member of the Boards of Directors of the College English Association, of the American Studies Association, and of the American Literature Group, Modern Language Association.

E. NEAL HARTLEY

Chairman of the Advisory Council and of the Education Committee, Board of Trustees of New England College.

KLAUS LIEPMANN

Chairman of the Music Committee, Boston Arts Festival.

THEODORE D. LOCKWOOD

Fellowship, the Belgian-American Educational Foundation.

ROBERT E. MACMASTER

Research Fellowship, Russian Research Center, Harvard University.

JOHN B. RAE

Member of the Executive Council, Society for the History of Technology.

HARALD A. T. O. REICHE

Visiting Lecturer, Brandeis University.

Area Representative for *The Classical World*, Classical Association of the Atlantic States.

JAMES B. STONE

Chairman of the Bibliography Committee, Boston Chapter, Society of Technical Writers and Editors.

ROBERT S. WOODBURY

Treasurer and Member of the Advisory Council, Society for the History of Technology.

Advisory Editor of the *Encyclopaedia Britannica.*

Department of Modern Languages

JOSEPH R. APPLEGATE

Chairman of the Regional Conference, English Language Section, National Association of Foreign Student Advisers.

WILLIAM F. BOTTIGLIA

Member of the Executive Board, Boston Chapter, American Association of Teachers of French.

NOAM A. CHOMSKY

Postdoctoral Fellowship, National Science Foundation.

Auxiliary Research Award of the Social Science Research Council.

HENRY C. HORNIK

Secretary of the Boston Chapter, American Association of Teachers of German.

WILLIAM N. LOCKE

Chairman of the Executive Committee, Modern Language Project, Massachusetts Council for Public Schools.

SCHOOL OF INDUSTRIAL MANAGEMENT

GEORGE W. ARMERDING

William Sumner Bolles Fellowship.

E. P. BROOKS

Honorary Degree of Doctor of Science in Commerce, Drexel Institute of Technology.

HERBERT F. GOODWIN

Director of the Boston Chapter, American Institute of Industrial Engineers.

EDWIN KUH

Program Chairman for the winter meetings, Econometric Society.

WILLIAM LETWIN
Faculty Research Grant of the Social Science Research Council.

LEO B. MOORE
General Chairman of Awards, Standards Engineers Society.
Member of the Board of Directors, Boston Chapter, Society for the Advancement of Management.
Fellow of the Standards Engineers Society.

ALBERT H. RUBENSTEIN
Chairman of the Boston Chapter on Engineering Management, Institute of Radio Engineers.

EDGAR H. SCHEIN
Auxiliary Research Award of the Social Science Research Council.

ERWIN H. SCHELL
Chancellor of the International Academy of Management.

THOMSON M. WHITIN
Fellow of the Econometric Society.

ZENON S. ZANNETOS
Faculty Study Fellowship, Ford Foundation.

SCHOOL OF SCIENCE

GEORGE R. HARRISON
Councilor of the American Institute of Physics.

Department of Biology

JOHN M. BUCHANAN
Lecturer, Harvey Society.

ALEXANDER RICH
Member of the Council, Biophysical Society.

ETHEL S. TESSMAN
Postdoctoral Research Fellowship, United States Public Health Service.

CLAIR E. TURNER
Gold Medal of the Academy of Medicine of France.
Great Cross of the Order of Merit, West German Federal Republic.

Department of Chemistry

AVERY A. ASHDOWN
Honorary Member of the New England Association of Chemistry Teachers.

ARTHUR C. COPE
Charles Frederick Chandler Medal of Columbia University.
Chairman of the Board of Directors, American Chemical Society.

CHARLES D. CORYELL
Co-chairman of the Greater Boston Committee for a Sane Nuclear Policy.
Member of the Kitzbühel-Vienna Conference on the Role of Science in Society.

JAMES E. DAVIS
Fellowship, National Science Foundation.

JOHN E. ENGELHART
Fellowship, National Science Foundation.

JOSEPH E. JOHNSON
Fellowship, National Institutes of Health.

FREDERICK G. KEYES
Fellow of the American Association for the Advancement of Science.

JAMES H. LOEHLIN
Fellowship, National Science Foundation.

CLARK W. PERRY
Fellowship, National Science Foundation.

LOCKHART B. ROGERS
National Councilor of the Electrochemical Society.

JOHN C. SHEEHAN
Award of the American Chemical Society for Creative Work in Synthetic Organic Chemistry.
McGregory Lecturer, Colgate University.

LYNN J. TAYLOR
Fellowship, National Science Foundation.

JOHN S. WAUGH
Alfred P. Sloan Research Fellowship.

PETER P. WICKHAM
Fellowship, United States Public Health Service.

DAVID C. WILLIAMS
Fellowship, National Science Foundation.

Department of Geology and Geophysics

NORMAN A. HASKELL
Guenter Loeser Memorial Lecture, Air Force Cambridge Research Center.

PATRICK M. HURLEY
President of the Section of Tectonophysics, American Geophysical Union.

ROBERT R. SHROCK
President of the National Association of Geology Teachers.

JOHN W. WINCHESTER
Visiting Lecturer, Columbia University.

Department of Mathematics

NESMITH C. ANKENY
Fellowship, John Simon Guggenheim Memorial Foundation.

DANIEL B. RAY
Alfred P. Sloan Research Fellowship.

Department of Meteorology

JAMES M. AUSTIN
Councilor of the American Meteorological Society.

JULES G. CHARNEY
Councilor of the American Meteorological Society.

HENRY G. HOUGHTON
Councilor of the American Meteorological Society.
Chairman of the Board of Trustees, University Corporation for Atmospheric Research.

NORMAN A. PHILLIPS
Associate Editor of the *Journal of Meteorology*.

Department of Physics

SIDNEY L. BORISON

Fellowship, National Science Foundation.

SANBORN C. BROWN

Technical Adviser to the United States Delegation, Second International Conference on the Peaceful Uses of Atomic Energy.

Treasurer and Chairman of the Committee on Apparatus, American Association of Physics Teachers.

Chairman of the School Science Committee, American Academy of Arts and Sciences.

WILLIAM W. BUECHNER

Smith-Mundt Grant of the United States Department of State to serve as Visiting Professor, National University of Mexico.

Fulbright Lectureship to the Catholic University, Rio de Janeiro, Brazil.

BERNARD T. FELD

Trustee of Associated Universities, Inc.

K. UNO INGARD

Fellowship, John Simon Guggenheim Memorial Foundation.

BRUNO B. ROSSI

Member of the American Philosophical Society.

Chairman of the Committee on Space Projects, Space Science Board, National Academy of Sciences.

MALCOM W. P. STRANDBERG

Fellow of the American Association for the Advancement of Science.

Fellow of the Institute of Radio Engineers.

GEORGE E. VALLEY, JR.

Exceptional Civilian Service Medal of the United States Air Force.

FELIX M. H. VILLARS

Fellow of the American Academy of Arts and Sciences.

VICTOR F. WEISSKOPF

Vice President of the American Physical Society.

WILLIAM M. WHITNEY

First Prize in the Elementary Laboratory Category, Apparatus Contest, American Association of Physics Teachers.

DIVISION OF SPONSORED RESEARCH

HARVEY BURSTEIN

Administrative Vice Chairman of the Boston Chapter, American Jewish Committee.

Member of the National Council and General Chairman of the Sixty-fourth Annual Convention, Pi Lambda Phi.

F. LEROY FOSTER

Director of the Engineering College Research Council, American Society for Engineering Education.

GERSHON G. FURMAN

Fulbright Award for Research and Teaching, Copenhagen, Denmark.

HERBERT P. GALLIHER

Associate Editor of *Operations Research.*

Chairman of the Education Committee, Operations Research Society of America.

DOUGLAS T. ROSS

Outstanding Young Man of the Year Award of the Boston Junior Chamber of Commerce.

JOHN E. WARD

Chairman of the Professional Group on Automatic Control, Institute of Radio Engineers.

DEFENSE LABORATORIES

Lincoln Laboratory

RICHARD H. BAKER

Chairman of the Subcommittee on Solid-State Circuits and Devices, Institute of Radio Engineers.

DONALD G. BRENNAN

Member of the National Council, Federation of American Scientists.

WILBUR B. DAVENPORT, JR.

Fellow of the American Association for the Advancement of Science.

RONALD G. ENTICKNAP

Member of the National Committee, Professional Group on Aeronautical and Navigational Electronics, Institute of Radio Engineers.

HARRY C. GATOS

Vice Chairman of the Boston Section, Electrochemical Society.

Member of the Executive Committee, Corrosion Division, Electrochemical Society.

Chairman of the Symposium on Surface Chemistry of Metals and Semiconductors, Electrochemical Society.

FRANK E. HEART

Chairman of the Eastern Joint Computer Conference.

BENJAMIN LAX

Associate Editor of *Microwave Journal* and of *Physical Review.*

Member of the Executive Committee, Solid State Division, American Physical Society.

JAMES W. MEYER

Award for the best paper, National Electronics Conference.

ROBERT PRICE

Program Chairman of the Boston Chapter, Professional Group on Information Theory, Institute of Radio Engineers.

HERBERT SHERMAN

Honorable Mention Award of the Professional Group on Engineering Management, Institute of Radio Engineers.

Arts and the Faculty

SCHOOL OF ARCHITECTURE AND PLANNING

PIETRO BELLUSCHI

Design of the Church of the Redeemer, Baltimore, Maryland (with Rogers, Taliaferro and Lamb, Architects).

Design of the Library for Bennington College, Bennington, Vermont (with Carl Koch and Associates, Architects).

Department of Architecture

WILLIAM H. BROWN

Design of Canton Valley Terrace, Fitchburg, Massachusetts.

Citation for Excellent Design, Twelfth Annual Conference on Aging.

GYORGY KEPES

One-Man Exhibitions at Galleria Numero, Firenze, Italy; the Museum of Fine Arts, Houston, Texas; the Dallas (Texas) Museum of Fine Arts; and the Baltimore (Maryland) Museum.

Group Exhibition at Carnegie International Exhibition, Pittsburgh, Pennsylvania.

Design of the Form Givers Exhibition, Corcoran Gallery, Washington, D.C., and the Metropolitan Museum of Art, New York, New York.

SCHOOL OF ENGINEERING

Department of Aeronautics and Astronautics

EDWARD S. TAYLOR

Silver salad service exhibited at the Boston Arts Festival.

Department of Electrical Engineering

ARTHUR L. LOEB

Recorder and Voice Soloist in the Old North Church and King's Chapel, Boston.

Department of Mechanical Engineering

C. FAYETTE TAYLOR

Sculpture, *The Flying Dutchman*, exhibited at the Busch-Reisinger Museum, Harvard University.

SCHOOL OF HUMANITIES AND SOCIAL SCIENCE

Department of Humanities

MILDA G. LEVERETT

Pinhole Vignettes, a series of *camera obscura* photographic studies, exhibited at the Whaling Museum, Gloucester.

DIVISION OF SPONSORED RESEARCH

JOHN VIERTEL

Project Zero Gravity, a television drama dealing with space medicine in the "Steve Canyon" Series.

Publications from the Institute

PERIODICAL PUBLICATIONS, BOOKS, AND REVIEWS BY THE STAFF, JULY 1, 1958 TO JUNE 30, 1959[1,2]

SCHOOL FOR ADVANCED STUDY

LÉVY, AZRIEL. The Independence of Various Definitions of Finiteness. *Fundamenta Mathematicae* 46, pp. 1–13, 1958.

LÉVY, AZRIEL. Comparison of Subtheories. *Am. Math. Soc. Proc.* 9, pp. 942–945, December, 1958.

SCHOOL OF ARCHITECTURE AND PLANNING

Department of Architecture

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MASTER OF SCIENCE — SANITARY ENGINEERING

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ROBERT BENJAMIN LEES, *Grammar of English Nominilizations* (June, 1959).

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MECHANICAL ENGINEER

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