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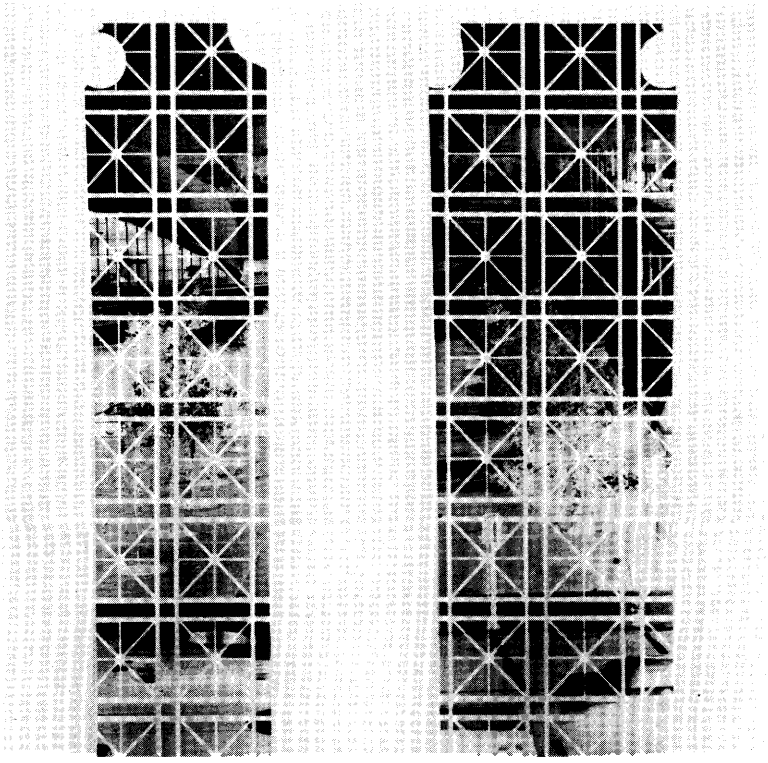
MASSACHUSETTS INSTITUTE OF TECHNOLOGY

PRESIDENT'S REPORT ISSUE

FOR THE YEAR ENDING OCTOBER 1, 1956



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CONTENTS

REPORT OF THE PRESIDENT 1

REPORTS OF THE DEANS OF THE SCHOOLS

School of Architecture and Planning 61
School of Engineering 71
School of Humanities and Social Studies 111
School of Industrial Management 135
School of Science 145

REPORT OF THE TREASURER 173

REPORT OF THE DEAN OF STUDENTS 229
Director of Athletics 238
Director of Student Aid 243

REPORTS OF OTHER ADMINISTRATIVE OFFICERS

Vice President for Governmental and Industrial Relations 249
Secretary of the Institute 252
Dean of the Graduate School 257
Director of Public Relations 262
Director of the Summer Session 263
Director of Admissions 266
Registrar 268
Director of the Registry of Guests 297
Adviser to Foreign Students 298
Medical Director 300
Director of Libraries 305
Heads of the Departments of Military and Air Science 318
Director of the Industrial Liaison Program 321
Executive Vice President of the Alumni Association 322
Director of the Technology Press 325
Placement Officers 326

PRINCIPAL HONORS AND AWARDS TO THE STAFF 331

PUBLICATIONS FROM THE INSTITUTE

Periodical Publications, Books, and Reviews by the Staff 345
Publications of the Departments and Laboratories 406

REPORT OF THE PRESIDENT

To Members of the Corporation:

I have the honor herewith to present the eighth of my annual reports on the affairs of the Massachusetts Institute of Technology. Each year I have sought to review the affairs at the Institute in their relation to the national setting, recording our response to the nation's changing needs and accounting for our stewardship of the private foundation we administer.

I. TO AUGMENT OUR LEADERSHIP

Last year, in discussing the nation's manpower requirements and the Institute's response to these requirements, I voiced the conviction that M.I.T.'s primary responsibility was to set the pace in its field by striving constantly to enhance the excellence of its education. This year I wish to continue this discussion by examining M.I.T.'s financial status in relation to this policy and to its growing responsibilities and opportunities.

Education's National Needs

In its report to the President last April, the Committee for the White House Conference on Education, of which I had the privilege of being a member, recommended that "a new look be taken at the entire question of how much money this society should spend on education . . . It seems obvious that within the next decade the dollars spent on education in this nation should be approximately doubled. Such an increase in expenditure would be an accurate reflection of the importance of education in this society . . . Good schools are admittedly expensive but not nearly so expensive in the long run as poor ones."

The Committee's estimate of the increase in the number of dollars needed is very conservative when we translate it into dollars per student enrolled, but the emphasis on the need for raising our sights is the significant part of the recommendation. The really important fact for us to consider is that over a period of fourteen years the percentage of the gross national product going to higher education has remained about the same while the size of the job higher education has been asked to do has increased, in proportion, more than the gross national product — primarily because of the

larger fraction of college-age youths going to college. Relative to many other less important fields of national expenditure, higher education has lost ground.

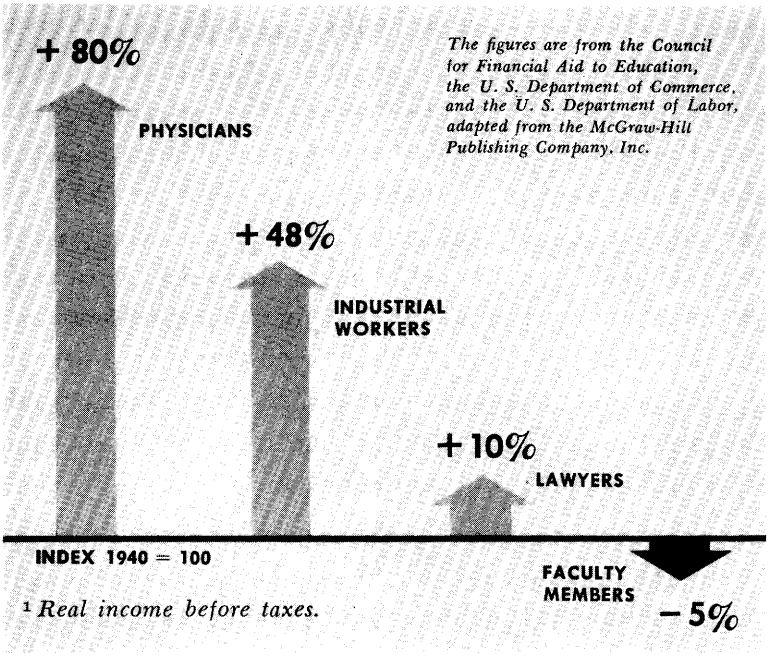
One of the principal reasons for this national decline in the "standard of living" of higher education is the deterioration of the real earnings of teachers. A recent report, "Teaching Salaries Then and Now," published by the Fund for the Advancement of Education shows that in the last fifty years salaries in the fields of education have risen much less than salaries in other occupations, with the result that the economic position of teachers — especially top college teachers — has deteriorated. In a period when the real purchasing power of automobile workers rose 140 percent, that of full professors dropped 2 per cent. The salaries of top professorial groups in our colleges and universities have deteriorated absolutely and relatively more than those of almost any other professional group in the nation.

This deterioration at the top is so great "that it affects the attractiveness of the academic career as compared to other professions and occupations" . . . with the result that "American society is deteriorating in the sector most critical for future progress and well-being. The quality of the future depends on education at all levels, and the quality of education depends on its top leadership. The best talent of the younger generation finds that education is not as highly valued by its seniors as law, medicine, advertising, or many technical skills." As a result of this economic deterioration of the teacher's position, "disaffection is being created at the most sensitive point in our society."

Many people, especially in industry, are unaware of the shockingly low salaries actually paid. A 1955 survey

of 329 colleges and universities showed that the average salaries for professors ranged from $4,602 in small colleges to $7,850 in large universities.

CHART I
THE RELATIVE TREND OF FACULTY SALARIES SINCE 1940[1]



The item of teachers' salaries is not the only item in the budget of higher education which has not kept pace with increases in our national standard of living, but it is the area of most significant and damaging failure. Of all the others (buildings, etc.), I mention only student aid and basic research. Scholarship funds now total between $50 and $75 million annually. Doubling this total in two to three years, quadrupling it in five would begin to bring our national student-aid resources to the level our growing needs require — especially if we are going to reduce the loss of the 100,000 or so top-quality high

school graduates who do not now have the means to go to college.

In our society, universities have been assigned the role of being our principal centers of basic research, in part because our future scientists must be cradled in the atmosphere of pure research and discovery. At present the overwhelming weight of national research expenditures is for applied research or development; basic research support comes harder, is by comparison meager, and provides inadequately for really uncommitted research.

While our college and university system shows vitality and progress today, it cannot long continue to do so if its personnel deteriorates. We need only recall the retrogression of American colleges in the first decades of the last century when the rapid multiplication of institutions over-ran the support available and a widespread mediocrity enveloped them. In the longer past we might well recall the lethargy of the European universities in the sixteenth, seventeenth, and eighteenth centuries. Cultural, social, and financial forces have from time to time diminished the vigor of universities; in the light of the past we cannot take for granted that our present-day system is immune to deterioration or that it does not require alert and vigorous efforts to keep it strong.

Raising Our Sights at M.I.T.

Coming now to the institution for which you and I are responsible, we find that M.I.T.'s economy reflects the national pattern of higher education. The increase in our resources in the past ten years, magnificent as it has been, has not matched the combined requirements of inflation, increased enrollment (especially at the very expensive level of graduate study), and widened responsi-

bilities arising out of M.I.T.'s position of national leadership. Our salary scale is too low (even though it falls in the top brackets for educational institutions), our student-aid funds are inadequate, and our Institute-controlled funds for basic research are too small.

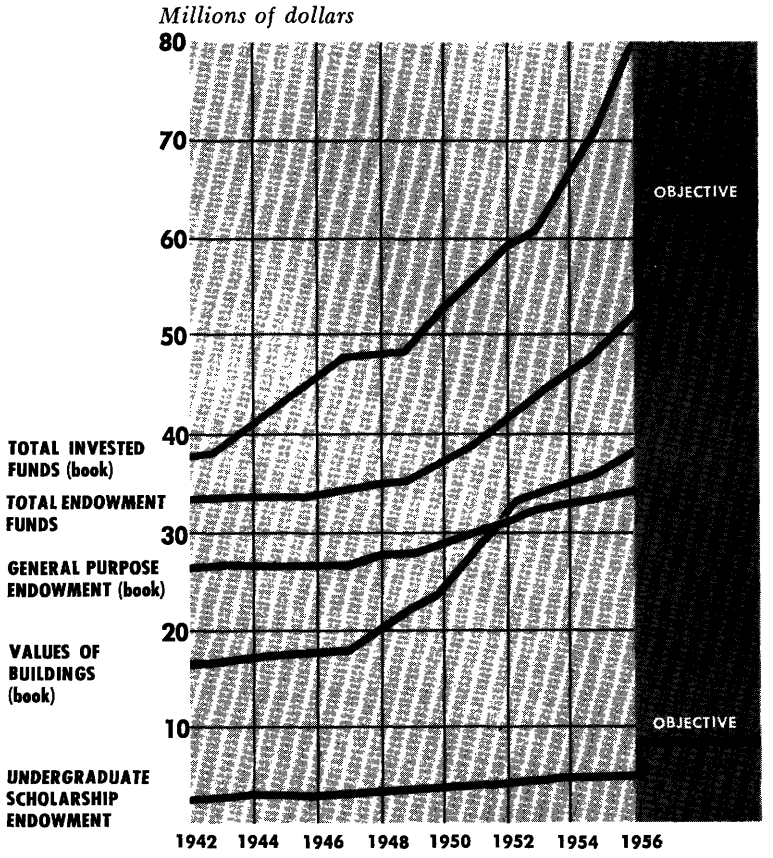
The facts that M.I.T. stands fifth among the nation's colleges and universities in the market value of its invested funds, that from time to time it has received magnificent gifts, that its alumni have built a flourishing Alumni Fund, and that in 1955-56 it received $10,387,000 in gifts, the largest in its history, — all these make clear that M.I.T. is a fortunate institution in the financial support it has been receiving. We should not, however, let this encouraging progress create the misapprehension that we are a wealthy institution in terms of the demands upon us or that we are achieving the degree of support called for by our national responsibility. Occasionally someone proclaims that M.I.T. is a wealthy institution and therefore does not warrant contributions in the degree that many other institutions do. Such a conclusion does not withstand analysis and reflects a serious misapprehension about the character and responsibility of the Institute in the year 1956.

By what measure is M.I.T. a wealthy institution, or by what standard does one appraise its wealth? The wealth of an institution is not measured in money but by its character, its excellence, its human resources, and its service. The money received by an institution or held in its endowment is simply a means for it to provide and augment its services to society.

The financial resources of an institution are meaningful only if we relate them to the opportunities to serve society. M.I.T. is certainly in a position today where it is steadily called upon to increase these services and where

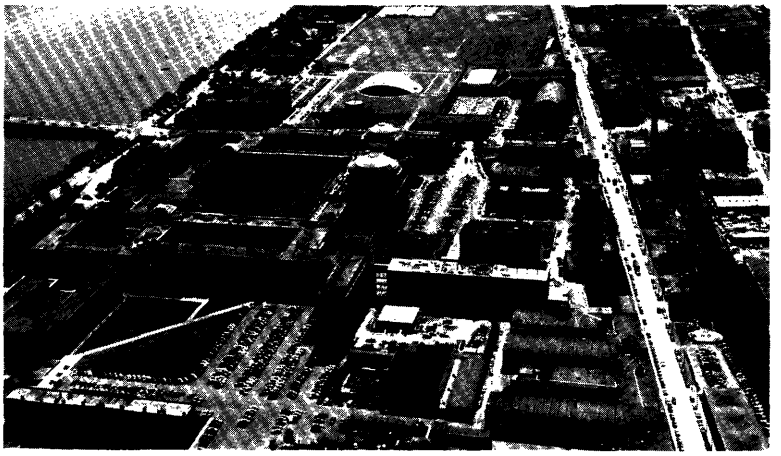
it has the demonstrated potential to do so — provided it has the means. The need for more first-rate scientists and engineers as well as the need for maintaining an advancing and flourishing scientific activity in the United States

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



are examples of what I mean. The financial resources of an institution thus are meaningful only if we relate them to its opportunities and obligations. In these terms, M.I.T.'s resources are modest indeed; in fact, when we compare our potential for accomplishment with what we have the financial means to accomplish, we are poor indeed; and this has never been truer than today when

the fields represented at the Institute are so vital to the safety, the welfare, and the prosperity of the nation.



M.I.T.'s continuing growth reflects expanding opportunities and responsibilities.

Some Institutional Comparisons

If we wish to talk in dollar comparisons, we can point to a number of institutions whose gifts are averaging substantially greater than M.I.T.'s and whose endowment per student is greater (at both Harvard and Cal. Tech. the endowment per student is better than twice M.I.T.'s). If we compare our scholarship funds with those of other major institutions having our standards of admission, we find ourselves frequently in an inferior position. If we compare our Faculty salaries with those received by men of comparable caliber in fields other than education, we cannot fail to conclude that M.I.T.'s funds are critically inadequate. Men of the type and quality represented by the M.I.T. Faculty are just those in great demand by industry.

Let us examine our gift position relative to other institutions, looking at the record for the past thirty-five years and at gifts received during 1954-55 and 1955-56:

M.I.T. GIFTS IN COMPARISON WITH SELECTED INSTITUTIONS[1]

	35-year total 1920–21 to 1954–55	*Average per year*
Harvard University	$292,763,000	$8,365,000
Yale University	263,277,000	7,522,000
University of Chicago	151,121,000	4,318,000
Northwestern University	118,304,000	3,380,000
Columbia University	108,559,000	3,102,000
Cornell University	101,219,000	2,892,000
Princeton University	81,601,000	2,331,000
University of California	80,347,000	2,296,000
M. I. T.	78,175,000	2,234,000
Johns Hopkins University	77,027,000	2,201,000
	Gifts in 1954–55	
Harvard University	$16,787,000	
Cornell University	9,241,000	
Yale University	8,564,000	
New York University	8,264,000	
Columbia University	7,379,000	
Stanford University	7,366,000	
University of Chicago	7,212,000	
M. I. T.	7,075,000	
University of California	6,177,000	
Northwestern University	5,779,000	

[1]From data compiled by John Price Jones.

Although information for the past year is not complete, I do know that a group of institutions which received $59,671,000 in 1954-55 benefited by $106,025,000 in 1955-56, or an increase of over 77 per cent. This compares with M.I.T.'s receipts of $7,075,000 in 1954-55 and $10,387,000 in 1955-56, an increase of 45 per cent. Two of these institutions during this past year each received gifts totaling over $20,000,000.

Our Kind of Institution Under Special Pressure

Along with other institutions of science and engineering, our salary problem is exceptionally acute. The shortage of scientists and engineers has pushed up the salaries offered by industry and government, with the result that

the gap between academic salaries in these fields and salaries in industry is widening. It is a shocking fact that young men receiving their doctor's degrees in science and engineering frequently now obtain jobs paying higher salaries than we can pay the teachers who directed their graduate training. Widening, too, is the gap between salaries paid by educational institutions and salaries paid by many other non-educational but non-profit institutions and organizations. Certain of the foundations, research institutes, quasi-government organizations, and other institutions especially in the field of research have salary scales substantially higher than our academic salaries at M.I.T. It is not that their salaries are too high; ours are too low.

As a result we are squarely up against the possibility that the best minds in our engineering colleges — and to some extent in our science schools — may be attracted away from teaching into industry or other fields. This possibility is further increased by the strenuous efforts now being made to recruit scientists and engineers for urgent defense projects requiring many hundreds of professional workers.

As I pointed out in my report last year, "engineering education has been under pressure because its young and imaginative teachers — especially those in the advancing, growing fields of technology — are sought after by industry more than any other group in our educational institutions. If engineering education is to meet this challenge and prevent the spreading scarcity of quality in engineering schools that has weakened science teaching in the high schools, it must find ways to make engineering schools a more attractive environment for top-flight engineers."

If we permit this kind of deterioration to continue,

the baneful effects for industry, for national security, and for the public welfare can become profoundly dangerous. Already we are engaged in an all-out technological race with the Russians. Already the Russians are training more scientists and engineers than the United States. Already they are offering greater incentives, rewards, and status to their scientists and engineers in education than are we. Already we have before the nation a desperate need to augment the quality and quantity of scientists and engineers.

More distressing is the apparent fact that we fail to attract enough of the exceptionally able young men to start a career at institutes of technology, especially in engineering. As a result, the quality of staff has unquestionably suffered, and M.I.T. is no exception. I do not propose that we match industrial salaries, but the gap is now too wide to offset the special compensations of academic life.

I hold that these conditions of inadequate compensation of teachers, especially in science and engineering, and especially at M.I.T., cannot much longer be countenanced, not only because of their great inequity but because they can demean these great professional fields and weaken the nation at a point where today it most needs strength. I hold that no institution can be considered wealthy or even adequately financed which cannot pay adequate salaries to its faculty.

Our Priority Needs

Our most urgent needs fall in the following three categories, each of which has a bearing on the excellence of our people and on the future quality of staff and students:

1. To give the Institute an adequate salary scale, one that insures our recruiting and holding first-rate men, one that insures our maintaining and enhancing the quality of our education, M.I.T. needs an additional million dollars a year over and above the large additional amounts we have added to our salary commitments during the past two years. We need ultimately to achieve at least a 30 per cent increase in our salary scale. Even this will not bring us up to the level of industrial compensation.

2. We need an additional $500,000 of income each year for student aid. We now lose too many outstanding students who want to come to M.I.T. but cannot do so because they lack funds.

3. We need additional funds to support basic research — funds which are under the sole control of the Institute and which can be used to support uncommitted research. At present the Institute's chief research support comes through "sponsored research." This support is invaluable, and much of it is provided in such a manner that it affords great freedom in supporting pure research. This form of outside support, however, needs to be supplemented by funds under the control of our administration and Faculty so that we can give more encouragement to disinterested curiosity and open-ended research — to people rather than projects and programs. The nation needs more of this kind of research. For this M.I.T. needs an additional $500,000 of income each year.

There are still urgent facility needs at the Institute that we must meet (improving and enlarging our student residence system, as outlined on page 25, and enlarging our classroom facilities, for example) if we are to hold this kind of position, but our first order of business is to underwrite the high calibre of our Faculty and students.

Underwriting Our Future

In the light of the comparisons I have made and the major needs I have described, it seems clearly in order for us to set our sights higher than in recent years as we plan M.I.T.'s financial future.

We would not be discharging our responsibilities in managing this institution if we took any lesser view than that it should be as good as, if not better than, any institution in its field or, more importantly, that it should realize its full potential and meet its growing educational and research responsibilities.

In a recent essay in *The Modern University,* edited by Margaret Clapp (Cornell University Press, 1950), Professor G. W. Pierson, Larned Professor of History at Yale University, draws this conclusion:

> ". . . what one feels compelled to stress as emphatically as the basic idealism of the university movement will allow is the critical role played by money — or rather the lack of it. For the plain fact is that it was the absence of the cash ingredient, the lack of financial support from the American public, which did more than all else to delay the American university."

The record is clear that the "big jumps" in the development of American universities came when bold leadership brought increased funds, which in turn made possible a strengthened faculty with freedom of action and the realization of new concepts and objectives.

I hope that M.I.T. never becomes so complacent or self-satisfied or impoverished of new ideas that it conceives of itself as having enough. We must never set any lesser goal for ourselves than to be an institution of such adequate resources that we can really meet the demands

upon us, that we can see our influence ever widening, our Faculty unexcelled, our facilities adequate to enable our staff and students to realize their fullest potential.

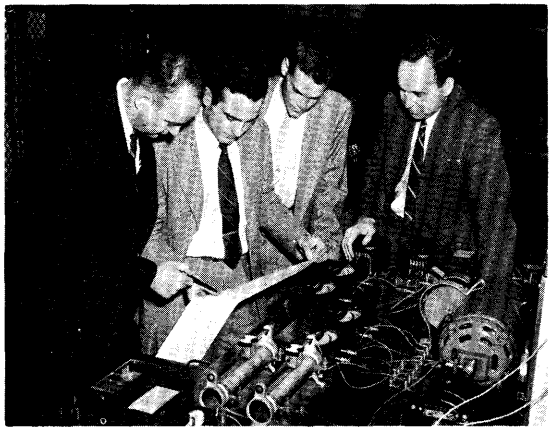
I am incited to make these observations because I think any attitude of complacency or any acceptance of the statement that M.I.T. is a wealthy institution in a monetary sense would tend to undercut the motivations and the ideals, the free enterprise, and the momentum which can make the difference between this being a great and vital institution and its declining into one which is pedestrian and static. Here is a clear challenge to demonstrate that a *private* institution can maintain and augment its vitality.

M.I.T. stands today at the very height of her powers and bidding fair, if she exerts herself vigorously and wisely, further to augment her excellence, her productivity, and her leadership. She could slip from this eminence, too, if she — if we — fail to understand and to meet the increasing requirements our society exacts of its leaders, both institutions and men, or if she sets her sights too low and becomes content with little plans, limited aims, and paltry means. If our past really proclaims our future, we will not be satisfied being anything but the best and having the means to be the best.

While I prefer in these annual reports to discuss subjects other than money, I feel compelled this year to reiterate these convictions because I feel they are vital to the welfare of the Institute. I feel that they must command the attention and action of those of us who serve as trustees. Most of our recent and current fund-raising has been directed at catching up with M.I.T.'s growth and enlarged responsibilities. As we make progress toward catching up, we need to set goals for future improve-

ments. The fact that we have been so successful in augmenting the Institute's resources in recent years is good, solid evidence that we are justified in planning another big jump in underwriting the Institute's quality and leadership.

A special and invaluable characteristic of our academic community is lively and informal interchange between students and their teachers.



". . . a new emphasis on creative thinking. . . . the finest example in the U.S. of the trend toward integrating science and the liberal arts."
— LIFE magazine, May 7, 1956.

II. THE YEAR IN REVIEW

Appointment of the Chancellor

The most notable event of the year was the election of Dr. Julius A. Stratton to the newly established post of Chancellor, an action which was taken by the Corporation at its June meeting. As Chancellor, Dr. Stratton administers the Institute's academic program in all its parts with all academic officers coming under his jurisdiction. In addition, he serves as deputy to the President, who is the Institute's chief executive officer. The Chancellor serves as the general executive officer for all Institute affairs, and, in the absence of the President, is authorized to have all the powers and perform all the duties and functions of the President. As Chancellor he also serves as a member of the Executive Committee of the Corporation.

The creation of the post of Chancellor for Dr. Stratton came in recognition of his great contributions to M.I.T. and his leadership in science and education both at M.I.T. and nationally. The appointment reflected the increased scope and responsibilities of the Institute, its many and unusual national obligations at this time, and the consequent need for a greater sharing and delegation of its administrative responsibilities.

I speak with delight and enthusiasm for the still closer partnership of Dr. Stratton and myself made possible by his new status. We have long worked together with a sense of common purpose and extraordinary concert on policy. With Dr. Stratton taking the major responsibility for the internal affairs of the Institute, our joint administrative efforts will be more effectively allocated and organized.

With Dr. Stratton as my deputy and directly responsible for our academic administration, with Admiral Edward L. Cochrane as Vice-President handling our extensive relations with industry and government, with Joseph J. Snyder as Vice-President and Treasurer, and with a further decentralization of responsibility in each of their domains, I am confident that we are prepared to meet any and all administrative demands that the remarkable growth and development of the Institute may impose upon us.

The increasing responsibility carried by these officers of the Institute is paralleled by increased authority and responsibility vested in the Deans of the Institute's five schools. Not only does the transfer of additional responsibilities to the Deans of the schools represent a sound reallocation of administrative responsibility; it also represents, as Dean George R. Harrison has observed, a growing self-awareness and an increased degree of self-determination within individual school Faculties. Under this new allocation of responsibilities, each Dean has the authority, as well as the responsibility, to promote the special characteristics and objectives of the departmental groupings he administers and each school a better opportunity to develop its own educational "personality."

This greater degree of decentralization by schools requires a greater reliance upon our coordinating agencies, the most important of which is the unified Faculty of the Institute and the various councils of administrative and Faculty officers. It is not our intention to have separate faculties or completely autonomous schools but rather to find a mid-position which recognizes the special characteristics and developing objectives of the separate schools and which at the same time preserves the concert

and directness with which administrative and Faculty groups formulate policy.

One of the great strengths of the Institute has been the pervasive confidence and sense of common cause which runs through its governing groups — the Corporation, the Faculty, and the administration — and which brings their actions into concert. We have a separation of powers and delegation of authority among the governing bodies resting upon this base of confidence rather than upon written statutes. We have increasing decentralization of administration but not fragmentation. With the co-ordinating mechanisms of the various councils fully used and with full and easy consultation among us, we can achieve decentralization without loss of compactness and without reducing the responsiveness, speed, and concert of our decision-making processes.

Other Administrative Appointments

Other important administrative changes were made during the year. In order that we may proceed without undue delay to carry through the recommendations of the Committee on Student Housing (see page 25), we asked E. Francis Bowditch, who has served as Dean of Students since 1951, to relinquish the duties of that office and devote his full attention as Special Adviser to the President to carrying through to realization the proposals of the Committee. In this new post reporting directly to me, he will give concentrated attention to the planning, the fund raising, and the other requirements for realizing the concepts of the Committee on Student Housing. To replace him as Dean of Students we appointed Professor John T. Rule who, since 1936, has been head of the Sec-

tion of Graphics and more recently head of the Courses in General Science, General Engineering, and Science Teaching. Professor Rule has worked closely and enthusiastically with undergraduates; he has commanded their confidence and affection and has thought clearly and sympathetically about the whole range of personnel administration which centers in the office of the Dean of Students. We are fortunate in his willingness to accept this new assignment to serve as counselor and protagonist for the students and to co-ordinate the wide range of administrative activities which center in the office of Dean of Students.

Dr. H. Guyford Stever, Professor of Aeronautical Engineering who has been on leave as Chief Scientist of the U.S. Air Force, returns this fall to the new position of Associate Dean of the School of Engineering; he will, in addition, continue teaching and research assignments in the Department of Aeronautical Engineering. Dr. William N. Locke, head of the Department of Modern Languages, has been appointed Director of Libraries to succeed Dr. Vernon D. Tate; Dr. Tate left in January on a State Department mission to survey libraries in Italy, and he is now Librarian at the United States Naval Academy.

Two other appointments are of great importance to the Institute's administration. During the year Major General James McCormack, Jr., United States Air Force (Ret.), accepted appointment as Special Adviser to the President. A West Point graduate holding a degree from M.I.T., a Rhodes scholar, and an officer with a record of great distinction, he brings to the Institute not only a deep understanding of military matters but a long experience in the field of research administration. The

second appointment is that of Philip A. Stoddard, formerly Associate Placement Officer and Acting Director of the Industrial Liaison Office, who has been named Assistant Treasurer of the Institute. In this post he will serve as a deputy of the Vice-President and Treasurer on operations relating to the physical property of the Institute, the various services provided the Faculty and students of M.I.T., and the services — other than fiscal — furnished the Institute's research laboratories.

To co-ordinate the administrative services for all sponsored research work at the Institute, we have formed a new Division of Sponsored Research, to take the place of both the Division of Industrial Cooperation and the Division of Defense Laboratories. Dr. F. Leroy Foster, who was Director of the Division of Industrial Cooperation, now directs the new Division, and James M. West is Associate Director. Henry W. Fitzpatrick, formerly Director of the Division of Defense Laboratories, has become Assistant Director for Administration of the Lincoln Laboratory.

The Institute has joined with four other educational institutions to organize the Institute for Defense Analyses, Inc., to conduct scientific analyses of present and future weapons systems. Other initial members of I.D.A., which will be associated with the Weapons Systems Evaluation Group in the office of the Assistant Secretary of Defense for Research and Development, are the California Institute of Technology, Case Institute of Technology, Stanford University, and Tulane University. I have been elected Chairman of I.D.A.'s Board of Trustees; Major General McCormack is President of the Corporation, and Joseph J. Snyder is Treasurer. The Ford Foundation made a grant of $500,000 to the new Institute to provide for its working capital and other needs.

The Educational Program

From the important actions, changes, and events of the past year not otherwise recorded in this report I select the following for special mention:

1. The Faculty continued to give searching attention to the constant reformulation which professional education requires. Prompted by reports of the special committee on enrollment under the chairmanship of Professor Gordon S. Brown and of the Committee on Undergraduate Policy, Dean C. Richard Soderberg proposed, and the Faculty agreed, that the School of Engineering undertake during the year an intensive study of its philosophy, a searching review of its aims, and an attempt to forecast future developments. These undertakings, in the words of Dean Soderberg, "represent the first steps toward shaping the School into an organic entity wherein a climate of opinion is emerging for the discussion and development of the answers to many urgent problems thrust upon us" by recent trends.

2. The Army and Air Force R.O.T.C. units at the Institute were joined this summer by a Naval R.O.T.C. unit. This new unit represents an experiment on the part of the Department of the Navy and M.I.T. to adapt the Navy's R.O.T.C. program to the special conditions and opportunities of an institute of technology. The unit will take not more than forty students this year, and it will make substantial use of M.I.T.'s subjects of instruction in recognition of the Navy's special need for engineers and scientists. We welcome this new unit with enthusiasm, and we undertake the experiment with confidence that it may be precedent-setting in effecting a new combination of technical training with military training.

3. The Department of Meteorology has been transferred from the School of Engineering to the School of Science in recognition of its growing community of interests with the Department of Geology and Geophysics and the Institute's opportunity further to develop a co-ordinated program in the earth sciences. The Section of Graphics, which was headed by Professor Rule before he became Dean of Students, now becomes part of the Department of Mechanical Engineering where it will be the responsibility of Professor James B. Reswick. Another re-grouping accomplished during the year is the establishment of a Political Science Section in the Department of Economics. Plans have been made to continue such special programs as General Science and General Engineering, and the curriculum of the Course in Science Teaching becomes the responsibility of the Department of Humanities.

4. Last year the Department of Humanities experimented with two sections (twelve each) of seminar tutorial groups for freshmen in the humanities core curriculum. The two groups were given considerable latitude in the scheduling of their work, were asked to read more than their classmates, and were held to higher standards of performance. At the end of their first term, the students asked for continuance of this program, urged that it be continued through the sophomore year, and emphasized that many more classmates would qualify and enthusiastically elect such a program.

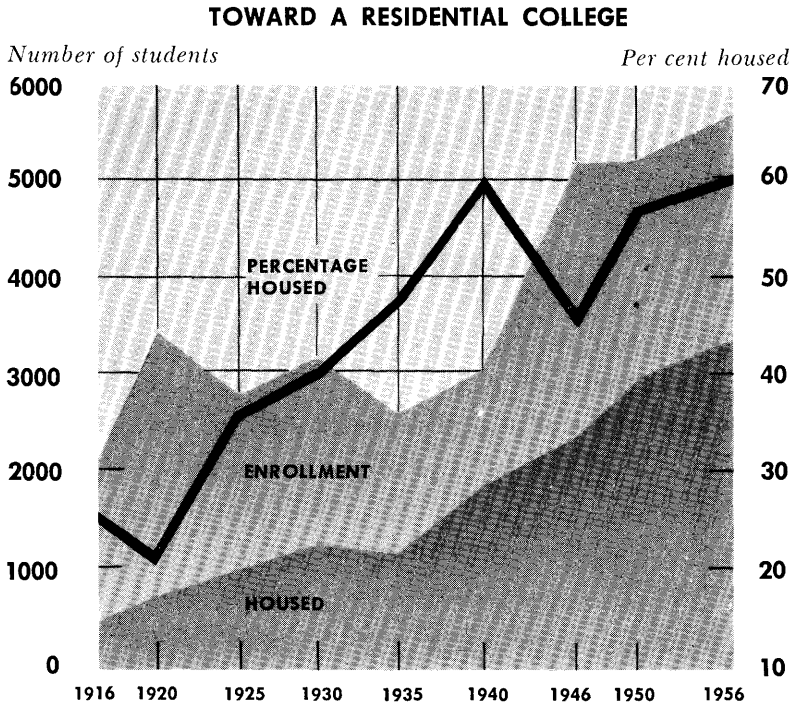
5. The 1956 Summer Session, the first composed of one ten-week term in place of the traditional two six-week terms, has demonstrated the flexibility of this new plan and particularly has confirmed the success of our special short-term concentrated programs for visiting profes-

sional people. There were thirty-eight such programs this year for which there were more than 3500 applications; of this number we could accept only 2762. The enthusiastic reception of these programs demonstrates again that they are a particularly effective way to use our facilities during the summer months in the advancement of scientific and technical knowledge but poses again the problem of how we contain the growth of load on our Faculty.

6. Progress was made during the year in evolving a School for Advanced Study at the Institute. The purpose of this School is to give formal recognition to the large

Leaders of education, industry, and government joined to pay tribute to the late President Karl Taylor Compton at a dinner given in New York by the M.I.T. Corporation on January 4, 1956.

amount of post-doctoral study already present at M.I.T. and to provide an organizational pattern and appointive procedure for post-doctoral study, for bringing distinguished scholars to the Institute for temporary or part-time appointments, and for taking care of distinguished appointees who do not naturally or by choice fit into any existing department. Professor Martin Buerger, who was named Institute Professor during the year, is the Director of the School.



7. The end of the year brought the completion of the report of the Committee on Student Housing, made up of representatives of the Faculty, Corporation, administration, and Alumni Association, all under the chairmanship of our fellow member, Edwin D. Ryer. This Committee, after a year's study, has come forward with a master plan for the development of student housing at the Institute. It has reaffirmed and sharpened the philosophical and educational concepts underlying our dormitory program. Particularly has it reaffirmed with eloquence the educational importance of student housing and the specific improvements we need to make this educational influence most effective. The Committee boldly calls for extensive modifications in our present dormitories to make them better places in which to live

and work and grow in intellectual maturity. It recommends that undergraduate housing be concentrated on the West Campus and that we start now to plan a new graduate center, using Walker Memorial and the dormitories adjacent to it, after suitable modifications, to give the Institute a wholly adequate and ample center for the living requirements of students of advanced standing. It proposes that each of our dormitories be a complete housing unit with its own social areas and dining facilities. It endorses student recommendations for a student union on the West Campus. It proposes that we build additional dormitory accommodations for 400 undergraduates on the West Campus, and it proposes how these should be designed in terms of size and layout in order best to function as effective living educational units. It proposes altogether an extension and development of our housing system requiring an ultimate expenditure of about $7 million. In my judgment, this is the most thorough, the most far-seeing study that has ever been made for the planning and development of this part of the Institute's program. I commend it to all constituent bodies of the Institute — the Faculty, the Corporation, and the alumni — for their support.

New Facilities

During the year the Institute moved forward with four important new additions to its laboratory and equipment resources for education and research. The first of these, the great Karl Taylor Compton Laboratories, is well along, and we should be able to occupy the building during the academic year.

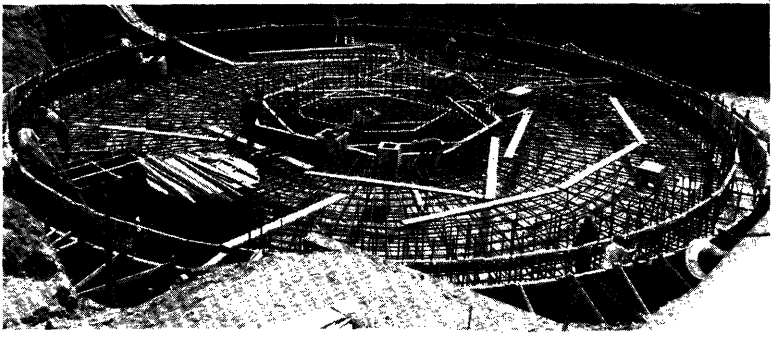
The second of these new facilities is a Computation Center, made possible by the International Business

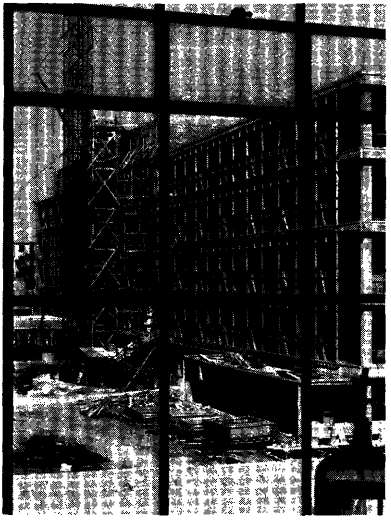
Machines Corporation. With its large, fast digital research computer (the IBM 704), the Center will meet the rapidly growing needs of the Institute for this kind of service – particularly in research – and, in addition, will serve some twenty-four other colleges in New England. The Center will also provide important service to the School of Industrial Management in its program of advanced studies of the implications from the management point of view of data processing, automation, and computation. Professor Philip M. Morse of the Department of Physics will be Director of this new Computation Center.

The third major new facility planned during the year is a six-billion-volt electron accelerator for basic research to be built, managed, and used jointly with Harvard University. This facility, named the Cambridge Electron Accelerator, will be built with funds from the Atomic Energy Commission and will cost about $6.5 million. It will require about four years to build. Not only is this jointly sponsored undertaking important as a new research tool for the Cambridge community in the field of nuclear physics; it is also important as a demonstration of how two institutions can join together to accomplish what a single institution would find difficult to undertake. When completed, the machine will be available to all Faculty members and research students at both institutions who wish to make use of its high-energy particles. Dr. M. Stanley Livingston, Professor of Physics at M.I.T., is the first Director. Harvard land adjacent to her Cyclotron has been selected as the site.

We have made important progress during the year on the building of a nuclear reactor for research and educational purposes. Construction of the reactor started

last June. Costing about $2.4 million, the reactor will be one of the most versatile ever constructed for research purposes and for teaching use, and it will give new impetus to the Institute's rapidly growing program of graduate study in the field of nuclear engineering. In this project we have had timely and generous assistance from the National Science Foundation and the Rockefeller Foundation.





The nuclear reactor (above) and the Karl Taylor Compton Laboratories (below) will help M.I.T. realize its new opportunities for teaching and research in physics, nuclear energy, and electronics.

Fraternity Initiations

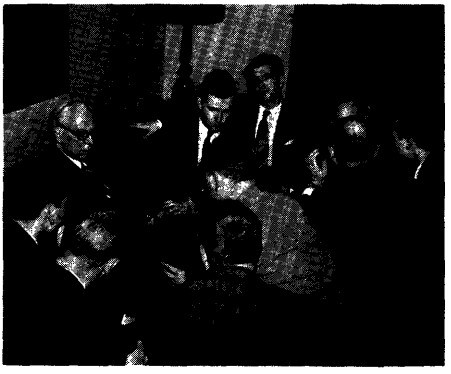
The tragic death during a fraternity initiation of Thomas Lynn Clark of the Class of 1959 shocked the entire Institute community. Recognizing that Tom Clark and his brothers in Delta Kappa Epsilon fraternity – innocent of conscious negligence – were victims of long-practiced traditions, the students and Faculty have joined in a searching re-evaluation of initiation practices and hazing. Acting through the Interfraternity Council and the Institute Committee, our students have taken steps to outlaw hazing and other outmoded activities throughout the campus. I hope that the conclusiveness and comprehensiveness of the policies adopted for containing and outlawing these immature practices will be widely recognized as typifying the best in student life and responsible student government.

With students taking the lead, a scholarship fund memorializing Tom Clark has been established to commemorate in the only way we can a fine young man we sorely miss and the nation could ill afford to lose.

The M.I.T. Community

One who returned to the Institute knowing it only as it was a decade ago might not have recognized M.I.T. in 1956. Its physical appearance has been transformed in many ways; but this change is a superficial one, and the change in character of the Institute and its community is of far deeper significance. The new Kresge Auditorium has proved a most important stimulus to the continuing growth here at M.I.T. of an exciting academic community which rivals in the breadth and depth of its interests any to be found in America.

Visitors came from every continent during the past twelve months to enrich our many professional activities; indeed, the list of such guests – who have shared their knowledge with us as colleagues, seminar speakers, and guest lecturers – is not assembled in any one place; and were it so gathered, the list would be far too long to show here. Among our visitors I list, almost at random, Dr. Edward P. Warner, President of the Council of the U.N.'s International Civil Aviation Organization, and Sir Geoffrey I. Taylor of the University of Cambridge, England, who spoke at aeronautical engineering seminars; the Right Honorable Clarence D. Howe, Minister of Trade and Commerce and Minister of Defence Production in Canada, who spoke at an all-Institute convocation; Professor J. L. M. Morrison of Bristol University, England, and Andre W. Sleeswyk of the Delft Institute of Technology, the Netherlands, speakers at mechanical engineering seminars; Sir Edward C. Bullard of the National Physical Laboratory and Cambridge University, England, who delivered a public lecture in the Department of Geology and Geophysics; and the Right Honorable Robert H. Winters, Canadian Minister of

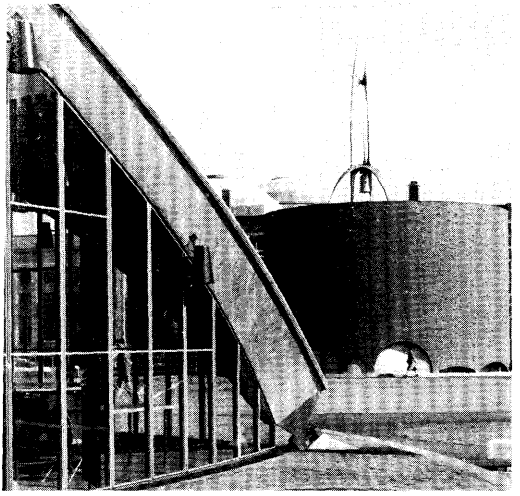


Alfred P. Sloan, Jr., found an eager audience of graduate and undergraduate students in the School of Industrial Management.

Public Works, who spoke to students employed at the Institute through the Student Personnel Office. At a notable session in the fall Alfred P. Sloan, Jr., Honorary Chairman of the Board of General Motors, spoke to Faculty and students in the School of Industrial Management, of which he is the founder. Lecturers in a series sponsored by the School of Architecture and Planning included Lewis Mumford, William Zeckendorf, and a number of distinguished practicing architects.

These many visitors continue a tradition of professional interchange which is at the heart of all scientific and technical advance, and we welcome every opportunity to share our work with colleagues from throughout the world, subject only to the occasional requirements of military security. Others of our many visitors, however, demonstrate more clearly the rapidity with which this community is broadening its interests and activities. In these affairs — as in professional activities — students have undertaken a role fully as important as that of the Faculty.

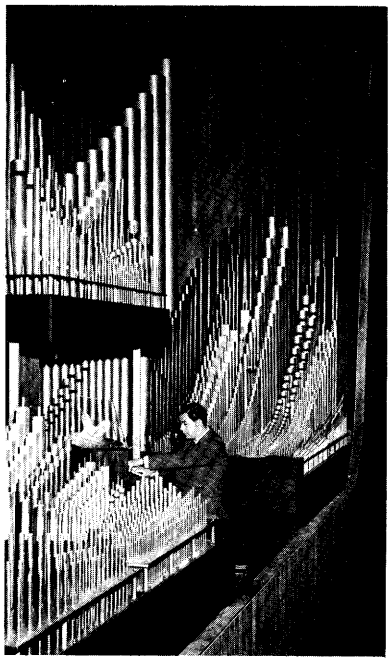
Among guests presented by the student Lecture Series Committee, for instance, were Commandant Jacques-Yves Cousteau, the noted French underseas explorer; His Excellency, Tran van Chuong, Ambassador of Viet Nam to the United States; Willy Ley, rocket research expert; and Louis Untermeyer, author and critic. To celebrate International Week, the Undergraduate Association presented special lectures by Asdrubal Salsamendi of Uruguay, Liaison Officer at the United Nations Department of Public Information; the Honorable Arthur Lall, permanent Indian delegate to the United Nations; and the Honorable Leverett Saltonstall, U.S. Senator from Massachusetts.



The M.I.T. Chapel received the Grand Architectural Award of the 1956 Boston Arts Festival and has been selected by the National Council of Churches as one of the best churches built in the last 25 years.

Thanks in large measure to the superb facilities provided by the Kresge Auditorium and M.I.T. Chapel, the Institute has had a rich and varied musical experience during the past year. These professional events were in addition to concerts by many M.I.T. student groups: the New England Opera Theater production of "Don Pasquale;" Norma Farber accompanied by an orchestra of members of the Boston Symphony Orchestra; the Julliard String Quartet; the Hungarian String Quartet; E. Power Biggs and a string group in a special Mozart concert arranged by the American Academy of Arts and Sciences; and Pierre Cochereau, organist of Notre Dame Cathedral in Paris, who presented the inaugural recital on the Fuller Organ in the Kresge Auditorium. This fall the Boston Symphony Orchestra will give its second M.I.T. concert, an occasion which we now hope has become an annual event. Concerts by the Connecticut College Choir and the Wellesley College Choir with the M.I.T. Glee Club were among student performances during the year.

Pierre Cochereau played the inaugural recital on the Kresge Auditorium organ, the gift of Former Governor Alvan T. Fuller.



The M.I.T. Choral Society's 1956 European trip included a lawn party at Bad Mergentheim and this rehearsal in the Marburg University music hall.

The M.I.T. Choral Society, after two splendid concerts in Kresge Auditorium last winter, was invited to participate in the Boston Arts Festival early in the summer and during July and August completed a three-week tour of Germany, singing with the European Youth Orchestra and the Orchestra of Darmstadt Technical Institute, M.I.T.'s scientific counterpart in Germany. German critics were enthusiastic about the Society's performances. Said the *Darmstadt Tageblatt,* "It is an amateur chorus, superbly balanced vocally, with strict discipline and clear diction, and absolutely sure in its entrances. We have the baton of Professor Klaus Liepmann to thank for the exemplary unity of this chorus." *Tauber Zeitung* commented on the M.I.T.-European Youth Orchestra finale in Bad Mergentheim: "Something not so obvious (as the merit of the performance itself) was the spontaneous and enthusiastic joining of people from all areas through the medium of music, a language we all understand . . . ; and the fact that a country of technical miracles and an institute not specializing in art sends a non-professional choir which gave such an overwhelming performance. Perhaps from another country we, too, can learn that a rich life is not won by scientific and technical progress alone. . . . Young musicians — in a real sense — do we thank for an enduring and impressive performance."

The Proctor Organ in the M.I.T. Chapel was the scene of a number of informal Sunday afternoon organ recitals during the last year; organists included Robert Pettitt (assisted by Phyllis Skoldberg, violinist); David Johnson (assisted by Mary Fraley Johnson, cellist); Frank C. Taylor, organist at the First Parish Church, Watertown; Lawrence C. Moe, organist at St. Paul's Cathedral, Boston; Marion Boron, organist at Christ Church, Cam-

bridge; and Evelyn Stevenson. Mr. Biggs originated one of his nationally broadcast organ recitals from this small but fine instrument in the fall. Late in the spring Salvador Arnita, chairman of the Music Department at the American University of Beirut, Lebanon, presented a special recital on the large organ in Kresge Auditorium.

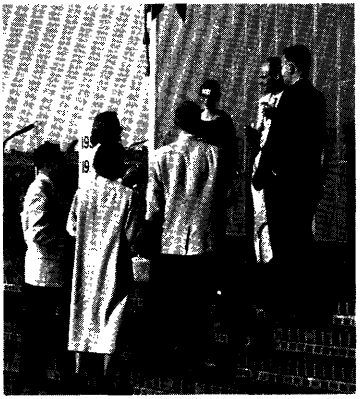
Under the leadership of Professor Joseph D. Everingham, and growing out of the availability of the Little Theater in the Kresge Auditorium, a flourishing student activity in the drama has developed. A combination of formal instruction and of student performances may well lead to the impressive results we have achieved in music. Dramashop, the student dramatic group, gave professional performances of three difficult modern plays: "Six Characters in Search of an Author," by Luigi Pirandello; "The Jubilee" by Anton Chekov; and "The Father" by August Strindberg; and in addition, in a Celebrity Series, Dramashop presented lectures by Louis Kronenberger, drama critic of *Time* magazine; and Robert Anderson, playwright.

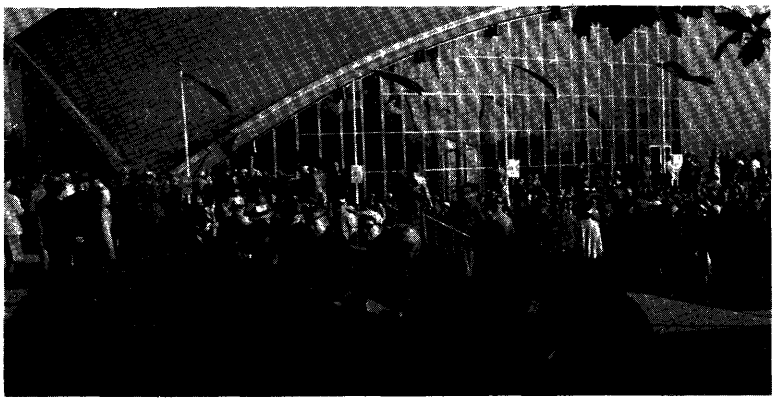
The active program of the Museum Committee has brought a number of distinguished exhibitions to the gallery in the Charles Hayden Memorial Library during the year. The series has included color lithographs by Georges Braque, contemporary French artist; oil paintings by Lancelot Ney of the School of Paris; contemporary paintings from the Smith College collection; a distinguished photographic exhibition of contemporary building in the Netherlands; work of Joan Miro, Spanish painter; and a showing of four etchers, John Taylor Arms, Samuel Chamberlain, Louis Rosenberg, and George Wales, all alumni of M.I.T.

As usual, it has been the Institute's pleasure to entertain a number of professional conferences and meetings, and again the Kresge Auditorium gives us a particularly fortunate place in which to do so. The eleventh annual M.I.T. Debate Tournament brought representatives from thirty New England colleges and universities to the campus; the Boston Society of Biologists sponsored a most important symposium on "The Effect of Atomic Radiation on Man;" in cooperation with the Department of State, the Center for International Studies was the scene of a conference on Asian-American Cultural Relations; the Medical Department and M.I.T. Coaches Association presented a symposium on the Physiological Effects of Exercise; the fourth annual Intercollegiate Conference of the New England Federation of College Orthodox Students met at M.I.T. during the spring; and the annual New England Intercollegiate Band brought students from sixteen New England colleges to play under the direction of Thor Johnson, the conductor of the Cincinnati Symphony Orchestra.

In June M.I.T. joined with Harvard as host to the Third International Congress on Acoustics, meeting with the Acoustical Society of America. More than 1300 delegates from seventeen countries — including six from the U.S.S.R. — were registered. Earlier in the year Kresge was the scene of a meeting of the International Commission of Optics, attended by 150 American and forty-two foreign scientists, and of the Third National Conference on Campus Safety. This fall, for a conference on communication theory sponsored by the Research Laboratory of Electronics and the Institute of Radio Engineers, we have been honored by the visit of three more scientists from Russian laboratories.

The plaza surrounding Kresge Auditorium was the colorful scene of this late-afternoon social hour on Alumni Day last June.





Corporation, Faculty, and Administration

The Institute continues to be distinguished by the professional achievements of its Faculty members (and by the honors which come to them as the result) and by the services of the members of its Corporation.

Seven changes have affected the membership of the M.I.T. Corporation during the past year, and we look forward to a long and fruitful association with four men new to the Corporation's rolls. Dr. James P. Baxter, III,

President of Williams College, has been appointed a Special Term Member. New Life Members are Gwilym A. Price, Chairman and President of the Westinghouse Electric Corporation, and David A. Shepard, Director of the Standard Oil Company (New Jersey). Members of the Alumni Association elected three of their number to Alumni Term Membership: Dwight C. Arnold, President of the Arnold-Copeland Company; Edward J. Hanley, President of the Allegheny Ludlum Steel Corporation; and Augustus B. Kinzel, Vice-President for Research of the Union Carbide and Carbon Corporation. Theodore T. Miller, President of the Polymer Chemicals Division of W. R. Grace & Company, also joins the Corporation as new President of the Alumni Association. Expirations of Term Memberships will cost us the associations of John A. Lunn, Vice-President of the Kendall Company, and Howard H. McClintic, Jr., of the Ferguson and Edmondson Company.

A number of visiting professors have brought new experiences and wisdom to our Faculty and students. Among these have been Dr. G. Wesley Dunlap, manager of a number of specialized engineering services at the General Electric Company, who has been Edwin Sibley Webster Visiting Professor of Electrical Engineering; Dr. William R. Hawthorne, Professor of Applied Thermodynamics at Cambridge University, England, who has been Jerome Clarke Hunsaker Visiting Professor of Aeronautical Engineering and who will be associated with us during the coming year as a Visiting Fellow of the School for Advanced Study; Dr. Claude E. Shannon, research mathematician at the Bell Telephone Laboratories, who continues as Visiting Professor of Electrical Communications through the first term of the current

year; Louis I. Kahn, Professor of Architecture at the University of Pennsylvania, who was Albert Farwell Bemis Visiting Professor of Architecture for five months last year; Edgar Kaufman, noted designer for the Museum of Modern Art and other groups, Albert Farwell Bemis Lecturer in Architecture; Dr. Hugh C. Longuet-Higgins, Professor of Theoretical Chemistry in the University of Cambridge, England, the Arthur D. Little Visiting Professor of Chemistry; and Dr. Philipp G. Frank, retired as Lecturer on Physics and Mathematics at Harvard University, Visiting Professor in the Department of Humanities. Ernst Levy continued for the second year his service as Visiting Professor of Music, and he returns for the current year. Dr. Robert S. Hartman, Associate Professor of Philosophy at Ohio State University, served as Consult-

Dr. Philipp G. Frank, Visiting Professor of Humanities.

Dr. William R. Hawthorne, Visiting Hunsaker Professor of Aeronautical Engineering, with Professor-Emeritus Jerome C. Hunsaker (right).

ant to the Dean of Students during the year, at the same time teaching two subjects in the School of Humanities and Social Studies.

Among our visitors for the coming year will be I. Edward Garrick, Chief of the Dynamic Loads Division at the Langley Laboratory of the National Advisory Committee on Aeronautics, who will be Hunsaker Professor; Robin Boyd, a distinguished Australian architect and lecturer at the University of Melbourne, who will be Visiting Professor of Architecture; and Dr. Stanislaw M. Ulam, senior scientist at the Los Alamos Scientific Laboratory, who will be Visiting Professor of Mathematics. Dr. Isador I. Rabi, Professor of Physics at Columbia University, and Dr. Edwin H. Land, President of the Polaroid Corporation, will be Visiting Institute Professors during the year ahead.

Important and distinguished additions have also been made to our Faculty during the year. Dr. Sidney S. Alexander, formerly economic adviser to the Columbia Broadcasting System, Inc., and Dr. Jay W. Forrester, a distinguished member of the M.I.T. research staff who directed construction of the Whirlwind digital computer, have become Professors of Industrial Management. Each will extend that School's research and teaching, Mr. Alexander in business economics and policies and Dr. Forrester in business applications of modern data-processing equipment. Eduardo F. Catalano, the noted Argentine architect who was acting head of the Department of Architecture at the North Carolina State College, has become Professor of Architecture. Dr. Jule G. Charney, a long-time member of the Institute for Advanced Study, Princeton, well known for studies of numerical weather prediction and dynamical meteorology, joins the Depart-

ment of Meteorology as Professor. Since 1955 associated with M.I.T.'s work at Brookhaven National Laboratory, Dr. Clifford G. Shull becomes Professor of Physics to continue teaching and research in neutron physics.

Meanwhile, death has taken the services of four prominent and beloved members of our Faculty and teaching staff: Dr. Ernst A. Hauser, Professor of Chemical Engineering, internationally known for his contributions to colloid science; Joseph N. Scanlon, Lecturer in the Department of Economics, who pioneered in new concepts of labor relations; Donald W. Taylor, Associate Professor of Soil Mechanics, for twenty-four years associated with M.I.T.'s growing and distinguished work in this field; and Dr. Witold Hurewicz, Professor of Mathematics, who died in a tragic accident in Mexico during the summer and who will be missed for his generosity and warmth as well as for his major professional accomplishments.

Dr. Francis O. Schmitt has been appointed Institute Professor and relieved of his duties as Chairman of the Department of Biology so that he may devote full energies to research and advanced teaching; Dr. Irwin W. Sizer, Associate Professor of Biochemistry, is serving as acting head of the Department. Professor Buerger has completed with distinction his term of service as Chairman of the Faculty, and Dr. John T. Norton, Professor of the Physics of Metals, has been chosen new Chairman.

Three members of the Institute family retired at the end of the past academic year: Joseph C. MacKinnon, whose service to M.I.T. began in 1915 and who has been Registrar since 1923; Delbert L. Rhind, Assistant Treasurer, who came to M.I.T. in 1921 and was Bursar from 1934 to 1954; and Professor Richard D. Fay, for twenty-

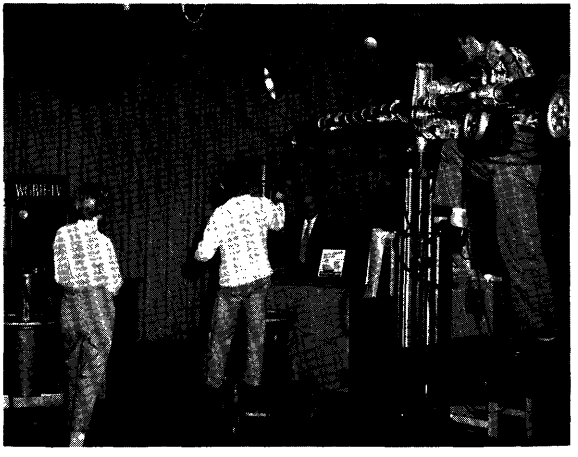
eight years a member of the Institute's research staff and Faculty in electrical communications and acoustics. Mr. MacKinnon continues as a Special Adviser to the Director of Physical Plant, Professor Fay as Lecturer in the Department of Electrical Engineering. Mr. MacKinnon has been succeeded as Registrar by Robert E. Hewes, who has been Associate Registrar since 1953.

In the death late in the spring of Nathaniel McL. Sage, the Institute's administration has lost the wise and friendly counsel of one of its long-time and most beloved members. Mr. Sage became Placement Officer in 1937, Director of the Division of Industrial Cooperation in 1940, and Director of the Office of Sponsored Research in 1955. During World War II he was responsible for the pioneering relationships between M.I.T. and the many government and industrial groups which sponsored vast research undertakings here; the patterns set under his guidance during this period have now become a standard basis for contracts between educational laboratories and outside organizations throughout the nation.

Among the honors which have come to members of the Faculty during the past year are these: the George Westinghouse Award of the American Society for Engineering Education to Professor Milton C. Shaw (mechanical engineering); the Distinguished Public Service Award of the U. S. Navy to Professor Charles S. Draper (aeronautical engineering), the Desmond Fitzgerald Prize of the Boston Society of Civil Engineers to Professor Albert G. H. Dietz (civil engineering); the Leon S. Moisseiff Award of the American Society of Civil Engineering to Professor John M. Biggs (civil engineering), the Premium Award of the Royal Aeronautical Society (England) to Professor Richard B. Adler (electrical engineering), the

Levy Medal of the Franklin Institute of Pennsylvania to Professor David A. Huffman (electrical engineering), the Gilbreth Medal of the Society for the Advancement of Management to Professor Herbert F. Goodwin (industrial management), the Max Planck Medal of the German Physical Society to Professor Victor F. Weisskopf (physics), and the Exceptional Service Award of the U. S. Air Force to Professor Albert G. Hill (physics), Professor John R. Markham (aeronautical engineering), Dean C. Richard Soderberg (engineering), and Associate Dean H. Guyford Stever.

Professor Raymond L. Bisplinghoff (aeronautical engineering) delivered the nineteenth Wright Brothers Lecture before the Institute of the Aeronautical Sciences; Professor Walter G. Whitman (chemical engineering) has served as President of the American Institute of Chemical Engineers, Professor Herbert H. Uhlig (metallurgy) as President of the Electrochemical Society, and Professor Richard H. Bolt (electrical engineering) as President of the International Commission on Acoustics.



Members of the M.I.T. community are increasingly active in programs on WGBH-TV, the educational television station operated on Channel 2 by the Lowell Institute Cooperative Broadcasting Council.

Unfinished Business

Among numerous proposals, plans, and needs which rest on the desks of deans and other administrative officers calling for action — and usually funds — may be noted the following:

Last year a distinguished committee under the chairmanship of President Edwin S. Burdell of Cooper Union in New York recommended establishment at the Institute of a Center of Urban Studies to supplement, extend, and strengthen our work in city planning and to provide research facilities in this area of growing importance. The principal recommendations of this committee were also endorsed by the Corporation Visiting Committee for the School of Architecture and Planning.

Similar studies on the part of committees appointed from outside the Institute remain yet to be acted upon in the School of Humanities and Social Studies. The first of these relates to the field of psychology, the second to the fine arts. We hope during the year to find the method and the means to clarify the status of these important academic fields at the Institute.

Successive Visiting Committees on the Department of Food Technology have urged more long-term financing for this Department, now far too dependent upon "soft" money.

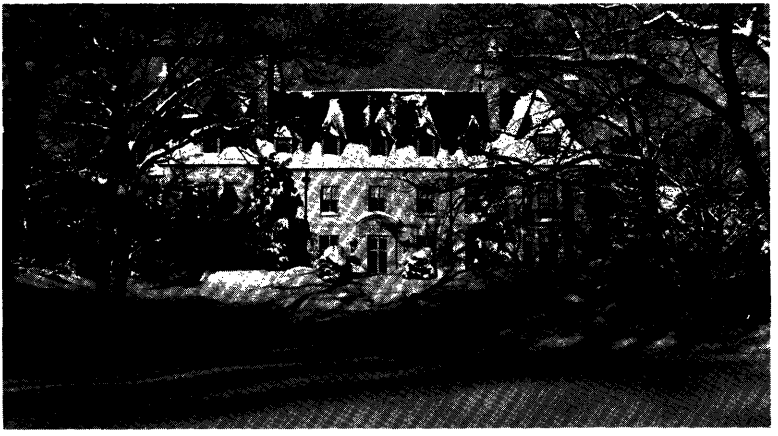
Other important recommendations of Corporation Visiting Committees include these:

1. It is recommended that the Department of Aeronautical Engineering expand its education effort in the areas of aeronautical propulsion by increasing the amount of time allotted to this subject and by revising the course content so that the propulsion field exerts appropriate attraction for students.

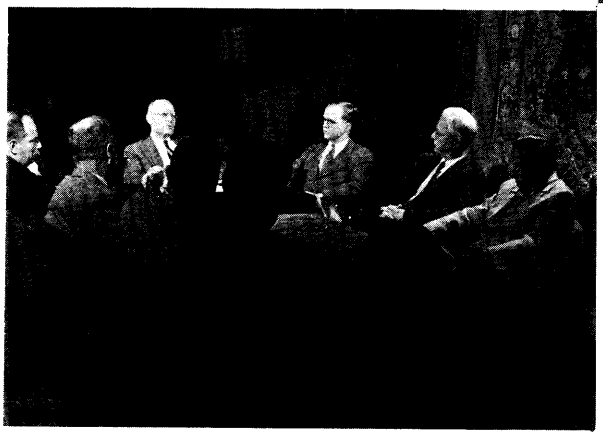
2. It is recommended that a sound estimate of student population in the Department of Physics for the next several years be made and that space, facilities, and Faculty requirements for the expanding student body be planned as early as possible to insure that the high quality of the work of the Department not suffer from overcrowding, shortage of facilities, and overloading of Faculty.

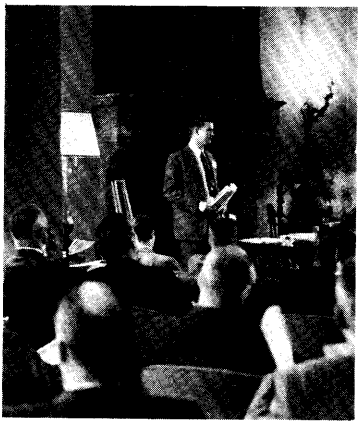
3. Sympathetic consideration is recommended to the need of the Department of Geology and Geophysics for more adequate library facilities adjacent to the Department, a commons room for the use of undergraduate students particularly, and encouragement to extend its present procedures for interesting more students in the Department.

4. It is recommended that M.I.T. take the lead among scientific libraries in making available Russian technical literature.



In its first year of service to the Institute community, Endicott House — the estate of the late H. Wendell Endicott in Dedham, Massachusetts — has proved to be a superb center for many M.I.T. activities. As the photographs on the following page testify, its gardens and terrace as well as its commodious conference rooms and other facilities make it a fine setting for student-Faculty conferences and special symposia of all kinds.





III. A STATISTICAL ABSTRACT

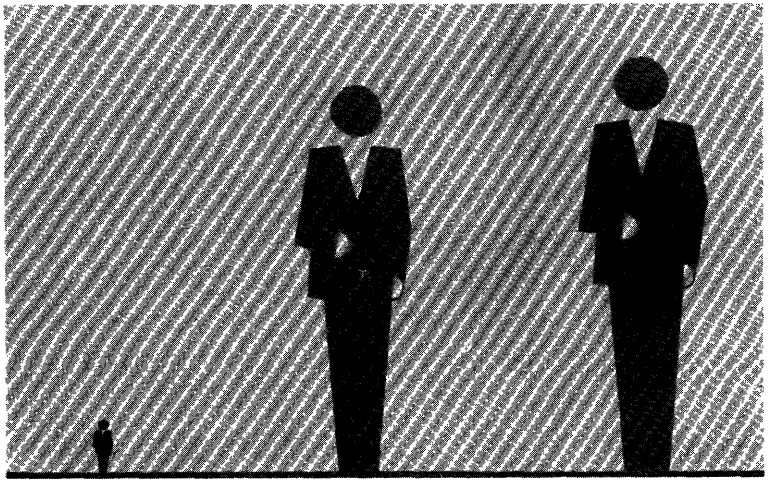
Enrollment

In 1955-56 the student body numbered 5,648 as compared with 5,348 in 1954-55. We estimate that enrollment this fall will reach 5,900. Veterans numbered about 6 per cent of the total enrollment in both 1955-56 and 1954-55. In 1955-56, 19 per cent of our students were married, as compared with 18 per cent in 1954-55. One hundred six women were enrolled, thirty-nine of whom were graduate students.

Enrollment in the graduate school was 1,992. There were 203 officers from the armed services enrolled for advanced degrees.

Students enrolled at M.I.T. during 1955-56 held degrees from 438 other colleges and universities, 264 American and 174 foreign.

THE EDUCATION OF THE FATHERS OF THE CLASS OF 1959



4% ATTENDED M.I.T. **43%** ATTENDED OTHER COLLEGES **45%** ATTENDED NO COLLEGE

* *No information available on 8%*

Student Aid

For the second successive year our financial aid to undergraduate students increased by almost 10 per cent, to a total of $1,039,829. This aid was provided by the Institute through $354,622 in scholarships, $390,937 in loans, and $294,270 earned by part-time employment in student staffs and other divisions of the Institute. Thirty per cent of our undergraduate student body was helped through scholarships and loans and almost one-third did some part-time work to earn during the college year.

During the past year, in keeping with a national trend due at least in part to the shortage of scientific and engineering talent, growing numbers of graduate students at M.I.T. have received financial aid to cover a portion of their living costs in addition to their entire tuition.

In all, we awarded during the past year 198 fellowships to graduate students, fifty more than in 1955, with grants totalling $320,655; and 102 scholarships valued at $61,553. Including staff awards, our total grants to graduate students last year amounted to $532,741, nearly $100,000 more than during the previous year.

With an increase of $200 in tuition becoming effective with the academic year 1956-57, it is most encouraging to report that additions of more than $400,000 have been made to the capital amount of the undergraduate scholarship endowment during the past year; also, gifts for current use as undergraduate scholarship awards increased by more than 50 per cent over last year, and for 1956-57 these gifts should triple the amounts given in 1954-55. The amounts granted in 1956-57 from current funds will be about $340,000, an increase of almost

55 per cent over 1955-56. This compares with the tuition increase of 22 per cent.

The initial contribution of the M.I.T. Alumni Fund is of major significance; slightly more than $50,000 was added to the undergraduate scholarship endowment by name, class, and regional funds. The Alumni Fund Board generously added an additional $50,000 for scholarship grants during 1956-57. This help is most timely, and we are deeply grateful to the alumni for their loyalty and financial support.

Foundations and industries are both showing a growing interest in helping qualified young people obtain education. This fall fifty young men and women will enter the Institute as freshmen sponsored by the two largest programs, General Motors and the National Merit Scholarship. A number of other companies have small but equally effective undergraduate aid programs. In addition, during the past year twelve industries established new graduate fellowships and scholarships at M.I.T.

The result of all these efforts has been to catalyze requests for scholarship assistance from hopeful prospective freshmen. This year we received 2,300 completed applications for financial aid from freshman aspirants. This represents a 60 per cent increase over 1953.

In addition to the gifts for scholarship awards, almost $55,000 was received by the Institute as a contribution by foundations and industrial companies which sponsored undergraduate scholarships during the past year, as an aid "toward meeting the full cost of education."

Finances

During 1955-56 our academic expenses amounted to $17,099,000 as compared with $14,813,000 in the fiscal

year 1954-55. These figures for academic expenses do not include the funds expended on sponsored research projects in the Division of Defense Laboratories and the Division of Industrial Cooperation.

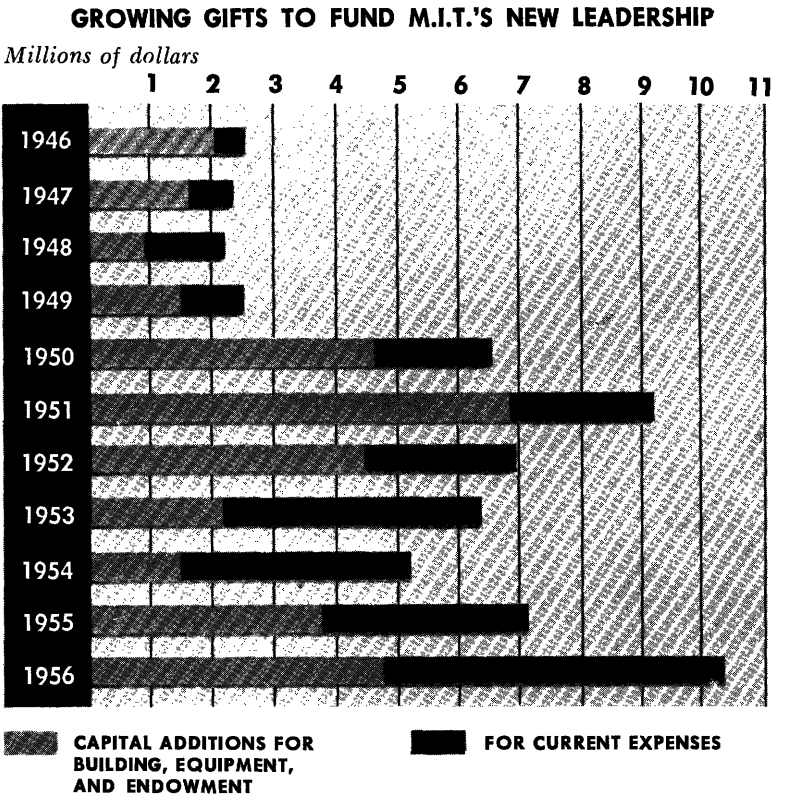
The Institute's endowment and other invested funds now have a total book value of $79,292,000, an increase over last year of $7,461,000, and are invested in securities with a market value of $123,683,000, greater than 1954-55 by $14,339,000. Plant assets stand at $37,980,000, about $1,894,000 above last year.

The rate of income earned in 1955-56 on the funds sharing in the general investments was 6.29 per cent of the book value of the funds, compared with 5.69 per cent last year. Of this, 5 per cent was allocated to the funds, compared with 4.5 per cent last year and 4.0 per cent the year before. Undistributed investment income was increased by $173,000, bringing this reserve up to $3,216,000, of which $595,000 is designated for allocation in 1956-57.

The program of progressive building maintenance was continued during the year, with the greater part of the expenditures devoted to improved maintenance of the basic building structures and utilities. Total expenditures for special alterations, maintenance, and equipment were $919,000, compared to $730,000 last year, while regular plant operating expenses increased from $1,599,000 to $1,828,000 in line with the expanded physical plant of the Institute and the increase in costs of our building operations.

Gifts

Gifts for the year exceeded the peak year during the great Development Program, with 1955-56 at $10,387,000 compared with the past high, $9,145,000 in 1950-51. Gifts for



endowment were higher than in any year since the end of the war, with $1,360,000 received in the munificent Ford Foundation program for faculty salaries. Endowment funds of $500,000 for research included an anonymous gift of $200,000 and $300,000 from the Estate of Edith Carson Wilder.

In the gifts received for buildings, major support to the Compton Laboratories and the nuclear reactor was provided by Irénée du Pont, Mr. and Mrs. Alfred P. Sloan, Jr., the Edwin Sibley Webster Foundation, the Rockefeller Foundation, and John L. Pratt. Alvan T. Fuller contributed generously toward the organ for the Kresge Auditorium.

The gifts totaled by the Alumni Fund office this year amounted to $575,000. This year alumni giving passed last year's record $547,000. The impressive generosity of M.I.T. alumni enabled us last year to start construction of the Karl Taylor Compton Memorial Laboratories. Of this year's total, $355,000 was credited to the Alumni Fund for further designation by the Alumni Fund Board and $220,000 was credited directly to funds for purposes specified by the donors.

So far the Fund Board has made an allocation of $50,000 for scholarship aid, and already fifty-three freshmen are receiving Alumni Fund assistance. In addition, a grant of $15,000 was made to support research in the treatment of malignant diseases being conducted by Professor John G. Trump in the Department of Electrical Engineering.

In the invested funds for current use, in addition to the alumni grant of $355,000, is $430,000 donated by the Ford Foundation as an expendable capital fund for professorships in economics.

The Athletic Administrative Board has spent the year in intensive study of M.I.T.'s athletic facilities with a view toward most effectively using the bequest of David Flett du Pont, a senior in metallurgy, following his untimely death in a tragic automobile accident. We are certain that Mr. du Pont's generous bequest of $1,006,000 will make possible the facilities, which M.I.T. has long sought, to support the program of athletics as recreation for which the Institute is widely known.

IN CONCLUSION

I would like again to remark, as I did last June on Alumni Day, that the efficiency of all we do at the Institute is greatly enhanced by our freedom from internal stresses, cliques, and factions. We are thus unusually free to concentrate the greater portion of our energies on important and constructive work. This does not mean that we do not have differing opinions or differences of opinion vigorously held but rather that we have an environment where such differences can occur without hardening into divisive, contentious issues. For this favorable condition many are responsible — but notably the Corporation and the Faculty of the Institute. The wisdom, the farsightedness, and the success with which the Corporation has carried its responsibilities for the trusteeship of our institution, its understanding of the Institute's special needs, and its recognition of the special characteristics of an academic community all have contributed to the strength and advancement of the Institute. As a consequence, we continue to have here, in difficult times and good, the pervasive confidence and sense of common cause of which I spoke earlier in this report. We continue to have here a priceless, invigorating quality of restlessness, self-dissatisfaction, and innovation, a driving urge to greater excellence, a sense of the deep importance of our mission to the welfare of our country. However imponderable they may be, these are our great assets which cannot be described in statistical terms, embodied in limestone, or reflected in a financial report.

Respectfully submitted,

JAMES R. KILLIAN, JR.
President

October 1, 1956

PERSONNEL CHANGES THROUGH SEPTEMBER 15, 1956

Corporation

TERM EXPIRATIONS:

Gwilym A. Price, *Special Term Member*
John A. Lunn, *Alumni Term Member*
Howard H. McClintic, Jr., *Alumni Term Member*
David A. Shepard, *Alumni Term Member*

NEW APPOINTMENTS:

Gwilym A. Price, *Life Member*
David A. Shepard, *Life Member*
James Phinney Baxter, III, *Special Term Member*
Dwight C. Arnold, *Alumni Term Member*
Edward J. Hanley, *Alumni Term Member*
Augustus B. Kinzel, *Alumni Term Member*

CHANGE OF TITLE:

Julius A. Stratton, *from Vice President and Provost to Chancellor*

Faculty

DEATHS:

Arthur A. Blanchard, *Professor Emeritus in Chemistry*
Ernst A. Hauser, *Professor in Chemical Engineering*
Witold Hurewicz, *Professor in Mathematics*
Donald W. Taylor, *Associate Professor in Civil Engineering*

RETIREMENT (with title Professor Emeritus):

Richard D. Fay, *Associate Professor in Electrical Engineering*

PROMOTIONS

to Professor:

Michael B. Bever, *Metallurgy*
William W. Buechner, *Physics*
Carvel Collins, *Humanities*
Robert M. Fano, *Electrical Engineering*
Nicholas J. Grant, *Metallurgy*
Klaus Liepmann, *Humanities*
Capt. Jack A. Obermayer, *Naval Architecture*
Warren M. Rohsenow, *Mechanical Engineering*
Irwin W. Sizer, *Biology*
Victor P. Starr, *Meteorology*
Clark C. Stephenson, *Chemistry*
J. Edward Vivian, *Chemical Engineering*
Gordon R. Williams, *Civil Engineering*
Walter Wrigley, *Aeronautical Engineering*

to Associate Professor:

George H. Büchi, *Chemistry*
Philip L. de Bruyn, *Metallurgy*
Peter Elias, *Electrical Engineering*
Morris Halle, *Modern Languages*
Donald R. F. Harleman, *Civil Engineering*
K. Uno Ingard, *Physics*
William D. Kingery, *Metallurgy*
Edward N. Lorenz, *Meteorology*
Osman K. Mawardi, *Electrical Engineering*
Alan S. Michaels, *Chemical Engineering*
Robert B. Newman, *Architecture*
James B. Reswick, *Mechanical Engineering*
David P. Shoemaker, *Chemistry*
Tau-Yi Toong, *Mechanical Engineering*
Albert B. Van Rennes, *Electrical Engineering*
Thomson M. Whitin, *Industrial Management*

to Assistant Professor:

Robert R. Archer, *Mechanical Engineering*
Elie J. Baghdady, *Electrical Engineering*
J. Perry Barger, *Chemical Engineering*
Amar G. Bose, *Electrical Engineering*
Gene M. Brown, *Biology*
Gordon L. Brownell, *Chemical Engineering*
David O. Caldwell, *Physics*
Harald A. Enge, *Physics*
Marvin H. Friedman, *Physics*
Floyd E. Gillis, Jr., *Industrial Management*
Moise H. Goldstein, Jr., *Electrical Engineering*
Marvin E. Goody, *Architecture*
Peter Griffith, *Mechanical Engineering*
Robert A. Hard, *Metallurgy*
George N. Hatsopoulos, *Mechanical Engineering*
George R. Healy, *Humanities*
Norman N. Holland, *Humanities*
Philip M. Lewis, III, *Electrical Engineering*
John D. Linsley, *Physics*
Bruce Mazlish, *Humanities*
Ronald E. Nece, *Civil Engineering*
Frederick W. Nesline, Jr., *Electrical Engineering*
Richard J. Nickerson, *Mechanical Engineering*
George S. Reichenbach, *Mechanical Engineering*
Frederick Sanders, *Meteorology*
Abraham J. Siegel, *Economics*

Henry S. Spacil, *Metallurgy*
Bernard Widrow, *Electrical Engineering*
Herbert H. Woodson, *Electrical Engineering*

LEAVES OF ABSENCE

have been granted to the following Faculty members during the year:

Professors:

Karl W. Deutsch
Albert G. Hill
Avery A. Morton
Francis W. Sears

Associate Professors:

E. Cary Brown
Clark Goodman
William K. Linvill
Kurt S. Lion
John B. Rae
George B. Thomas, Jr.
Felix M. Villars
Thomson M. Whitin

Assistant Professors:

Amar G. Bose
Alve J. Erickson
Thomas P. Goodman
Myron A. Hoffman
James D. Koerner
John B. Nash
J. Lowen Shearer

CHANGES OF APPOINTMENT:

Martin J. Buerger, *to Institute Professor*
Walter Isard, *to Lecturer in City Planning*
Francis O. Schmitt, *to Institute Professor*
William A. W. Krebs, Jr., *to Visiting Associate Professor*

RESIGNATIONS:

Professors:

Alex Bavelas
Capt. James M. Hicks
Louis B. Wetmore (Visiting)

Associate Professors:

Charles H. Blake
Donald P. Campbell
Albert B. Van Rennes

Assistant Professors:

Charles W. Adams
Thomas V. Atwater
George B. Baldwin
Robert L. Beare
Roland F. Beers, Jr.
Warren G. Bennis
James E. Boyce
Richard T. J. Charles
Robert C. Dean, Jr.
Sidney D. Drell
Eugene L. Foster
Douglas W. Fuerstenau
Myles Maxfield
William J. McGill
Thomas F. McNulty
Denis U. Noiseux
Thomas F. O'Dea
Jesse H. Proctor, Jr.
George E. Pugh
Paul E. Stoft
Donald R. Walker

NEW APPOINTMENTS:

Visiting:

Robin G. P. Boyd, *Bemis Professor in Architecture*
Joachin B. Diaz, *Professor in Mathematics*
Evsey T. Domar, *Professor in Economics*
Kay Fisker, *Professor in Architecture*
Philipp G. Frank, *Professor in Humanities*
Isadore E. Garrick,
Jerome Clark Hunsaker Professor in Aeronautical Engineering
Frank H. Hahn, *Professor in Economics*
Louis I. Kahn, *Bemis Professor in Architecture*
George E. Kimball, *Professor in Chemistry*
Edwin H. Land, *Institute Professor*
H. C. Longuet-Higgins, *Arthur D. Little Professor in Chemistry*
Herbert Marcuse, *Professor in Humanities*
Isador I. Rabi, *Institute Professor in the School of Science*
Claude E. Shannon, *Professor in Electrical Engineering*
Lars G. Sillen, *Arthur D. Little Professor in Chemistry*
Stanislaw M. Ulam, *Professor in Mathematics*
Paul A. Weiss, *Professor in Biology*
Derwent Whittlesey, *Professor in Economics*
William R. Hawthorne, *Fellow in the School for Advanced Study*
Francis E. Low, *Associate Professor in Physics*
James C. Abegglen, *Assistant Professor in Economics*
Robert A. Clark, *Assistant Professor in Mathematics*
John H. Horlock, *Assistant Professor in Mechanical Engineering*
Walter E. Thirring, *Assistant Professor in Physics*
Stanley P. Wasson, *Assistant Professor in Humanities*

Professors:

Sidney S. Alexander, *Industrial Management*
Eduardo F. Catalano, *Architecture*
Jule G. Charney, *Meteorology*
Jay W. Forrester, *Industrial Management*
Clifford G. Shull, *Physics*

Associate Professors:

William F. Bottiglia, *Modern Languages*
Ewan W. Fletcher, *Electrical Engineering*
Robert L. Kyhl, *Electrical Engineering*
Daniel Lerner, *Economics*
Marvin E. Shaw, *Industrial Management*
Lt. Comdr. Joe W. Thornbury, *Naval Engineering*
Patrick D. Wall, *Biology*

Assistant Professors:

Joseph R. Applegate, *Modern Languages*
Dean N. Arden, *Electrical Engineering*
Eugene Bell, *Biology*
William H. Ceckler, *Chemical Engineering*
John F. Cochran, *Physics*
Richard R. Doell, *Geology and Geophysics*
Martin Dyck, *Modern Languages*
Robert L. Fleischer, *Metallurgy*
Merton C. Flemings, *Metallurgy*
John Granlund, *Electrical Engineering*
Uri Haber-Schaim, *Physics*
Davis H. Howes, *Economics*
Arthur K. Kerman, *Physics*
A. Scheffer Lang, *Civil Engineering*
Laurence W. Martin, *Economics*
Thomas W. Mix, *Chemical Engineering*
William H. Pinson, Jr., *Geology and Geophysics*
Lucian W. Pye, *Economics*
Hartley Rogers, Jr., *Mathematics*
Edgar H. Schein, *Industrial Management*
Isadore M. Singer, *Mathematics*
David A. Stevenson, *Metallurgy*
John A. Swets, *Economics*
Roy Weinstein, *Physics*
Roger W. Wescott, *Humanities*
John W. Winchester, *Geology and Geophysics*

CHANGES IN DEPARTMENTS OF AIR SCIENCE, MILITARY SCIENCE, AND NAVAL SCIENCE

Appointments:

Capt. Joseph S. Lewis, *Professor in Naval Science*
Maj. Joseph M. Walters, Jr., *Associate Professor in Military Science*
1st Lt. Peter E. Hexner, *Assistant Professor in Military Science*
Lt. John G. Landers, *Assistant Professor in Naval Science*
Capt. Alan D. Wheeler, *Assistant Professor in Air Science*

Resignations:

Lt. Col. William Mattis, *Associate Professor in Military Science*
Maj. Douthit L. Furches, *Assistant Professor in Military Science*
Capt. Edward H. Littlejohn, *Assistant Professor in Air Science*

Administration

APPOINTMENTS:

John P. Anderson, *Assistant to the Director of Admissions*
Merrill J. Baumann, *Industrial Liaison Officer*
Professor Martin J. Buerger, *Director of the School for Advanced Study*
Harvey Burstein, *Security Officer*

Professor William VanA. Clark, Jr.,
Assistant Dean of the School of Industrial Management
Francis J. Farry, *Assistant to the Accounting Officer*
Robert D. Haberstroh, *Industrial Liaison Officer*
Thomas W. Harrington, Jr.,
Assistant to the Director of the Division of Sponsored Research
Professor Robert S. Hartman,
Consultant to the Dean of Students & Visiting Professor in Humanities
Matthew B. Leggett, *Assistant Director of Admissions*
Edward L. McCormack, *Auditor*
General James McCormack, Jr., *Special Adviser to the President*
Joseph C. MacKinnon,
Special Adviser to the Director of Physical Plant, part-time
Stanley Salmen, *Executive Director, Secondary Science Film Project*
Professor Irwin W. Sizer, *Acting Head of the Department of Biology*
Walter A. Sonnenberg, *Assistant Accounting Officer*
Volta Torrey, *Director of Television*
Robert K. Weatherall, *Assistant to the Dean of Students*
James M. West, *Associate Director of the Division of Sponsored Research*

RESIGNATIONS:

Robert E. Booth, *Associate Librarian*
John O. Outwater, Jr., *Industrial Liaison Officer*
Henry T. Spiers, *Assistant Accounting Officer*
Vernon D. Tate, *Director of Libraries*

RETIREMENTS:

Joseph C. MacKinnon, *Registrar*
Delbert L. Rhind, *Assistant Treasurer*

LEAVE OF ABSENCE:

John J. Rowlands, *Director of the News Service*

DEATH:

Nathaniel McL. Sage, *Director, Office of Sponsored Research*

CHANGES OF APPOINTMENT:

Ruth L. Bean, *to Assistant Dean of Students*
Lawrence E. Beckley,
to Associate Director of the Instrumentation Laboratory
E. Francis Bowditch, *to Special Adviser to the President*
Eugene R. Chamberlain, *to Assistant Director of Admissions*
Peter T. Demos, *to Associate Director, Laboratory for Nuclear Science*
David A. Dudley, *to Associate Director of Admissions*
Frederick G. Fassett, Jr., *to Dean of Residence*
F. Leroy Foster, *to Director of the Division of Sponsored Research*
Vincent A. Fulmer, *to Assistant Director of the Industrial Liaison Office*
Robert E. Hewes, *to Registrar*
Robert J. Holden, *to Associate Dean of Students*
Mary D. Howe, *to Assistant Placement Officer*

James G. Kelso, *to Placement Officer*
Professor William N. Locke, *to Director of Libraries*
John I. Mattill, *to Assistant to the Director of Public Relations*
Walter L. Milne, *to Assistant to the Director of Public Relations*
Professor Philip M. Morse, *to Director of the Computation Center*
Professor John T. Rule, *to Dean of Students*
John W. Sheetz, III, *to Executive Secretary for Development*
William Speer, *to Associate Dean of Students for Counseling*
Professor H. Guyford Stever,
to Associate Dean of the School of Engineering
Philip A. Stoddard, *to Assistant Treasurer*
Professor Julius A. Stratton, *to Chancellor*
Frank M. Verzuh, *to Assistant Director of the Computation Center*
Evelyn B. Yates, *to Associate Placement Officer*

SCHOOL OF ARCHITECTURE AND PLANNING

In recent years the professions of architecture and planning have been expanding and evolving in response to economic growth and technological changes. A great population peak will soon engulf university education, and the highest educational standards will be subjected to severe stresses. Our staff has given thought to the future of both the graduate and the undergraduate programs.

UNDERGRADUATE CURRICULUM

The undergraduate curriculum in architecture, a five-year course, is more definitely professional than most of M.I.T.'s bachelor's programs, partly because of the extra year but also because our subject matter tends to stand apart among academic groupings and to have large components not shared by other disciplines. Architecture shares somewhat less than other professions in the M.I.T. common core, but our students do take four years of humanities, two years of physics, and one year of calculus. In addition, the work in freshman drawing, applied mechanics, building materials, and numerous electives puts our students in classes with students having different professional interests. Engineering specialists in illumination, electricity, and heating and ventilation offer instruction for us.

The Department of City and Regional Planning has no longer any undergraduate courses; but the Burdell Committee, which made a study of the problems of this Department, reported in January, 1956, that the demand for highly trained personnel to practice, teach, and pursue research is out of all proportion to the number of students presently enrolled in schools of planning. This might force our School to look again at the possibilities of reestablishing a four- or five-year undergraduate planning course which would attract undergraduates who upon graduation would be qualified for professional practice at the same level as undergraduates who enter the fields of engineering and architecture after a corresponding amount of training.

ARCHITECTURAL DESIGN

Pedagogical methods in architectural design have attained great freedom in recent times, and the project method continues to offer great stimulus to learning when introduced by skilled leadership. Teamwork is stressed, particularly in the fact-finding stages but also sometimes in joint presentation of a solution. Open juries have become forums for the public discussion of design principles.

We feel that the morale in this work is healthy. In the long view our major concern is that of maintaining the strongest possible teaching staff at a time when architects of unusual ability are so much in demand in practice. Our effort is to keep a balance among three kinds of teachers: (1) senior teachers who have long-term appointments and responsibility for policy, (2) young assistants among whom are to be found the career teachers of the future, and (3)

visiting critics, men of unusual attainment who make short-term contributions. In this third category falls the exchange program with the Danish Royal Academy of Fine Arts of Copenhagen, this year represented by Professors Mogens Koch and Mogens Black-Petersen; also the visits of Louis Kahn and Edgar Kaufmann, both of whom came under the financial sponsorship of the Bemis Foundation, and G. E. Kidder Smith, author of several books on contemporary architecture in Europe and South America.

VISUAL DESIGN

Under the direction of Professor Gyorgy Kepes, a vigorous program has been developed in that part of the curriculum formerly devoted to pure drawing. Here materials and space are manipulated in pursuit of esthetic meanings, to the end that these may be experienced more sharply than when controlled by functional and technological pressures. This kind of work demands of the student sustained effort in a studio equipped with a variety of special tools as well as devices for light control and photography. More and more it tends to deal directly with architectural materials (or scale analogs) more than with rendered symbols. We look to this series to develop the artistic formation of our students, but we have difficulty—with our fractionated curriculum—in providing adequate blocks of time and the opportunity for occasional full envelopment.

STRUCTURES

Structural analysis is a third-year study that builds on the student's previous experience in calculus, physics, and applied mechanics. Following its completion, students may study structural principles in a rather philosophical seminar course, or they may elect work in civil engineering of a more detailed analytical nature. We feel that our teaching is in transition from an older, essentially dissection-minded approach toward a more synthetic and three-dimensional view, and we note this trend in engineering circles. We are also groping toward a collaboration between structural theory and the kind of free formal invention that occurs in visual design, and we want to accomplish this without loss of mathematical rigor if possible.

HISTORY OF ARCHITECTURE

We feel a general resurgence of interest in architectural history

on the part of young men in professional studies. Nationally, there is a vigorous crop of young scholars, most of them especially interested in the problems of evaluating the last 100 years. The offerings in this area are being built up under the direction of Professor Albert Bush-Brown; coordination with the School of Humanities and Social Studies is being closely maintained. Special elective programs in this field will become available. One of these, Structure of the City, a freshman elective, is being taught for the first time this year by Professor Joseph Hudnut, retired Dean of the Harvard University School of Design.

Parenthetically, architectural history and related subjects provide wonderful opportunities for insistence on accurate and readable written composition. Architects and engineers are likely to neglect this art if not prodded. There is an increasing interest in local architectural history, and this tends to give immediacy and reality to historical studies.

ENGINEERING

As part of the general groundswell, architects and structural engineers both show a trend toward closer intellectual rapport than has been the case for some time. Engineering, however, has become in recent years so involved with new areas of specialization that the miscellaneous engineering of buildings tends to be neglected. There are some excellent teachers on the M.I.T. Faculty in these areas, but not many bright young men are being attracted toward careers as consultants for non-structural aspects. The exception to this is architectural acoustics, now taught within our own Department by Professor Robert Newman. Here are occurring great advances in understanding, and a few young architects are qualifying themselves for special competence in sound control. Our School should examine the problem of promoting a greater abundance of qualified independent consultants. In the long run our profession would stand to gain by recruiting these specialists from its own ranks.

GRAPHIC EXPRESSION

Draftsmanship as a disciplined medium of communication diminished in emphasis in architectural education beginning in about 1930. Our curriculum is stronger now in the problems it poses, but it has declined in the fundamentals of graphic expression that might make their solution easier. We shall have to win back

recognition that graphic skill, like the technique of a musical instrument, can only be acquired by prolonged effort. Too much emphasis in elementary and secondary years is placed on the emotional release of the graphic arts and not enough on the discipline of communication. We get freshmen at M.I.T. whose scores are very high on conventional aptitude and achievement tests but whose fingers are mute to drawing as the language of design. This is one of the most conspicuous differences between our schools and European ones.

While we are conscious of this problem, we have not solved it. We are the only course at M.I.T. that now requires freshman drawing and descriptive geometry. Generally this work can be strengthened and oriented toward a freer and more eloquent way of working. More emphasis on craftsmanship throughout the curriculum also brings good results.

GRADUATE SCHOOL

The program for the degree of Master in Architecture remains a kind of one-year finishing school attracting students from schools all over the United States and foreign countries. Although at any one time graduate students are only about 15 per cent of our enrollment, the turnover is more rapid and the number of alumni produced is comparable to those coming from the undergraduate course. The vast majority of graduate students obtained their undergraduate professional degrees at schools other than M.I.T., and the course is a mecca for superior students seeking advanced study. Whereas in the undergraduate course M.I.T. now has about sixty competitors in the United States and produces only 2 or 3 per cent of bachelors in architecture, only a handful of older schools offer graduate work. In 1955 M.I.T. conferred twenty-three of the national total of ninety-one masters in architecture. This is an area in which it is important to maintain a certain preeminence.

The formulation of graduate educational policy is a delicate task. This short year is a climax in the lives of the students, and they expect a very rich experience. There must be a balance between opportunities for interchange with our undergraduates, our Faculty, and M.I.T. as a whole on the one hand, and the need for concentrated work together as a class on the other. There is a need for visiting critics, yet the limited time must not be diffused among too many influences.

COLLEGE TRANSFER

An increasing number of students come to our School with previous college experience, often with bachelor's degrees, but with little or no professional study in architecture. These students do not qualify for graduate professional work but they tend to do well in the undergraduate course. Some of these students are combining work at another college with our course as part of a deliberate plan; others do it only because they decide late to be architects. Often these students have difficulty meeting our requirements in science and mathematics and have to repeat work done before coming here. There seems to be no easy way to overcome these difficulties.

DEPARTMENT OF CITY AND REGIONAL PLANNING

In city and regional planning the outstanding event of the year was the report of the Burdell Committee, composed of outstanding practicing planners and architects. The report, having praised the Department for the vitally important role it has played in the field of city planning education in the United States, expressed the belief that M.I.T., having unparalleled resources, should establish a unit for research of the highest caliber on urban and regional problems. Such a research center should deal realistically with present difficulties and imaginatively with future opportunities. In this task it could avail itself of the services of additional staff from appropriate departments of the Institute, including economists competent in handling commercial and residential developments and in transportation economics, urban sociologists or social anthropologists, and public and administration experts in local and regional government. The center should have access also to engineering and other specialists in the Institute who would bring their talents to bear on the complex problems of an urban society. The Department of City and Regional Planning, being entirely a graduate school with a program for the Master in City Planning, is open to graduates of architecture as well as of other disciplines. Although architecture and planning have become separate and distinct, it is our belief that they should not be allowed to grow further apart. To this end architects should learn something of the methods of city planners, and advanced students of architecture should undertake certain design exercises at the community scale, solving them with the help of advice from the planning faculty.

RESEARCH

In recent years the School has accepted alone or jointly a number of grants-in-aid enabling us to carry out research in fields such as space heating with solar energy, subjective measurement of the luminous environment, the use of plastics in house construction, and the perceptual form of cities. A study has been completed on municipal costs for the Federal Reserve Bank, and research on new techniques for analyzing economic resources development is being conducted.

These activities have proved stimulating to teachers and students and may from time to time result in contributions to professional understanding. Against this must be weighted the administrative burdens of such programs and the danger of diverting our effort from the principal task of making our teaching more effective. We are happy when these researches are sponsored by corporations in the building industry, for it seems healthy to have their partnership in the pursuit of knowledge. We believe that there are many areas of investigation appropriate to architectural research, but that profession is more oriented to synthesis than to analysis; we must expect that long experience will precede important results. Information gleaned from the various projects has been passed on to the students and has resulted in exciting problems, discussion, and finally solutions of merit. This year our fourth-year class in architectural design participated in the Society of Plastics Industries' Plastic House Competition, and one of our students won the first prize of $1,000. Three other students in the class won main prizes in this competition and four won honorable mentions.

STUDENTS

M.I.T. has the honor of having established the first United States academic course in architecture, nearly a century ago. As time goes on this experience advantage dwindles. Today all privately supported institutions are being pressed by tax-supported ones that have accumulated impressive momentum and resources.

The continued success—not to say survival—of a school like ours depends on doing a superior job; we cannot afford merely to equal the excellent schools. Next year M.I.T.'s tuition will be $1100, and living expense in Cambridge totals at least as much more. Even with a superior educational environment we cannot have a superior school without getting substantially more than our share of the most

gifted students. Some way must be found for them to get here and stay here, even though the high cost tends to exclude all but sons and daughters of high-income families.

Industry in general is responding well to the need for massive financial support for M.I.T. and other colleges and universities. It is understandable that large corporate benefactors are particularly interested in educational programs likely to provide future leaders in the industries concerned. Architectural and planning graduates do not go to work for corporations of this sort. Neither industry nor government seems to place high priority on the survival of architecture and planning, and consequently architectural schools seldom obtain specific grants for endowment of programs or for student aid in the form of scholarships. Whether the necessary support could come exclusively from within the profession itself is debatable. The situation is particularly difficult in the Department of City and Regional Planning because of the greatly increased competition with other schools, most of which offer research and teaching assistantships to entering students and practically all of which have lower tuition fees. Perhaps we should try to meet this competition by earmarking scholarships for this Department. One of the most successful answers to this problem of student financing is the Technology Loan Fund. More and more this is coming to be regarded as a very orderly process in which the beneficiary in effect promises to help a future student in return for the help given him. Unfortunately many students are obsessed by a desire to avoid long-term debt and therefore do not benefit by this program.

STAFF CHANGES

Changes in our staff include the resignation of Professor Thomas McNulty after seven years with the Institute. Professor Walter Isard resigned on July 1 to accept an appointment in the Department of Economics at the University of Pennsylvania. However, he will come to M.I.T. for two days every other week for the next Fall Term to conduct a graduate seminar in Industrial Location and Regional Development. New instructors were Reginald C. Knight in architectural design and Henry A. Millon in architectural history. Two of our Fulbright students, Bernard Spring and Sanford Greenfield—upon their return from Fulbright studies in Scandinavia and in France, respectively—were invited to be members of the teaching

staff as Instructors in Architectural Design. Lecturers at the School for short periods were Lawrence K. Frank, Buckminster Fuller, Roy C. Jones, Minoru Yamasaki, and Paul Rudolph. Professor Lloyd Rodwin was on leave of absence for four months and served as a Visiting Professor at the University of Puerto Rico. He also served as the representative of the Housing and Planning Section of the United Nations in organizing a conference on "Problems of Planning Education in Latin America," jointly sponsored by the United Nations, the Pan American Union, and the University of Puerto Rico and the Commonwealth Government of Puerto Rico. He was also one of the principal speakers at this conference held in Puerto Rico in March, as were Professor Frederick J. Adams and Dean Pietro Belluschi. Many well-known personalities in the fields of architecture and planning and in related fields visited the School and gave special lectures to our students, among them Lewis Mumford, Ernesto Rogers, Pier Luigi Nerni, and William Zeckendorf.

ACTIVITIES OF THE STAFF

Professor Herbert L. Beckwith was a member of the American Institute of Architects' National Committee on Education and of the National Architectural Accrediting Board. Professor Bush-Brown, with Dean John E. Burchard, is writing the A.I.A. History of American Architecture. Professor Isard has served as Chairman of the Regional Science Association and during the year presented papers at the meetings of the Association of American Geographers, the American Institute of Planners, the American Economic Association, and the Regional Science Association. Professor Burnham Kelly served as Visiting Lecturer at the University of Illinois and the University of Michigan. Professor John T. Howard served as President of the American Institute of Planners. Professor Newman served as Visiting Lecturer on architectural acoustics at Harvard University, Yale University, and Clemson College. Richard W. Hamilton and Professor Marvin E. Goody delivered numerous lectures throughout the year on plastics in building, and a plastics house was designed this past year by Professor Goody under the supervision of Mr. Hamilton. Professor Kepes and Professor Rodwin have both written books published this past year: *The British New Towns Policy* by Lloyd Rodwin, published by the Harvard University Press in March, 1956, and *The New Landscape in Art and*

Science by Gyorgy Kepes, published by Paul Theobald and Co., July, 1956. Dean Belluschi went to Australia in May as a guest of the Australian Institute of Architects at their Convention. On the way back to the United States he visited the Philippines, Formosa, and Japan in connection with his work as advisor to the Secretary of State on foreign embassy buildings. For the second time he won first award for the best article in a professional architectural magazine: "The Meaning of Regionalism in Architecture," published in *Architectural Record*, December, 1955.

PIETRO BELLUSCHI

SCHOOL OF ENGINEERING

I. PROBLEMS OF THE PROFESSION

No basic change has occurred during the year in the professional manpower problem in engineering. The number of men graduating with B.S. degrees in engineering in the United States in 1954 was the lowest since 1949. In 1955 there was a small increase, and there was also a small increase in the number of Master's and Doctor's degrees awarded. There is every reason to expect that this problem will continue to be critical for several years, although the universal awareness of the manpower problem as a whole, which has characterized the last year, may in time have some beneficial effects.

The total student enrollment in the School of Engineering for the year 1955–56 was 3616, representing 64 per cent of the total student population of the Institute. The enrollment of the School has increased by about 10 per cent during the last five years, the increase being about equally divided among the major departments. The numerically smaller Departments of Aeronautical Engineering, Metallurgy, and Naval Architecture have shown, on the whole, a decline in undergraduate enrollment, but there are signs that this trend may now be reversed.

M.I.T.'S RESPONSE TO THE CHANGING TRENDS

The nation's manpower problem clearly involves a continuing need for increased numbers of engineering graduates of all categories, justifying the marshalling of all our resources to this end. There is also a change in the pattern of engineering activity, however, which places increasing demands upon people with advanced training and upon individuals with potentialities of leadership. Like many other institutions, M.I.T. is thus confronted with challenging problems of future policy. Our educational objectives need to be formulated more clearly if we are to make the best contribution to the nation's needs.

M.I.T. is preponderantly a professional institution, and in planning for the future we must give adequate attention to the maintenance and growth of our base of research and graduate education, as well as to the undergraduate program. It is only through a balanced development of all of its resources that M.I.T. can best serve the nation. While the individual departments of the School of Engineering differ in their enrollment tendencies, the School as a whole is characterized by a heavy undergraduate program which could not be expanded appreciably without weakening this base of research and graduate education. This is particularly true in the major departments. When viewed in the light of past history, some degree of expansion of our activity appears inevitable. However, the mode of expansion and the selection of the right emphasis must be the object of conscious planning, and this will occupy an important part of the attention of the School in the coming years.

Among the professions with a basic dependence upon science, engineering is unique in its attempt to find room for a program of professional education in the undergraduate school. The entire structure of the profession and its program of accreditation are based on this fact. This arrangement had its origin at a time when engineering had yet to develop academic traditions and was characteristic particularly of the United States; it is now an important part of our foundation. It has had many important advantages and has undoubtedly served the industrial development of this country by providing a relatively abundant source of engineering manpower. But the system has failed to make a clear distinction between the technician and the professional man. During the many decades when our manpower was supplemented by a steady flow

of trained men from abroad—technicians as well as professional men—this aspect of our educational system perhaps represented an appropriate compromise in relation to the nation's need. There are many indications, however, that a re-appraisal is now in order.

One of the most significant developments in this connection during recent decades has been the rapid growth of graduate education, not only in engineering, but also in the physical sciences. This system has provided us with a small but steadily increasing flow of well-educated professionals in engineering and may well represent the most important contribution of engineering education during these decades. The maintenance and enlargement of this group would appear to be one of M.I.T.'s most important missions in connection with the manpower situation. Many of our most gifted students in engineering now proceed to the Doctorate, maturing professionally through participation in teaching, research, and outside industrial activity.

This expansion of graduate education in engineering could hardly have taken place without the parallel growth of sponsored research in the universities. The fundamental importance of this is clear when it is realized that the preponderant majority (about 95 per cent) of graduate students get some financial aid, either in the form of fellowships, grants, or positions as assistants. These financial implications, however important, have tended to overshadow the deeper significance of this development; the vital truth is that mature research and professional activity are indispensable ingredients of education and professional development in engineering. Not all sponsored research has been conceived broadly enough to play this role in the best manner, but taken as a whole, the sponsored research program of the modern era has aided immeasurably the growth of professional education in engineering.

One of the most important aspects of graduate engineering education concerns the problem of recruitment of staff. On the whole, we have been able to cope successfully with specific issues that have arisen during the year in relation to this problem, but the trends apparent give deep reason for concern. Our ability to keep the outstanding men on our staff in the future depends not only on the possibility of further improvements in staff salaries but also—and perhaps to an even greater degree—on the continued possibility of providing challenging opportunities to our young

staff for creative work, both within and outside of the Institute. A devotion to teaching is one of the prerequisites for success on our faculty, but teaching alone cannot provide sufficient intellectual stimulus for the vigorous professional man.

While many sections of American industry display wisdom and statesmanship in their approach to this problem, the fact remains that we are subjected to steadily increasing pressure from industrial enterprises which hope to entice our best men to their ranks. So far we have been surprisingly successful in meeting this pressure, but as the manpower situation in engineering grows more acute and in the absence of a letup in the inflationary trends of our society, our continued success in this respect seems far from assured. There are reasons for fearing that the competitive self-interest of many of our industries will render them unable to resist the temptation to consume the seed corn, which is represented by our young teachers and graduate students. Our only hope is to become really competitive with industry in the total inducements we can offer the professional teacher on our staff.

In recent years engineering education at the graduate level has been characterized mainly by emphasis on applied science adjusting itself to our academic traditions. To what extent such advanced education should become more professional in nature, with more emphasis on engineering practice than on applied science, has been much debated during the year. The various fields in engineering show marked differences in this respect, electrical engineering and metallurgy leading in their close association with the physical sciences.

In the meantime, a liberalization of the undergraduate curriculum has occurred, even in engineering. This process has taken place to a varying degree in many engineering institutions. It involves a strengthening of the fields of science, the humanities, and the social sciences, accompanied by a corresponding reduction in the content of specialized fields of technology. It has found expression in the Report on Evaluation of Engineering Education issued in 1955 by the American Society of Engineering Education and in the report entitled, "General Education in Engineering," issued in 1956 by the same society.

It is certain that these tendencies will continue to influence the underlying philosophy of engineering education, and it is clear that

they will have a profound effect on the type of conscious planning which can be made within an entity like the School of Engineering at M.I.T. These problems have indeed precipitated within the School a searching review of its aims, as well as an attempt to forecast future developments. Our efforts represent the first steps toward shaping the School into an organic entity, wherein a climate of opinion is emerging for discussing and developing the answers to many urgent problems pressed upon us by these trends. Until recent years the Institute as a whole, with its entire Faculty, provided such a forum. As the objectives of the various schools become more diverse, the problems peculiar to engineering must increasingly find their treatment within the School itself. These discussions will continue in the fall, and there is clearly under way a deeper assessment of engineering education at M.I.T.

By what precepts are we to develop the slowly emerging concept of advanced professional education in engineering which is being formed in the Graduate School? How can the engineering subjects of the undergraduate school be enriched to serve, along with science and the humanities, as a leaven of a general education appropriate to the development of the leaders of the future? Where are the proper boundaries in engineering education between applied science related to technology and contemporary practice? How can we strengthen the creative resourcefulness and imagination which are indispensable to the vigorous industrial activity of our country? How can we strengthen our competitive position in the recruitment of outstanding men for our staff in the face of increasingly insistent competition from industry? These and a host of other problems are being attacked by the staff of the School, and the coming years are certain to yield significant developments.

II. THE YEAR IN ENGINEERING

The School of Engineering is made up of a series of strongly cohesive departments, each forming an organic entity with a relatively long history and with traditions partaking to some degree of those of the field of engineering which it serves. This is a matter of strength and a source of pride, and as indicated above, new developments are under way for the handling of issues of broader scope. In the meantime, the individual departments continue to show remarkable initiative in their respective fields. They are all searching for a more effective interpretation of their educational mission, but the means employed show a wide variety.

Several major decisions affecting the structure of the School have been made during the year.

Meteorology is but one of the several sciences dealing with our physical environment. Many major problems of the peaceful world, such as adequate supplies of fresh water and of food, depend for their solution on many interrelated aspects of the physical environment. We hope to develop here at M.I.T. a closer integration of all the earth sciences. The Departments of Meteorology and of Geology and Geophysics will form the nucleus, and co-operation is anticipated from neighboring institutions in such areas as oceanography. To facilitate the administrative aspects of such co-operation and in recognition of the increased emphasis on theoretical studies, the Department of Meteorology, under Professor Henry G. Houghton, was transferred from the School of Engineering to the School of Science as of July 1, 1956. The report of this Department, therefore, appears for the last time under the School of Engineering.

Following the appointment of Professor John T. Rule as Dean of Students, the Section of Graphics, hitherto an independent service unit attached to the School of Engineering, has been transferred to the Department of Mechanical Engineering and has become the Graphics Division under the supervision of Professor James B. Reswick. The activities related to freehand sketching and graphic arts have been taken over by the School of Architecture. While no major change of emphasis in the program of Drawing or Descriptive Geometry is contemplated for the immediate future, the role of this

component of engineering education will be carefully reviewed. Professor Rule leaves the Section of Graphics after seventeen years as its head, in which capacity he has contributed very effectively to the maintenance of the intellectual content of this discipline.

The students now enrolled in the Courses in General Science (IX-A) and General Engineering (IX-B) will be encouraged to complete their present programs, but no new registration in these courses will be accepted beginning with the Fall Term of 1956. With the broadening of the undergraduate curriculum at the Institute, the activities and objectives of these programs will be transferred to the respective departments of the Schools of Engineering and Science. Some of these objectives will undoubtedly be fulfilled by the new Course XXI. Through the Undergraduate Policy Committee, the Faculty will be asked to consider the authorization of an undergraduate degree without specification. We are aware that such programs will generally fall outside of the present system of accreditation of the Engineers' Council for Professional Development.

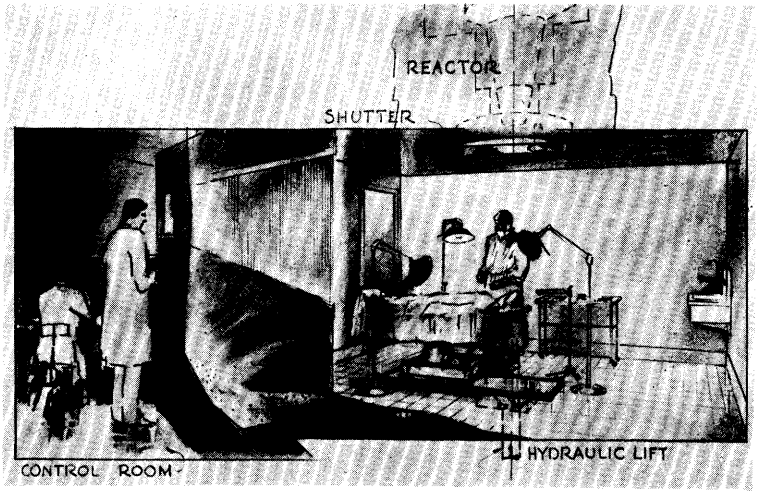
FACILITIES

Improvement of facilities in the School of Engineering continued during the year, though adequate housing of much of our research still continues to be a problem. The Dynamic Analysis and Control Laboratory and a large section of the activities of the Insulation Research Laboratory are still housed in temporary quarters in Building 20. With the completion of the Compton Laboratories, a segment of the Research Laboratory of Electronics will be adequately housed, but much work must be continued in Building 20. The Department of Electrical Engineering is in need of additional office space for its expanded staff and larger facilities for meeting and communicating with its large body of staff and students.

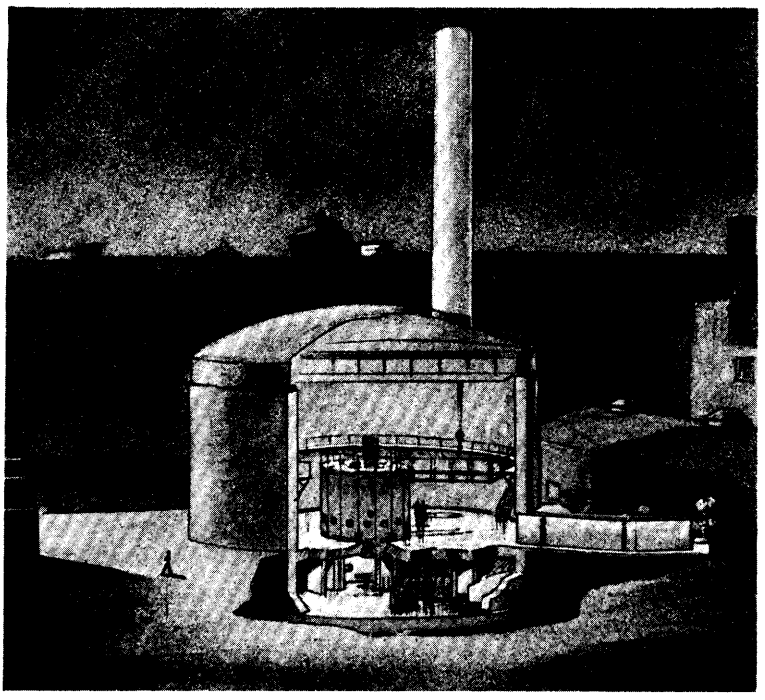
NUCLEAR REACTOR

The most significant addition to our facilities was the start of the construction of a nuclear reactor to serve the activities in nuclear engineering in the Chemical Engineering Department.

M.I.T.'s two principal purposes in building the reactor are to advance the Institute's program of graduate education in nuclear engineering and to make possible a varied program of research in



M.I.T.'s nuclear reactor, with extensive facilities for research in many technological fields, will be completed early in 1958. Typical of its unusual facilities will be the medical treatment room (in the small drawing) made possible by a grant of the Rockefeller Foundation.



this field. In order that the reactor might fulfill its high promise as a research and teaching tool, it was necessary to choose a site close to the campus and to the medical and industrial center of metropolitan Boston. Studies which have been under way since the spring of 1954 have indicated that a heavy-water moderated reactor, using enriched U-235 as fuel, would provide the best combination of the attributes of safety and usefulness for the Institute's needs. The reactor now being built will be similar in principle to that developed at the Argonne National Laboratory, which has been in operation for a number of years. It will operate at a power of 1,000 kilowatts but will not be of the power-plant type. At the design power level of 1,000 kilowatts, the reactor is expected to develop a maximum flux of about 1.5×10^{13} thermal neutrons per square centimeter per second.

With this relatively high flux, the large number of experimental openings, and the versatility provided by the number of alternative positions in which the irradiations may be carried out, the reactor will provide facilities without equal for the type of research programs which can be undertaken at a university. The usefulness of such a reactor has already been confirmed by the degree of interest the design has aroused in companies who have seen the plans and among the foreign representatives who have visited the Institute.

The total cost of constructing the reactor and the building to house it is estimated at about $2,400,000. More than half of this sum has been generously contributed by alumni and corporate friends of M.I.T. in connection with the memorial laboratories honoring Dr. Karl Taylor Compton. Financing of the reactor has also been assisted by welcome grants of $250,000 from the Rockefeller Foundation to defray the cost of the medical therapy facility, and $500,000 from the National Science Foundation.

Ground was broken for the reactor building on June 6, 1956, with final design and construction being undertaken by A. C. F. Industries, Inc. It is expected that the facility will be in operation in September, 1957.

Professor Manson Benedict of the Department of Chemical Engineering is in charge of the entire nuclear engineering program. Dr. Theos J. Thompson, who directed the construction of a research reactor at Los Alamos for the Atomic Energy Commission before coming to M.I.T. as Associate Professor of Nuclear Engineering,

is in charge of the reactor construction and design. He is assisted in this work by Thomas Cantwell, Research Associate. Operation of the reactor will be the responsibility of the Nuclear Engineering staff of the Chemical Engineering Department, with a reactor supervisor in charge of normal operation. A full-time radiological safety officer will be employed, reporting to Dr. Harriet L. Hardy of the Institute's Occupational Medical Service.

PERSONNEL

Several significant honors have been awarded to staff members of the School of Engineering during the year. Professor Raymond L. Bisplinghoff of the Department of Aeronautical Engineering delivered the Nineteenth Wright Brothers Lecture before the Institute of the Aeronautical Sciences. Professor Charles S. Draper was awarded the Navy Distinguished Public Service Award for the development of a long-range navigation system. Professor John R. Markham and Professor C. Richard Soderberg received the Exceptional Service Award of the United States Air Force, the former for his many outstanding contributions to the field of aeronautics, and the latter for his service to the Air Force in the development of jet propulsion.

Professor H. Guyford Stever completed his service as Chief Scientist of the United States Air Force and returns to duty at the Institute in September as Associate Dean of the School of Engineering. Professor Stever plans to divide his time between his new position and activities in the Department of Aeronautical Engineering.

Professor Manson Benedict of the Department of Chemical Engineering was elected to the National Academy of Sciences, being the ninth member of the School of Engineering so honored and the third member of his Department. Professor Walter G. Whitman returned in January, 1956, after having served with distinction as Secretary-General of the International Conference on the Peaceful Uses of Atomic Energy, held under United Nations auspices in Geneva during the summer of 1955; he is currently President of the American Institute of Chemical Engineers. A paper by Professor Antoine Gaudin of the Department of Metallurgy presented at the Geneva Conference and two others presented jointly with Reinhardt Schuhmann, John Dasher, and Robert Macdonald at the annual meeting of the American Institute of Metallurgical

Engineers in February, 1956, constitute the first full disclosure of principles and details of technology in the hitherto secret field of uranium extraction. The information covers the work done at M.I.T. since 1943 and that done elsewhere by development of processes initiated here. A $1 billion-a-year industry now uses these developments. Professor Herbert H. Uhlig served as President of the Electrochemical Society and Professor Richard H. Bolt of the International Commission on Acoustics during the year.

The School of Engineering has this year actively continued its program of staff exchanges and visiting professorships. (Some of these activities are reported under the respective departments below.)

Dr. William R. Hawthorne, Hopkinson and Imperial Chemical Industries Professor of Applied Thermodynamics at Cambridge University, England, has served with distinction as the first Jerome Clarke Hunsaker Professor of Aeronautical Engineering, contributing inspiration and leadership for seminars and courses in the fields of fluid mechanics, thermodynamics, and aircraft propulsion. While here he also cooperated with the Department of Meteorology in a series of seminars on hurricanes. Dr. Hawthorne presented the first Minta Martin Lecture, "The Aerodynamics of Aircraft Engines," which was well received at M.I.T., the University of Maryland, the California Institute of Technology, and the Case Institute of Technology.

I. Edward Garrick, Head of the Dynamic Loads Division of the Langley Aeronautical Laboratory of the National Advisory Committee for Aeronautics, has accepted the Hunsaker Professorship for the 1956–57 academic year. Mr. Garrick has a long record of outstanding achievement in aerodynamics and aircraft structures and will lead advanced research and seminars in the aerodynamic and structural problems associated with modern aircraft.

Dr. George Wesley Dunlap, Manager of the Instrument and Nuclear Radiation Engineering Department at the General Electric Company, served as Visiting Webster Professor of Electrical Engineering for the academic year. Dr. Claude Elwood Shannon, Research Mathematician of the Bell Telephone Laboratories, joined the staff in January as Visiting Professor of Electrical Communications and will remain until January, 1957. Dr. Shannon was elected a member of the National Academy of Sciences and

a Fellow of the Institute of Radio Engineers. Both men have made important contributions to the Department, not only in their specialties but also through their wise counsel on broad issues of education.

Dr. Knox Millsaps of the Air Force Research and Development Command was Visiting Professor of Applied Mechanics in the Department of Mechanical Engineering and made valuable contributions to the teaching and research program of that Department. Professor Ascher H. Shapiro is returning in the fall after a year at Cambridge University where he took over the duties of Professor Hawthorne. Professor Chihiro Hayashi of the University of Kyoto, Japan, spent the year as Guest of the Department of Mechanical Engineering, giving an advanced course in non-linear vibrations. Professor John A. Hrones was on leave of absence during the Spring Term, traveling through Europe. There were other exchanges of junior staff members, and more are planned for next year.

Many of the School's Faculty served on professional committees, as guest lecturers, and as advisers to government and industry; these assignments, many of them substantial honors to our staff, are too numerous to be listed here.

AERONAUTICAL ENGINEERING

In aeronautical engineering the emphasis is upon a close association of staff and students with a large and varied program of research and development, sponsored mainly by the armed forces. The leaders of the Department take an active part in the nation's aeronautical developments, creating an environment of combined engineering and science which is a source of inspiration to the students. The undergraduate enrollment is relatively small; the graduate enrollment is increasing, and the Department performs an important mission of education in aircraft specialties for officers of the United States Air Force.

By encouraging research in all the fundamental fields of aeronautics, we achieve cross-fertilization of knowledge among various groups and individuals. This process provides a well-integrated and creative environment of combined science and engineering that in turn provides inspiration for students. For example, sponsored research by the Fluid Dynamics Research Group and the Naval Supersonic Facility has resulted in reports describing advanced

work in aerodynamics. The material of these reports has been used for publications, then as subject matter for graduate courses, and finally as a regular part of undergraduate teaching. A very important result of this pattern of operation is that the curriculum is kept alive and up to date and is well presented by enthusiastic instructors.

Seven sections within the Department carry on sponsored research activities: the Fluid Dynamics Research Group, the Aeroelastic and Structures Research Laboratory, the Wright Brothers Wind Tunnel Facility, the Naval Supersonic Laboratory, the Aerophysics Research Laboratory, the Gas Turbine Laboratory (supervised by Professor E. S. Taylor but actually in the Mechanical Engineering Department), and the Instrumentation Laboratory. During the 1955–56 academic year these activities provided significant educational experiences and employment for thirty full-time research assistants, seventy-eight part-time students, and thirty-seven cooperative students from Northeastern University. Of these, seventeen full-time research assistants and five half-time assistants were drawn from the Department's graduate students. Thus sponsored research in the Department provided a source of financial aid to over 50 per cent of its graduate students and from the standpoint of thesis assistance gave more or less direct help to substantially all the men who received advanced degrees.

During the past year three books were published by members of the Department. In addition, work done in the Department led to forty-nine publications in technical journals and 121 limited-distribution reports, the majority of which were classified.

The Cooperative Course in Aeronautical Engineering has continued to provide an excellent opportunity for students to gain experience in the industrial applications of science and engineering. The men in the program are enthusiastic about the cooperative work, and the percentage of the sophomore class electing this course shows very little change from the corresponding figure for last year—about 30 per cent. Aircraft companies continue to show a lively interest in the Cooperative Course men and would gladly accept twice the number of students if they were available. During the past year the Douglas Aircraft Company of Santa Monica, California, and the Sandia Corporation of Albuquerque, New Mexico, have joined the cooperating companies, which already

included Lockheed Aircraft Corporation, North American Aviation, Inc., Northrop Aircraft, Inc., and Republic Aviation Corporation.

The subjects given in the Aeronautical Engineering Department are always in a state of flux in the sense that they are continuously subject to revisions in order to keep them abreast of aeronautical science, rapidly pushing into regions that require considerable extension of scientific knowledge without permitting the abandonment of any already familiar principles. Essential knowledge is now being generated so rapidly that new material must be integrated into regular subjects long before it is covered in textbooks or even authoritative articles. This process can be effective only if the teachers themselves are working on, or are intimately associated with, research encompassing the most recent advances within the field.

The goal of the Department, as far as the undergraduate curriculum is concerned, is to provide education deep enough in science and broad enough in practical applications for graduates to develop either in the direction of engineering or in the direction of research. The responsibilities of an aeronautical engineer today demand a scientific background which includes the knowledge necessary to provide a fundamental understanding of four basic areas: aerodynamics, structures, propulsion, and control. These areas involve differing admixtures of such basic sciences as fluid mechanics, thermodynamics, statics, rigid body and non-rigid body mechanics, metallurgy, and the chemistry of combustion—all of which require the use of applied mathematics. In addition to basic understanding, students are required to achieve an ability for integrating into a well-balanced flying vehicle the physical components needed to meet the requirements of these four functions. Bachelor's degree men should have a clear understanding of the meaning of their responsibilities and have the scientific knowledge and technical skill necessary to fulfill their accepted obligations. Supplementing the undergraduate program, graduate work in aeronautical engineering provides advanced education for men wishing to broaden and deepen their knowledge of the field. The curriculum in this connection is strongly dependent on information currently being generated by research and on the availability of research facilities for creative thesis work.

Student activities outside the classroom form an essential part

of the education of aeronautical engineering students, and Faculty advisers are active in drawing students into closer contact with their teachers. Professor Holt Ashley is adviser for Sigma Gamma Tau and for the Honors Group. The individual meetings of these two groups provide a very effective means of communication.

During the past year the student chapter of the Institute of the Aeronautical Sciences, with Professor James W. Mar as adviser, has been more active than ever. Its 100 members represented almost a 300 per cent increase over the previous year. Meetings were held monthly; at two of these, engineers from Boeing and Lockheed presented interesting discussions of current aeronautical problems. Faculty members of the Department who had spent a portion of their summer at aircraft companies spoke on their experiences. A highlight of the year's activities was an all-day trip to the Sikorsky Aircraft Division of the United Aircraft Corporation. About thirty-five members enjoyed a well-planned tour of the company's facilities. The group was also represented at the Northeastern Conference of student chapters, where five M.I.T. papers were presented.

Professor Bisplinghoff acted as adviser for the Aeronautical Engineering Society, which has a long history of strong activity in building and using gliders and in flying private airplanes. Professor Elmer E. Larrabee performed a similar function for the Model Aircrafters. During the past year both the Society and the Model Aircrafters lost working space on the campus and for this reason were severely handicapped in retaining enthusiasm among the students. We hope that in the future facilities can be provided to stimulate a return of interest in these worth-while activities.

CHEMICAL ENGINEERING

The Department of Chemical Engineering, one of the oldest and most distinguished in its field, gains strength through its intimate association with major industrial enterprises. Although the emphasis on graduate education and research is strong, the Department presents a balanced picture of undergraduate and graduate enrollment. The emphasis on sponsored research, particularly for the government, is moderate, the major support coming from industry. Graduate study is supported to a large degree by fellowships and grants. The School of Chemical Engineering Practice is an important part of the tradition in that field.

The undergraduate phase of the year's activity was stimulated by an unusually large and capable senior class, notable both for scholastic interest and for leadership in student affairs. While there is a certain fortuitousness about the quality of any specific class, we sense that the changing pattern of undergraduate life and curriculum at M.I.T. and greater selectivity in admissions may be showing their effect in the caliber of chemical engineering seniors.

The introduction into the sophomore year of two professional subjects which had previously been given to juniors—one in each term—was a distinct innovation. This was effected by transferring Applied Mechanics from the second to the third year. We feel that professional attitudes and interest have been helped by this move and were pleasantly surprised to find that the sophomores were prepared to handle the work.

Graduate school enrollment reached an all-time high, primarily because of the rapid growth in nuclear engineering. Interest in this field is intense, and the expanding program now attracts students from various undergraduate disciplines who wish to pursue their graduate specialization in areas of nuclear technology. The addition of Professor Melville Clark brought added competence in reactor physics to the teaching staff under Professor Benedict. The important development of a nuclear reactor has already been mentioned elsewhere in this report.

The schedules for operation of the Chemical Engineering Practice School and the Engineering Practice School at Oak Ridge were modified this year in a move to free the students' time for summer employment. The beneficial effects of this and other minor adjustments are already evident, and it appears that a marked expansion of Practice School activity lies just ahead.

The Department's research program is directed primarily toward the development of promising young men who are pursuing work for the doctorate. Its opportunities to support these men in their thesis research come from several sources. More than one-third hold fellowships supplied by industrial concerns, with little or no restrictions on the subject of the thesis. About one-third are supported by contract funds, either from government or industry, which allow considerable freedom in the selection of topic and the method of pursuing it. National Science Foundation fellowships care for an increasing number of men. The varied nature of financial support

provides a healthy degree of stability and of flexibility. Efforts will be made next year to develop similar support for thesis research in the area of nuclear engineering.

The industrial use of beds of fluidized solids as heterogeneous chemical reactors has grown rapidly in recent years. An extensive research program is being carried out to determine the characteristics of such units as chemical reactors in comparison with the older fixed bed type. The results indicate that there is a rapid mixing of the fluidized solids throughout the bed, resulting in a very uniform temperature, but that the mixing of the fluidizing vapor is slow. The vapor passes through the solid both by flowing in the interstices between the solid particles and as "bubbles," regions of low solid concentrations. The "bubbles" pass rapidly through the bed and account for most of the gas flow in normal operation. While there is some solid in the "bubbles," in most cases it is not sufficient to carry out the desired vapor-solid reaction, and transfer between the "bubbles" and the surrounding solid is necessary for effective operation. The results indicate that, depending upon the rapidity of the chemical reaction at the solid surface, the limiting rate factor can be the rate of vapor transfer in and out of the "bubbles," the rate of the chemical reaction at the solid surface, or a combination of the two. Based on these concepts idealized models of the action of a fluidized bed have been developed which explain and correlate many of the observed results. Present work is emphasizing the rate of transfer of the vapor between the "bubbles" and the dense fluidized solid surrounding it.

The Fuels Research Laboratory of the Department has support from three contracts in the field of high-output combustion. Research projects include model studies of ramjet combustion, the quenching of extreme-temperature combustion products to determine enthalpy, the effect of gas recirculation on combustion progress, the effect of pressure on the gaseous radiation from combustion products, and the reaction kinetics of a well-stirred reactor. In the last of these fields, involving the study of a spherical combustion chamber with central feed, differences in combustion rate have been found between two stoichiometrically and thermally identical but chemically different fuels, indicating that chemical rate is significant in limiting the process. However, other experiments indicate that mixing resistance has not been completely eliminated

even with the violent mixing accomplished by sonic feed through eighty separate holes. The order of the reaction has been found to lie much nearer one than two.

The staff has participated actively in professional and public affairs. Professor Glenn L. Williams was in charge of the International Combustion Symposium held at Yale University during the summer of 1956. In the course of the preparations he has been abroad for planning sessions with European colleagues and has arranged for participation in the Symposium by Russian scientists. Mr. Thomas Mix, who will direct the Oak Ridge Practice School next year, received the Karl Taylor Compton Prize awarded to a graduate student for service to the M.I.T. community.

On February 10, 1956, Dr. Ernst A. Hauser, Professor of Chemical Engineering and an internationally known authority on colloid science, died suddenly. Dr. Hauser was non-resident Associate Professor of Colloid Chemistry at M.I.T. from 1928 to 1931 and became resident Associate Professor of Chemical Engineering in 1935. He was promoted to full professor in 1948. During his years on the staff he contributed much to the activities of the Chemical Engineering Department and also to the Quartermaster Corps during World War II.

CIVIL AND SANITARY ENGINEERING

The Department of Civil and Sanitary Engineering in the present epoch is noted for its effort to advance professional aspects of engineering education, particularly through early indoctrination of young students in civil engineering problems. The balance between undergraduate and graduate enrollment is reasonably satisfactory and the participation in sponsored research moderate but varied.

During the year a pilot second-year subject, Civil Engineering Projects, was offered as a step toward investigating the feasibility of the vertical system of engineering education. Three major planning projects, each sub-divided into a series of shorter problems, were developed by the students in this subject. Each assignment aimed to place the student in a position where his technical knowledge and analytical ability, while indispensable, were nevertheless an insufficient base for the total solution to the situation and therefore required the support of imagination and judgment. In this manner an effort was made to stimulate what might be thought of as a balanced mental development of the students in which imagination

and judgment are placed on a comparable level with the more exact processes of thought. The first year's experience with this approach to engineering education was distinctly encouraging, and a continuation—with certain modifications—is contemplated with enthusiasm for next year.

The Department has maintained its high level of research during the year. The Division of Building Engineering and Construction, together with the Department of Architecture, is designing and constructing a plastics "House of Tomorrow" under the sponsorship of the Monsanto Chemical Company. Structural shape and architectural design have gone hand in hand, and a great deal of pioneering in structural design has been made necessary by the relatively new and untried structural properties of the materials.

The replacement of soaps by synthetic detergents has led to a solution of housewives' problems in hard-water areas but has given rise to several problems in the fields of water and sewage treatment and stream pollution control. Research is being carried out in the Sedgwick Laboratories of Sanitary Science on the effects of these detergents on the unit operations of treatment processes and the natural purification of streams. Biochemical unit operations have been shown to be most seriously influenced in terms of foaming and inability to destroy the detergents. The reason lies in the differences in molecular configurations of soaps made from fatty acids and the alkyl-benzene-sulphonate detergents. Extensive research has shown that acclimation of organisms to some detergents can provide adaptive enzymes to fit the specific molecular configurations and thus accelerate the oxidation process. Molecular engineering is the key to this research which may lead to the development of new or different detergent materials for the soap industry. The primary specifications for these new products will be a molecular configuration which will fit the enzyme patterns of microorganisms available to the sanitary engineer in the design and operation of biochemical unit operation in waste treatment processes.

The Structures Division, in cooperation with the Orthopedic Service of the Massachusetts General Hospital, has been studying engineering factors involved in lower-back pain, a major cause of which is believed to be the development of a lumbar disc lesion or a failure of the disc between two vertebrae of a spine. The primary effort has been to establish certain mechanical strength character-

istics of typical lumbar discs by themselves and in combination with the adjacent vertebra, by purely mechanical tests performed on a section removed at autopsy from recently deceased persons as well as on specimens from both normally healthy individuals and those showing various stages of degeneration of the lumbar discs. Medical portions of the project have been under the supervision of Dr. Joseph Barr of the Massachusetts General Hospital.

In December the Department suffered a major loss in the death of Professor Donald Wood Taylor, who had been head of the Soil Mechanics Division since 1938. His high character and scholarly attainments had won him undeniable recognition in the field of soil mechanics, where he stood among the leaders of the country.

ELECTRICAL ENGINEERING

Electrical Engineering is the largest department of the School and has an ever-increasing enrollment in both undergraduate and graduate activities. The Department continued with the development of its new curriculum, and this June it graduated the second class that had studied under the revised program. In spite of the widespread, even international, enthusiasm for the character of the new course content, the Faculty intends to review continually the organization of the various subjects and to increase its skill in the presentation of the new material. Members of the Faculty have reported fully and freely on the results of this academic program in professional journals and in panel discussions before professional societies during the past year.

With the leveling off of the effort devoted to revising the core curriculum, the Department set out to develop numerous senior elective and graduate subjects to be offered in the academic year 1956–57. The planning of these new advanced subjects was conducted by an *ad hoc* committee under the direction of Professor Peter Elias. The development of the subjects of instruction offered to non-electrical students has continued under the direction of Professor Thomas F. Jones.

Student interest in electrical engineering continues at a high level, with the number of sophomores and freshmen approaching 25 per cent of each class at the Institute. Expansion of the teaching laboratory facilities and the training of junior staff to make possible first-rate instruction to the 200 that this registration entails has been aggressively pursued. The total load on the Department

continues to be heavy.

The Cooperative Course (VI-A) graduated its one-thousandth student in September, 1955. With the admission of the International Business Machines Corporation to the program, the number of cooperating companies has been increased to ten.

During the past year, members of the Faculty published three books, edited a special issue of the *Transactions* of the Institute of Radio Engineers, and published approximately one hundred manuscripts in technical journals together with some twenty limited-distribution unclassified reports. During the summer of 1955, the Department offered five special summer conferences. Five students from the Department were awarded Fulbright Fellowships for the academic year 1956–57.

Graduate student and Faculty research maintained its vigorous tempo. The jealously nurtured partnership relation that exists between Faculty and graduate students in advancing the frontiers of knowledge through teaching and research continues to be a significant factor in attracting top-flight students and junior staff to the Department. Sponsored research projects undertaken by the Department supported wholly or in part the education of some 200 students. The close interaction between sponsored research and advancement of the educational program is noteworthy and is exemplified by the situation in the new area of control and conversion of energy. Five years ago, research in the then-known power field was substantially non-existent, whereas current research in the area of aircraft electrical systems sponsored by the Air Force and directed by Professors David C. White and Alexander Kusko has led to the completion this year of three doctorate theses, two master's theses, several bachelor's theses, and the presentation of three professional papers before the American Institute of Electrical Engineers. The environment and enthusiastic tempo of creativity resulting from this research were reflected in the achievements of of Professor White and his group in the development of a senior core subject, Electric Power Modulators. Even though this new and somewhat revolutionary material was offered to undergraduates for only the second time, a new generalized machine has been developed as a laboratory tool for the purpose of teaching the unified and more general concepts of rotating electrical machine evolution and operation. The work has been discussed

with numerous educators, and the new approach to the machinery plus the new laboratory equipment has generated considerable interest in other universities. Staff and graduate student interest and activity in this area is continuing to expand, and additional research work is being instigated in the area of electrical energy conversion techniques for vehicles flying at high altitude with high Mach number. A basic long-term research program seeking revolutionary new electrical systems is also being explored.

Our education and research program in the field of switching circuits, under the leadership of Professor Samuel H. Caldwell, received new vigor through a grant from the Westinghouse Electric Corporation. This grant provides support for additional laboratory assistance and for the acquisition of modern switching components and measurement equipment. These improved facilities are enabling us to provide more challenging experimental problems for students of switching theory and to support thesis research in areas important to high-speed computation and automatic control. The Franklin Institute awarded the Levy Medal in October, 1955, to Dr. David A. Huffman for a paper based on his doctorate research in this field.

The High Voltage Research Laboratory, under the direction of Professor John G. Trump, has continued its investigations of the properties of high-energy electrons and X-rays and their application to medicine. These applications include, in cooperation with the Lahey Clinic of Boston, the two-million-volt deep-tumor X-ray therapy and the direct treatment of superficial malignant lesions with high-energy electrons. In cooperation with several other medical groups, further progress has been made on the sterilization of a human tissue obtained at autopsy for banking and subsequent surgical use; several hundred sections of aorta, femoral arteries, and other structures are now being electron-sterilized for more than a score of hospitals. Progress has been made on the inactivation of the hepatitis virus which occasionally constitutes a serious medical problem in pooled blood plasma.

The basic physical studies in the High Voltage Research Laboratory have emphasized: (a) the production of beams of high energy positive and negative ions for use in accelerators for nuclear physics; (b) the basic electrical processes which affect the voltage-insulating properties of high vacuum; and (c) new techniques for

producing high vacuum in accelerating systems. Dr. Lars Beckman of the Royal Institute of Technology at Stockholm, Sweden, has been guest scientist in the laboratory during the year.

The Laboratory for Insulation Research, under the direction of Professor Arthur R. von Hippel, assumes more and more the role of another strong interdepartmental link between science and engineering in the important area of materials research. Its broad approach to synthesizing materials of prescribed physical or electrical properties, and to controlling phenomena by an understanding of their molecular causes has found wide recognition. A new senior elective subject, Molecular Engineering, has been offered; the course was also given as a Special Summer Program in August, 1956. An interdepartmental graduate subject, Insulators, Semiconductors and Metals, is already well established.

Under the joint direction of Professors J. F. Reintjes and George C. Newton, Jr., the research program of the Servomechanisms Laboratory underwent major changes. Several major projects were brought to a successful conclusion. The analogue computer which has been under development for Lincoln Laboratory for the past three years has been completed, and field tests showed highly satisfactory performance. Automatic control of machine tools by numerical means, a technique pioneered in the Laboratory, is now being widely adopted by industry, and during the year members of the numerical-control group terminated their association with the Laboratory in order to set up a private facility for manufacturing numerically controlled director systems. With the termination of these activities, the Laboratory is intensifying its efforts in other areas of computation, data-processing, and instrumentation. A study of the aerodynamic equations of modern aircraft with a view toward optimizing the design of computer systems used in operational flight trainers is currently under the direction of Professor Newton. The analogue-digital instrumentation program initiated two years ago is attracting the attention of industrial groups working in the area of data processing. A one-week Special Summer Program in Analogue-Digital Conversion Techniques was organized by Professor Alfred K. Susskind in response to the many requests for information concerning these techniques. Research in the utilization of general-purpose digital computers for the reduction of data secured from digital instrumentation systems continues, with

emphasis upon methods of improving communication between the human operator and the computer. Computer-component research in the areas of magnetics and servos is going forward under the guidance of Messrs. Paul Johannessen and James F. Kaiser. A program of research directed toward employment of modern materials and devices in electromagnetic-radiation detection systems is under the direction of Professor Reintjes.

In recognition of its outstanding scientific and educational contributions in the field of automatic control, the Servomechanisms Laboratory was cited by the Associated Industries of Massachusetts at its Fortieth Anniversary Meeting in October, 1955, and was awarded an appropriate plaque.

The National Geographic Society has given Professor Harold E. Edgerton's Stroboscopic Laboratory the funds to build electronic flash cameras and associated equipment to attempt to photograph the deepest known spot in the ocean. This effort is contemplated for the fall of 1957, at the Challenger Depth near Guam. The prototype camera and sonar equipments were scheduled for trial in the Atlantic near Libreville, Africa, during the summer of 1956, at a depth of about 20,000 feet. Captain Jacques-Yves Cousteau of the French scientific vessel "Calypso" collaborates closely with Dr. Edgerton in this work.

The Analytical Engineering Group of junior staff and graduate students supervised by Professor William K. Linvill has continued research on dynamic transportation and allocation problems under the sponsorship of a grant-in-aid from the Union Carbide and Carbon Corporation. The problem of determining the optimum production, warehousing, and shipping schedule to supply a seasonal demand of product at minimum cost has been solved. A computer program for the Whirlwind I Computer has been set up which uses the transportation method of linear programming to provide an efficient means of solution. Theoretical research is continuing with the investigation of a class of multistage allocation problems. In addition to the work sponsored by Union Carbide and Carbon, the group continued with its researches on various systems analyses problems on behalf of Project Lincoln and the Office of Naval Research in collaboration with the work of Professor Philip M. Morse of the Department of Physics. The components research group under Lincoln sponsorship has in process an investigation

of thin film phenomena as elements in high-speed computing machines.

The Department sponsors the Research Laboratory of Electronics jointly with the Department of Physics, and the Acoustics Laboratory jointly with the Departments of Physics and Architecture. Reports by the Directors of both of these laboratories—Dr. Jerome B. Wiesner and Dr. Richard H. Bolt, respectively, both Professors of Electrical Engineering—are submitted separately. Approximately 30 to 40 per cent of the research energies of the Faculty and graduate students of the Department support these two interdepartmental activities.

Professor Richard D. Fay, for twenty-eight years a member of the Institute's research staff and Faculty and a specialist in acoustics, retired on June 30 of this year. He will continue to lecture in the Department of Electrical Engineering as professor emeritus.

MECHANICAL ENGINEERING

Mechanical Engineering, the second largest department of the School, operates in a professional field of enormous extent, catering to almost all branches of industry. The Department has achieved a good balance of research and education, enabling it to maintain an unusually large junior staff with a rapid turnover. In this manner it is performing a unique task of professional education.

During the calendar year 1955 the Department staff presented seventy-two papers before professional societies and in professional journals, in addition to technical reports in unpublished form. Honors that came to them include the George Westinghouse Award of the American Society for Engineering Education to Professor Milton C. Shaw; an American Society of Mechanical Engineers award to Professors James B. Reswick and Thomas P. Goodman for their paper on the Determination of System Characteristics from Normal Operating Records; and a Northwestern University Merit Award to Professor Warren M. Rohsenow, an alumnus of that institution.

During the year the Department lost three members of the staff by death or retirement. Mr. Robert B. Cheney, who died suddenly in August, 1955, had been with us as an instructor and later technical instructor since 1939, completing thirty-six years of service.

Messrs. Dean A. Fales and Mayo D. Hersey had been on our staff for many years, lately as research associates in the fields of

automotive engineering and lubrication, respectively. Both, having reached the age of sixty-five, retired from the Institute on July 1, 1956, but are continuing their professional activities elsewhere.

The Department awarded substantially the same number of degrees (including graduate degrees) this year as last year, but the senior class this year was much larger than last year's group. This, however, does not represent a trend; next year's senior graduating class will be smaller again. The number of graduate students registered on October 1, 1955, was 166 as compared to 119 the year before. This is believed to represent a trend; our graduate class seems to be increasing from year to year.

A new subject, Automation (2.782), was offered to seniors for the first time. Another new subject by Professor S. Y. Lee covers Instruments for Control Engineering.

During the summer of 1956 the Department offered nine Special Summer Programs (out of a total of thirty-eight for the entire Institute), thus making, as in previous years, a materially greater contribution to this activity than that of any other Department. The Programs deal with special subjects on a mature plane; they usually are of two weeks' duration and are intended for an audience of practicing engineers in the age group from twenty-five to fifty. The subjects this year covered aspects of strain gages, vibration and shock, wear, heat transfer, product design, control engineering, and textile technology. With registration for these subjects often exceeding 100, the Department's staff reached an audience of some 800 professional people. Such contacts enhance the prestige of the Institute and provide a source of stimulation for the staff itself.

With one exception, noted above, the material facilities for teaching are in good shape. The modernization of the Steam Laboratory, proceeding on a five-year plan, continues satisfactorily. The basement of the Laboratory has been completely rebuilt and is now operating in its new form, giving opportunity for thesis investigation to a large number of teams of students, graduate as well as undergraduate, but principally the latter. The main floor is as yet unfinished but is scheduled for modernization in the coming year.

For the past several years the Dynamic Analysis and Control Laboratory under Professor John A. Hrones has been conducting a program of research and development in the field of gas-operated missile control systems, with the aim of replacing the presently used

hydraulic systems by simpler and more reliable gas-operated systems. In the early stages of the program, studies of systems employing high-pressure air demonstrated that speeds of response comparable to those obtained in hydraulic systems could be realized. This work has been continued, employing products of combustion in place of air. When high-energy fuels are employed, such systems permit a drastic reduction in the size of the energy source for the control system; alternatively, in some applications gas may be bled directly from the propulsion system. During the past year designs have been evolved for several control applications, and a prototype unit provides a maximum output of 1 1/2 horsepower with a speed of response of 4 milliseconds. Hot-gas-operated systems can be expected to provide superior operating characteristics in a multitude of applications in high-speed aircraft and guided missiles. This work was done largely by academic staff and has led to one doctor's thesis and several master's theses.

In another Laboratory project Professor Robert W. Mann and Sherman K. Grinnell have studied the characteristics of machinery for supplying the small quantities of electric power for a short time—measured in minutes—required for the control of certain missiles. This study led to the conclusion that a solid propellant high-speed partial admission gas turbine and generator was the practical answer and that the dimensions and general appearance of the turbine must be drastically different from steam and gas turbines in common use. A first turbine of very unconventional dimensions was designed, built, and tested to satisfaction. With a four-inch diameter, the turbine ran up to 60,000 rpm, and the blades were 0.1 inch high and 0.25 inch wide, making the turbine rotor look substantially like a rough surface. This is an example of the large changes any machine can undergo if it is required to operate under very unconventional circumstances. The electric generator is equally unconventional. During the past year two additional units designed to special specifications were built, successfully tested, and delivered to the Navy's Bureaus of Ordnance and Aeronautics, which sponsored this development. This work also was done mainly with academic personnel and provided opportunity for several theses.

The rapid development in steam boilers during the last decade has brought their operation above the critical pressure and temperature. While in the past considerable research effort has been placed on

heat transfer to fluids with essentially constant thermal properties, only two studies have been made of the heat transfer in forced convection to fluids with widely varying properties. These studies were performed on water, which in passing near but above the critical point affords a large and sudden change in specific heat and gradual variations in thermal conductivity, viscosity, and density. Because other fluids behave similarly, a study is now being made of heat transfer to the organic fluids for which temperatures and pressures just above the critical point are low enough to simplify the design of apparatus. It is known that the convection heat transfer process is drastically altered when the properties are changed, for with a large temperature gradient from the wall to the center of the tube, widely different thermodynamic states occur. The simpler models for the correlation of forced convection data then break down. A search for new flow models will accompany the taking of data for the organic fluids, and correlations among all the data, including that for water, will be sought. The project is under the direction of Professors Warren M. Rohsenow and J. P. Barger, who are working with the assistance of several graduate students.

METALLURGY

Metallurgy has the largest and most effective research program for its size and in its field exerts a very significant influence, particularly through its distinguished staff. During the year the amount of fundamental research being done has continued its steady increase, and graduate enrollment remains at a high level. Undergraduate enrollment is still below the desired level, but some evidences of an upturn are visible, although the premises for a major expansion do not appear to be good.

The undergraduate curriculum in metallurgy has been completely revised, and the new curriculum will go into effect next year. This contains a required core of subjects in chemistry, physics, metallurgy, and mechanical engineering and permits a wide selection of elective subjects in the junior and senior years. It thus allows a student in the Department to satisfy his interests in the specific fields of metallurgy without sacrificing the breadth embodied in the core curriculum. The new program has the further advantage of permitting students to select subjects outside the field of metallurgy and will thus appeal to interests in such fields as applied mechanics, solid state physics, nuclear engineering, and other areas. The former

division of the Course into two options has been eliminated in favor of the new arrangement, which still permits a student to concentrate in either of the two areas formerly specified, namely, general metallurgy or mineral engineering.

The method of fluorescent X-ray analysis has been examined by Professor J. T. Norton and his associates, and the absorption effects which influence the accuracy of chemical analysis of alloys have been studied. A microprobe method for the analysis of a very small area of sample is under development. This general method of chemical analysis is expanding rapidly and holds great promise as a practical tool. Methods of analysis based on X-ray absorption have also been shown to be capable of application to many types of metallurgical problems and have been used for studies of solid state diffusion.

Professor Nicholas J. Grant and his associates have demonstrated the extremely great potential of sintered and extruded metal-metal oxide alloys as high-strength, high-temperature materials. Such materials are little affected by temperature and are highly resistant to annealing effects and grain growth at elevated temperatures. They constitute a new type of alloy of great potential in the development of metals for use at high temperatures. Growing out of this research was the material of the 1956 Annual Powder Metallurgy Lecture of the American Institute of Mining and Metallurgical Engineering by Professor Grant and Dr. Oliver Preston.

Another advance in powder metallurgy has been reported recently by Professor John Wulff and Dr. Malcolm Basche. Their studies of the kinetics of the process have shown that the so-called recrystallization embrittlement of molybdenum is really due to the solutionizing of contained carbides, oxides, or nitrides in commercial molybdenum on the heating cycle and their precipitation in grain boundaries and slip planes during cooling. This finding is of great importance with respect to the use of molybdenum as a high-temperature material for ordnance, nuclear, and gas turbine applications.

METEOROLOGY

As reported last year, the Department of Meteorology is discontinuing its undergraduate curriculum, except for the students currently registered. Suitable undergraduate preparation for a career in meteorology is available in several of the other undergraduate

curricula at the Institute, and undergraduates may continue to elect certain subjects in meteorology in preparation for the graduate professional courses. The abandonment of the undergraduate curriculum will have little effect on the Department because of the small numbers of undergraduates in recent years and because most of the present undergraduate subjects will be continued for the benefit of beginning graduate students with no previous training in meteorology.

The graduate enrollment was about the same this year as last. An expansion of about fifty per cent could be handled without an increase in staff or space. The demand for trained meteorologists greatly exceeds the supply, as is the case in most scientific and engineering fields.

The most significant trend in meteorology is the rapid development of theoretical and quantitative approaches to some of the most fundamental problems of the science. The basic theory has been available for several decades, but its application has been severely limited by the lack of adequate observational data and the formidable computation problems. Within the last ten years the combination of more nearly adequate data and the high-speed digital computer have fostered what appears to be a major break-through in theoretical meteorology. Through its extensive research programs the Department has played a leading role in these revolutionary developments. The Department will be greatly strengthened in this area during the coming year by the addition to its staff of Dr. Jule G. Charney and Dr. Norman A. Phillips, both previously associated with the Institute for Advanced Study at Princeton. Their work has already earned them world-wide renown, and their addition to the present staff will clearly make it pre-eminent in the world.

Two complementary approaches are being followed in the development of numerical models of the atmosphere. One concerns the thermodynamic equation, the equation of continuity, and the equations of motion, which, taken together, comprise a closed set of equations completely describing all possible motions of the atmosphere. The apparent generality of this approach is limited by the observational data, by the difficulty of introducing the radiational input of energy and the dissipation processes, and by the very generality of the equations, which include such non-meteorological disturbances as sound waves. For the latter reason, and to

simplify the computations, the equations must be modified so that they are no longer exact. In spite of these limitations the results have been very encouraging, and such models depict the larger-scale circulations with reasonable verisimilitude for periods of about two days.

Another approach is to consider the changes in the circulation pattern from one series of observations to the next as a time series. The circulation pattern is represented by orthogonal polynomials, and the behavior of the time series is studied with the aid of modern statistical techniques. In essence, this procedure reveals how nature solves the governing equations. The results of this time-series approach are almost as good as those from the method outlined above for periods of two days or so, and they seem to be better for the longer periods in which the energy budget becomes of increasing significance.

The research program of the Department includes ten projects sponsored by the Weather Bureau and the three services within the Department of Defense. Although the major emphasis is on theoretical work, the program includes projects on instrumentation, cloud physics, extended forecasting, and climatology. The research effort is closely integrated with the academic program through the use of current results in teaching and through the use of graduate assistants on the projects.

NAVAL ARCHITECTURE AND MARINE ENGINEERING

The Department of Naval Architecture, like aeronautical engineering, is devoted to a clearly delineated field of activity. It is a small department and represents a small field of education even in the national scene. Its industrial base is subject to severe fluctuations, making long-range planning difficult. It has achieved a distinguished position in certain fields of research and plays an important role in the training of naval officers.

Captain J. M. Hicks, U.S.N., Commanding Officer of the U.S. Naval Administrative Unit at M.I.T. and Professor of Naval Engineering, retired from the Navy on June 30, 1956, and was relieved upon retirement by Captain J. A. Obermeyer, U.S.N., Professor of Naval Architecture. Lieutenant Commander J. W. Thornbury, U.S.N., recently appointed Associate Professor of Naval Engineering, assumes Captain Hicks' teaching assignments in the Department.

The Class of 1959 in Naval Construction and Engineering (Course XIII-A) is composed of sixteen U.S. Naval officers, five U.S. Coast Guard officers, and five foreign naval officers, making a total of twenty-six new students and a total enrollment of seventy-five in this Course. Three foreign naval officers have registered as undergraduates in Naval Architecture and Marine Engineering (Course XIII). Twenty-nine professional degrees were granted during the year.

Display space in the Hart Nautical Museum has been increased during the past year, making possible a complete portrayal of the development of sailing vessels and steamship and motorship propulsion. Ship and machinery plans have been assembled, and the advance in steam navigation is shown to better advantage by the addition of more models of notable steamships. A model of the sailing yacht *Ranger*, which held the international championship, is now on display through the courtesy of Mrs. Fred L. Pidgeon. Although only a few ship models were received this year, we have been offered the yacht picture collection of the late Charles H. W. Foster, and we are studying plans to share it or cooperate in its use with the Peabody Museum in Salem, Massachusetts. The Second Bank—State Street Trust Company, under the leadership of the late Alan Forbes, published an attractive brochure containing colored reproductions of the Benjamin Russell paintings of whaling and other ships. Over half of these are from originals which were given to the Institute by Mr. Forbes. Suitable credit was given to our Museum.

During the past year, in addition to its normal instructional use, the Propeller Tunnel has been the source of several graduate theses of considerable stature. In addition, basic research work on controllable pitch propellers has been undertaken for the David Taylor Model Basin. Progress on this has been seriously interrupted, however, by similar complementary work for an actual design for the Baldwin-Lima-Hamilton Corporation, undertaken at the urgent request of the Bureau of Ships, Department of the Navy. Also, under contract with the Society of Naval Architects and Marine Engineers and under the direction of Professor Frank M. Lewis, extension of earlier work on hydrodynamically excited vibrations has been continued.

We have been requested by the David Taylor Model Basin to

initiate basic research into propeller stresses, and it is probable that this will be possible next fall. A full-time research assistant will be made available under the contractual agreement.

The following research projects were undertaken in the Ship Model Towing Tank during the year: a study of the effects of anti-pitching fins on the seakeeping performance of three ship types—sponsored by the Office of Naval Research—continued from the previous year; a continued investigation of the effect of changes in ship form on seakeeping performance—sponsored by the Society of Naval Architects and Marine Engineers; seakeeping tests to determine the cause of ship vibrations due to anti-pitching fins—sponsored by the Netherlands Ship Model Basin; and a number of miscellaneous tests for naval architects and shipyard design offices. Future research plans include the continuance of the research on seakeeping for the Society of Naval Architects and Marine Engineers and the Holland-America Lines. A proposal has also been made to the Office of Naval Research for continuance of the anti-pitching fin research.

The instrumentation of this facility has not been essentially increased during the past year. However, as a thesis project two students developed an extremely small and sensitive propeller torque and thrust dynamometer which will measure the torque and thrust on the propeller before the shaft enters the model stern tube bearing. This dynamometer, although requiring further development, will make it possible to conduct self-propelled model tests in the laboratory exercises and to pursue another type of research project. As mentioned in previous years, the capabilities and accuracy of the Ship Model Towing Tank would be greatly increased by the installation of a monorail carriage and associated equipment.

Work is nearly completed on the study of the buckling of flat plate panels. The first of several papers based upon this project is expected to appear soon in the journal of the Society of Naval Architects and Marine Engineers, which sponsored the program. The Hull Structure Committee of the Society has expressed interest in continuing work on a second phase of the program as soon as possible. Heretofore, simple support conditions have been provided on all four panel edges and the long edges then loaded in compression until ultimate failure occurred. The new phase will restrain the long, loaded edges against rotation and will seek to substantiate available theoretical analyses.

GRAPHICS

For a number of years the basic subject in Engineering Drawing has included a gradually increasing amount of analytic graphics. During the year 1954–55 a new subject, Graphical Processes, dealt exclusively with this phase of the material. Its success led to the removal of the graphical content from Engineering Drawing so that students could make a clear choice between Engineering Drawing and Graphical Processes. This permitted more free-hand sketching and a useful term project within the former subject. A new freshman elective in Elementary Nomography was also offered. Except for the subject called Graphical Processes, the decrease in the number of students electing to take one or more of these subjects continued during the past year. As noted elsewhere in this report, most of these activities have been transferred to the Department of Mechanical Engineering.

ACOUSTICS LABORATORY

The outstanding event of the year for the Acoustics Laboratory was an International Congress, sponsored by the International Commission on Acoustics, held in conjunction with a meeting of the Acoustical Society of America, in Cambridge, Massachusetts, June 17 to 23, 1956. More than 1300 participants, of which 160 came from sixteen countries outside the United States, made this by far the largest technical gathering ever held in acoustics. The program included some 280 papers, with ten presented by Laboratory members.

The Planning Committee included Professor Richard H. Bolt as Chairman, John A. Kessler as Secretary, and Professors Leo L. Beranek, Philip M. Morse and Walter A. Rosenblith. Substantial contributions to the organization of the technical program were also made by Professor K. Uno Ingard for physical acoustics, Professor Robert B. Newman for architectural acoustics, and Dr. Theodor F. Hueter for sonics. Related activities during the previous week, a Seminar and a Conference on Speech Communication, were planned by a committee that included Professors Kenneth N. Stevens and Morris Halle.

Kresge Auditorium served admirably as headquarters and as the location for many of the technical discussions and demonstrations. The sessions and many special events, including an open house in the Laboratory, provided unparalleled opportunities for scientific

interchange with acoustics specialists from all parts of the world.

During the year the physical acoustics group under Professor Ingard continued its active program in atmospheric acoustics, with particular emphasis on the interaction of sound with turbulence. Using a technique reported the previous year, successful laboratory experiments were performed on the scattering of sound by turbulence. An interesting result was the "line broadening" caused by random motion of the turbulent flow, analogous to thermal line-broadening observed in X-ray diffraction. These studies suggest experimental acoustic means of investigating certain properties of turbulent flow.

Measurements of sound propagation over ground were performed on a more or less continuous basis at the Laboratory's mobile field station. Detailed data were obtained on the relation between atmospheric conditions and sound propagation. Of special interest was a spectacular variation caused by diurnal variation in temperature gradients; sound level differences of 20 decibels between daytime and nighttime propagation were observed.

Model experiments on sound propagation over absorbing surfaces were made and correlated with theory, both for pure tones and for random noise. In this connection, systematic theoretical and experimental studies of acoustic properties of soil have been started. It has been found, for example, that the absorption coefficient of sand is strongly influenced by variations in water content. An automatic impedance meter for such field measurements is near completion.

Research in aero-thermoacoustics under Professor Osman K. Mawardi dealt mainly with the noise from turbulence in a boundary layer and with the propagation of sound in a rotating flow. Results from the latter study offered an explanation of screech noise in ram jets. Studies were continued on the propagation of sound in gases at high temperatures.

The speech research group under Professor Stevens continued its investigations of the processes of speech production and perception, with emphasis on applications to speech transmission over communication channels of low capacity. A preliminary band-width compression system was assembled and tested. The listening tests indicated that vowel sounds are transmitted with a high level of accuracy but that the intelligibility of consonant sounds is rather

low. For this reason, studies of the production and perception of consonant sounds have been continued, with particular attention to fricatives, nasal consonants, and the transitions between vowels and consonants.

A dynamic electrical analog of the human vocal tract was used to study the production of sequences of speech sounds. Static electrical and mechanical models of the vocal tract were also used in the consonant studies. Perceptual tests were performed to determine the accuracy with which human listeners can discriminate between speech-like sounds; the results will lead to requirements for accuracy of speech transmission systems.

A related program on speech analysis from a linguistic viewpoint, under the supervision of Professor Halle and sponsored by the Research Laboratory of Electronics, is located in the Acoustics Laboratory in order to coordinate more closely the Institute's researches in speech communication.

The ultrasonics group headed by Dr. Hueter concentrated on studies of visco-elastic loss mechanisms in biological tissues. A number of specific relaxation processes were identified using a combination of techniques applicable over a wide frequency range.

One process, observed in nervous tissue, is associated with the properties of the living state and disappears with denaturation. Some of this work was conducted in collaboration with the Medical Acoustics Research Group at the Massachusetts General Hospital. Other work, dealing with the influence of focused ultrasound on brain waves, used auto-correlation facilities of the Research Laboratory of Electronics and electro-physiological facilities at the Massachusetts General Hospital.

Continuing studies of the statistical characteristics of complex acoustic signals were carried out with the electronic computing and data reduction system previously reported. Instrumentation activities relevant to electronic computation and data processing included the development of an electronic storage system for use in a flutter-free magnetic data recording system, and long-term studies of bias and cross-current in dual triodes widely used in the computing equipment.

About twenty-five Faculty and staff and some forty undergraduate and graduate students were associated with the Laboratory. Twenty-one theses were completed: two for doctor's degrees,

eight for master's and engineer's, and eleven for bachelor's degrees. Some twenty papers were published in professional journals.

The staff maintained active participation in national professional affairs. Professor Ingard was chairman of the American Standards Association subcommittee on measurement of sound propagation through panels. Dr. Hueter was appointed chairman of a new committee of the Acoustical Society of America on sonic and ultrasonic engineering. He was also a member of the medical physics committee of the Institute of Radio Engineers and a lecturer at the Gordon Research Conference. Dr. Arthur S. House was an Associate Editor of the *Journal of Speech and Hearing Disorders* and served on the membership committee of the American Speech and Hearing Association.

Professor Mawardi gave a series of four invited lectures at the University of California at Los Angeles in November on the subject of the interactions of sound with turbulence and heat. He was also appointed Chairman of an American Standards Association subcommittee on the standardization of acoustic impedance. Professor Rosenblith was appointed to the Executive Council of the Armed Forces-National Research Council Committee on Hearing and Bioacoustics and Professor Bolt was appointed its Deputy Chairman. Professor Stevens, Dr. Hueter and Mr. Kessler were elected Fellows of the Acoustical Society of America.

Mr. George L. Lamb, Jr., was awarded the Owens-Corning Fiberglas Fellowship in Acoustics and will continue his doctoral research in the Laboratory. Dr. C.G.M. Fant, Director of the Speech Transmission Laboratory at the Royal Institute of Technology, Stockholm, Sweden, joined the Laboratory in June as a summer guest. Dr. James E. Young, spent part of the year on a fellowship at The University, Southampton, England, and Dr. David Pridmore-Brown received an Imperial Chemical Industries Fellowship for research in the Mathematics Department of the University of Manchester for the year 1956–57. Dr. Richard K. Lyon was appointed Assistant Professor at the University of Minnesota.

Professor Richard D. Fay retired at the end of the year, after twenty-eight years on the staff of the Institute and some forty years in the field of acoustics. The Laboratory is pleased that he will continue his productive research activities as Professor Emeritus.

RESEARCH LABORATORY OF ELECTRONICS

The Research Laboratory of Electronics has continued to operate at approximately the same level reported last year. Fifty members of the Faculty, ninety-three students, thirty-seven D.I.C. staff members, and eight visitors participated in the research program. The total staff of the Laboratory, including monthly non-staff and hourly employees, numbered 287.

The operating budget for the period totaled $1,300,000, derived principally from the basic research contract with the United States Army, Air Force, and Navy, two Lincoln Laboratory purchase orders, and a contract with the Navy Bureau of Ordnance. In addition to the major contracts listed above, the support for special projects in the fields of electroneurophysiology, mechanical translation, and speech studies is provided by the Bell Telephone Laboratories, the National Science Foundation, and the Teagle Foundation. During the past year the Laboratory received support from the Atomic Energy Commission to permit the start of a research program on the properties of high-density gas discharges.

The Laboratory receives support for its Industrial Fellowship Program from the Radio Corporation of America, the Federal Telecommunication Laboratories, the Sperry Corporation, the Hughes Electronic Corporation, and the General Communication Company. During the past year six full-time graduate students were supported by the Program.

Though the Research Laboratory of Electronics is sponsored by the Departments of Physics and Electrical Engineering, Faculty and students from several other departments have participated in activities of the Laboratory. The distribution of Faculty among the various departments was electrical engineering 23, physics 13, modern languages 4, economics 3, and chemistry 2. During this period, the Laboratory had visitors from eighteen foreign countries as well as from most of the United States.

During the past year, seventeen students working in the Laboratory received B.S. degrees, eleven received M.S. degrees, and fourteen received Doctor's degrees. During the same period, members of the staff published thirty-four technical and progress reports and forty-eight journal articles and presented papers at thirty-five different meetings.

Though the research program of the Laboratory is determined

by the interests of the individual Faculty members and consequently will vary with time, much of the work represents a continuation of activities reported previously.

The physics program includes the nuclear resonance research of Professor Francis Bitter; Professor Malcolm W. P. Strandberg's radio frequency spectroscopy investigations on paramagnetic resonance and research on a microwave emission spectroscope; Professor Wayne B. Nottingham's research on thermionic emission, physical electronics of the solid state, and very high vacuums; the investigations of microwave gas discharges and the studies of high-density plasma being conducted by Professors William P. Allis and Sanborn C. Brown; and the program of atomic beam research being carried out by Professors Jerrold R. Zacharias and John G. King with the dual objectives of learning about the structure of atomic nuclei and greatly improving the basic standards for the measurement of distance and time.

The program being directed by Professor C. W. Garland of the Chemistry Department is centered upon learning about the properties of matter at low temperature.

The electrical engineering program includes the microwave electronics research of Professors Lan J. Chu, Louis D. Smullin, and Hermann A. Haus; the bioelectric signal research by Professors Walter A. Rosenblith and Norbert Wiener; the nonlinear circuit theory work directed by Professors Henry J. Zimmermann, Samuel J. Mason, and Richard C. Booton, Jr.; the network synthesis developments of Professor Ernst A. Guillemin and his students; the signal description research by Dr. Manuel V. Cerrillo; the information theory and communication systems research by Professors Robert M. Fano and Peter Elias with Visiting Professor Claude E. Shannon; the switching circuit investigations of Professors Samuel H. Caldwell and David A. Huffman; the statistical communication theory research by Professor Yuk-Wing Lee and his students; the solid-state devices research by Professors Richard B. Adler and Fano; the propagation and noise studies by Professor Jerome B. Wiesner and his students; and the electroneurophysiology investigations by Drs. Warren S. McCulloch, Jerome Y. Lettvin, and Patrick D. Wall.

Professors William N. Locke and Victor H. Yngve of the Modern Languages Department have continued their investigation of methods of language translation by means of electronic machines.

Professor A. Noam Chomsky has continued his research on mathematical studies of grammars, and Professor Morris Halle his studies of the properties of speech signals.

C. Richard Soderberg

SCHOOL OF HUMANITIES AND SOCIAL STUDIES

As a result of Faculty actions of the past two years, the School of Humanities and Social Studies offers a number of paths to an undergraduate degree. The Department of Economics and Social Science has expanded its opportunities in Economics, Politics, and Engineering or Science (Course XIV) so that social science subjects may now be combined with concentration in a branch of science as well as in a branch of engineering. The social science concentrations have added political science subjects organized to provide a special field. Aided by the Rockefeller grant of a year ago, the Department of Humanities has developed its Course in Humanities and Engineering or Science (XXI), which offers concentrations in science or engineering combined with concentrations in philosophy, literature, or the nature of American industrial society. Under Professor John M. Blum, who is in direct charge of the Course, many changes have been made in subjects offered by the Department so that they may at once fit the needs of the students in Course XXI and yet be available in some of the sequences open to all undergraduates.

The capstones of the new Course XXI are the special senior seminars which will be offered for the first time in 1957 and for which Professor Karl W. Deutsch and Professor Giorgio D. de Santillana are already preparing materials. For the coming year members of the Department have arranged a series of evening meetings with leading Faculty members of the Schools of Science, Engineering, and Industrial Management so that problems may be better designed and participation by their colleagues made most fruitful.

Both of these fine undergraduate combinations deserve more registration than they have yet attained. The enrollment in Course XIV remains small, although this year's junior class of nineteen is the largest of recent years. Course XXI is much newer, and the first real class has just finished its freshman year. About fourteen of them will evidently enroll as sophomores in Course XXI; it may be interesting to note that all but one are interested in the philosophy and literature concentration. American industrial society has as yet few takers.

POLITICAL SCIENCE SECTION

Of the major regroupings accomplished during the year, that in political science was the most far-reaching. I reported a year ago that an ad hoc committee headed by Professor Charles P. Kindleberger had made a number of recommendations looking towards a strengthening of the subjects and the research in political science at M.I.T. All of these recommendations were accepted. A Political Science Section has been established in the Department of Economics and its first Chairman is Professor Norman J. Padelford. The Section is interdepartmental and includes representatives of the Department of Humanities as well as of the Department in which it is based and staff members from the School of Industrial Management and from the Center for International Studies.

The undergraduate option in political science has been reorganized and now begins with a subject called Government, Politics, and Technology, taken in the second term of the sophomore year. Here the underlying assumptions of politics and of changing technology are analyzed with a view to discovering how they come to relate to one another. Following this students will take one subject in each of the fields of political theory, comparative political

systems, political behavior and communications, and international relations and foreign policy; and they will then select one of these fields for a sequence of advanced studies. In the senior year all those who concentrate in political science will participate in a special seminar which will focus upon a number of major problems of decision-making on issues of current national and international concern.

This program has two unusual features that should be of interest to potential students. First, it retains, of course, the strong training in basic science and engineering for which M.I.T. is noted and which is usually absent from social science programs. The value of this for the present world can hardly be overestimated. Second, it is studied in close conjunction with economics and industrial relations. This is theoretically possible in most institutions, but the cross-departmental walls are not often so low as they are at M.I.T. Students in this political science option are encouraged to take electives in subjects of economics and industrial relations which deal with government policy concerning business, labor, money and banking, and international trade. They are also encouraged to form their programs so that some electives will be taken in the American industrial society or philosophy sequences of Course XXI and in the Business and Engineering Administration offerings in the School of Industrial Management.

There are other important developments of this kind in the School of Humanities and Social Studies, but I have chosen to dwell on this one at some length so that it may become clearer that rich and unusual opportunity is open at M.I.T. in unexpected as well as in expected channels.

The work of the Political Science Section has begun with great celerity. This was partly due to the energy and persistence of Professor Padelford and partly to the fact that we had a number of first-class political scientists scattered in various parts of the campus. But the manpower in this field is not sufficient for the long pull, and it will be necessary in the near future to strengthen the Section with a few additional tenure appointments. Since these should not be achieved at the cost of promotions in our already-strong fields such as economics, it is clear that we have a problem of fund-raising to support a small number of chairs.

CORE CURRICULUM IN HUMANITIES

We continue to have great pride in the core curriculum in Humanities required of all students in the first two years. During this past year we have kept changes to a minimum in order to reexamine the principles. We end with the previously held conviction that the commitment to general education with a strong humanistic bias is the right one, that we are right to do intensive work on selected great books and great time-place foci, and that rigorous training in reading and writing are to be an integral part of this and not brought in as separate subjects. We have found an increasing approval of this among our students and a continuing skill among our Faculty in adapting themselves to the challenges of this program without losing or sacrificing their specialized scholarly skills. Our teachers are *not* becoming "general educationists" and will not, if they leave us, be deprived of their specialized value in the academic market place.

We have made two experiments in the core. We offered a sequence of weekly lectures aimed at enriching the classroom experience and providing an opportunity for those students who wished to come into contact with some distinguished faculty members both from M.I.T. and from other colleges and universities. We were unable, due to the congestion of the M.I.T. schedules, to obtain an hour for these lectures which did not impose severe limitations on student attendance; but even after all allowance is made for this, we have to conclude from the attendance record that the experiment was a failure, and we will not continue it. What this says about student loads, student interest, quality of lecturing, or even the merit at M.I.T. of an English system (many lectures which one does not have to attend), we do not endeavor to conclude.

The other experiment was a clear success as perhaps might have been predicted; the only question is how much it can and should be extended. Two of us took a dozen selected freshmen with high verbal and College Board English scores and also high promise for their other work at M.I.T. through the freshman core on what was essentially a seminar-tutorial basis. They were given considerable latitude in scheduling their work, were asked to read much more than their classmates, and were held to high standards of performance. At the end of the first term the students asked for a continuation of this program; at the end of the year they asked to

continue in it as sophomores; these requests were all unanimous. They assert, moreover, that there are a hundred or more other classmates who are worthy of such treatment. This poses us a real problem. As a participant in the experiment, I know that it is rewarding to the teacher; as an administrator I know its cost. We will continue to examine the possibilities. It would help if even the brightest students who come to us as freshmen were a little more self-reliant at the outset, could be given fairly broad tasks and left alone for gestating periods; but to meet this requirement seems a frightening thing to most college freshmen I have met.

The general assertion that we have not tinkered much with content in the core does not apply to the sophomore option on The United States: Men and Issues. Here we established an ad hoc committee to propose a content more in keeping with that offered under the Western Values option. The committee came forward with a course essentially in American intellectual history as broad and loose as the existing one might be deemed narrow and tight. It was not adopted but led to improving compromises. This option continues to be a strong one, but we are accepting the fact that it seems easier to develop a broad philosophical approach to the really great works of Western man than to the narrower range of American history; this may be because there have been fewer specialists to satisfy, possibly because the obviously majestic range of the Western Values material forces one into discriminating selections that do not seem quite so necessitous in the American history option. We need to continue to study the latter.

MODERN LANGUAGE STUDY

Many of the curricular changes in this School of late years have been dramatic and sudden. Some have occurred more gradually and these tend to be overlooked. Professor William N. Locke has pointed out to me that the Department of Modern Languages has become essentially a new department in the past eleven years of experimentation, with a developing emphasis on the literary and humanistic values of language study.

Since the end of the war in 1945 subjects in literature and language have gradually been added to round out the slim offerings of the period just before the veterans returned. Then there were only elementary French, German, Spanish and Russian, intermediate

French and German, and one reading course in French literature. Now we have three advanced subjects in French literature, three in German, one in Russian; we have numerous other new subjects including two in linguistics, freshman electives in spoken French and spoken German, graduate subjects for learning reading in those languages, and the very interesting elective sections in French humanities for qualified freshmen and sophomores.

These elective sections came to a turning point this year, for they reached the end of the three-year experimental period for which they had been financed by The Rockefeller Foundation. We did not know whether enough students could be found who would be willing and able to take on the load of extra work demanded by doing their humanities in French. Could American boys and girls with no more than four years' study in the language handle serious reading, lectures, and discussions in French? Could a teacher be found with sufficient ability to get such students over the difficult transition from thinking in English to thinking in French, and who could then direct that thinking into a critical evaluation of serious subjects? The answers have been made in the affirmative, and M.I.T. has decided to continue this subject which so far as we know is unique in American education. A dozen liberal arts colleges have asked for reading lists and details of organization. Because of the nature of our departmental organizations it may have been easier for M.I.T. than for others to undertake the initial experiment, but with its demonstrated success we hope that others may see the advantages it offers to students who are qualified to profit from it.

HUMANITIES ELECTIVES

Junior-senior elective sequences continue to be offered in nine fields, with no one so lightly patronized as to lead us to consider dropping it. Despite the difficulties of scheduling which are really substantial, students continue to work out interesting programs and to flock to the teachers they want. The Department of Humanities had a total enrollment of juniors and seniors in its advanced subjects of 1,285, an increase of 305 over the previous year. Those enrolled in the Department of Economics were 2,553, an increase of 103. In the Department of Humanities, 497 enrolled in history subjects, a substantial increase; 563 in subjects of literature; and 225 in subjects of music. History as thus classified includes history of ideas, which verges on philosophy. In the Department of Economics,

1,180 registered in economics subjects, of which 740 were in beginning economics; 717 in psychology subjects; 296 in subjects of industrial relations; and 360 in subjects of political science. In considering the totals for the two major departments one must remember that elementary economics is taken by most M.I.T. students in their junior years and that the Department of Humanities teaches every freshman and sophomore in addition to its upperclass responsibilities.

When the Faculty provided for free time in the freshman year and suggested that a variety of freshman electives be prepared, it was inevitable that there would be successful and unsuccessful experiments. One of the very successful ones has been Professor William D. Stahlman's subject in Philosophy and Scientific Methodology. Although designed for students who may have a potential interest in Course XXI, it was and will continue to be open to all freshmen. The fall enrollment was ninety-six. If this enrollment continues we shall have to provide Professor Stahlman with assistance, since it is not wise to ask him to devote all his time to this subject. The other new freshman elective in the Department of Humanities, American Character and Institutions, also intended as an introductory subject for students in the American industrial society option, was taught by David B. Gleicher of the Center for International Studies. Here the registration of six was much less than desired, but the subject will be continued until word gets around that it is available and the matter will then be reviewed.

Enrollments in the other two freshman electives in the Department of Humanities were smaller than in previous years. English Composition drew forty-seven and Public Speaking seventy. The Spoken French and German electives of the Department of Modern Languages remain marginal in their registration at about ten students each per term—and this despite the fact that the more difficult literature and linguistic subjects show increasing enrollments.

Professor Robert R. Rathbone continues to give outstanding instruction in technical writing in cooperation with the Departments of Electrical Engineering, Mechanical Engineering, and Metallurgy. All these departments seem enthusiastic about the results and wish for assistance of this sort from the Department of Humanities. In addition to a seminar series on Technical Report Writing for

instructors, Professor Rathbone worked during the fall term of 1955 with a total of 275 juniors and seniors. During the spring term he had 169 juniors and seniors who had help either in their mechanical and electrical engineering courses or on their baccalaureate theses. It would seem that other departments, particularly in the School of Engineering, would wish this service; but it is certain that Professor Rathbone can be spread no thinner and that in fact we should give him assistance for the task he is now performing.

REMEDIAL READING

A perennial question with us is that of identifying the students who really need help in developing reading skills and of finding ways to help them after they are identified. Many readers may find it strange that any student admissible to M.I.T. should have this impediment, but there is evidently such a group in every American university. On the suggestion of Dr. James M. Faulkner, Medical Director, Dr. Edwin M. Cole and two members of his staff worked this year with the Department of Humanities on this identification problem. From a group of 200 students in the freshman class who made low scores on the verbal scholastic aptitude tests, Dr. Cole selected seventy-eight who, he felt, needed remedial work. Of these seventy-eight, who of course had to work on a voluntary basis, thirty-eight finally had some professional assistance either on the basis of individual work one day a week or in a small group two days a week. The problem of scheduling these remedial sessions proved very difficult and in large measure accounts for the small number receiving the instruction. Dr. Cole is now analyzing the test results of the remedial group, but the results are not yet available. Next year we shall try to improve on testing and selecting procedures, provided Dr. Cole is again able to make this sort of instruction available. The whole question of remedial reading instruction is a thorny one, raising among other questions the fundamental one as to whether any student thus crippled is really admissible to a superior educational institution any more than he would be if similarly crippled in mathematics.

ADVANCED COURSES

There have been few noteworthy changes in the graduate economics program; three subjects in the field of economic growth have, however, been added to the graduate program in the Depart-

ment of Economics, where students will now be able to choose economic development as one of their fields of concentration. The program in economic growth is especially well provided with instruction by the many senior members of the Department who are associated with the Center for International Studies, where contemporary investigations in this very field have such a large and successful place.

But the most important addition is one which might be reported under undergraduate courses, under new funds, under new appointments, or under the problem of integration of the Center for International Studies. I put it here because its first impact is likely to be felt in the advanced studies.

This is the new grant of $430,000 from The Ford Foundation made to M.I.T. to strengthen work in the behavioral sciences. The grant proposes a new form of financing long-term commitments on college faculties. In fact, through use of the interest and gradual exhaustion of the principal, it will underwrite two new tenure positions over a period of twenty-five years, which is about the actuarial expectancy for such positions. This vastly reduces the capital cost of financing a permanent chair and does not establish in perpetuity a position which perhaps should be rejustified each quarter century without personally committing the incumbent. It was the express intention of The Ford Foundation that this fund be used for long-term commitments in the broad field of the behavioral sciences at M.I.T. and that at the beginning we should use it in connection with the work in international communications being carried on under Professor Ithiel deSola Pool in the Center for International Studies. One of the initial posts will therefore be created to assist in teaching in this field, and the appointment will be made in the Department of Economics and Social Science. Starting next fall, a small group of special graduate students will be admitted. These men will be preparing for careers in international information activities and for scholarly study in that field. Some of them will presumably be on leave from government posts. A number of new subjects are being offered primarily to meet the needs of this program, but they will also add to the curricular opportunities in political science at the undergraduate level.

This is the most positive step that has yet been taken to integrate the work of the Center for International Studies with that of the

Department of Economics in particular and the School of Humanities in general. Further steps, some of which are of a similar nature, are needed.

EXTRACURRICULAR MATTERS

By its nature the School of Humanities has the responsibility for a number of extracurricular matters of importance in the general education of our students.

This past year the most exciting new development has been in the field of drama and in the activities centering around the new theater. Interest has grown rapidly. This program has developed around Professor Joseph D. Everingham and his assistant, Mrs. Helen Bottomly. They teach two subjects in drama in the humanities curriculum, and in one year the enrollment in these has doubled. Professor Everingham also supervises the undergraduate Dramashop which he reorganized in the spring of 1955 from what was then in all essentials a moribund student organization. The membership in 1955–56 swelled to 125, with an active participating membership of some seventy-five. The program of this group has four principal aspects. Major student productions, directed by Professor Everingham, included a new translation by Tyrone Guthrie of Pirandello's "Six Characters in Search of an Author," not previously performed outside New York; and Strindberg's "The Father," preceded by Chekhov's farce, "The Jubilee," which together constituted the major spring production. Lighting, sets, costumes, and production were designed by members of the Dramashop; attendance was excellent and the quality of the productions competed with the standards of other local college groups.

In addition to these major productions the students have developed three workshop evenings in each of which they produce, on a budget of $15, one one-act play, entirely directed, designed, and acted by them. The workshops, free to M.I.T. students, proved so popular that overflow audiences have been turned away from each engagement. One-act plays by Aiken, Irvin Shaw, Coward, Schnitzler, Evreinov, and Conrad were performed. After each performance Professor Everingham moderated a critique in which the audiences were invited to participate.

Four theatrical celebrities spoke and then met the members of the Dramashop informally. These were Jerome Kilty, Louis Kronen-

berger, Robert Anderson, and Richard Wilbur. Finally, there were evening non-credit classes in acting and directing for students who wished to put in this much overtime.

When we brought Professor Everingham to M.I.T. we told him we wanted to bring the combination of formal instruction in theater and student performances of plays to the same high standard attained by Professor Klaus Liepmann in music. Professor Everingham seems to be accomplishing this.

The work in music at M.I.T. continues at its expected high standard. Indeed, it is the penalty of continuous success that after a while there is little more that can be said. Professors Liepmann, Ernst Levy, and Gregory Tucker and Anton G. Winkler constitute an unusually talented and balanced group for the work in music. The Concert Band, the Brass Choir, the Glee Club, and the Symphony Orchestra all continued to give concerts with leading organizations from other colleges. The concert by the Boston Symphony Orchestra in the Kresge Auditorium was such a great success that it will become a regular event as part of the subscription Humanities Series, which has grown from a precarious start to a sure-footed collection of first-class musical experiences. Most of these are provided by such well-known outside organizations as the Budapest Quartet, the Hungarian Quartet, and the Juilliard String Quartet, and well-known soloists; Professor Levy regularly plays one of the finest and most popular of all the concerts, and on this year's series we also had an unusual performance of "Facade," by the Sitwells and William Walton, conducted by Professor Liepmann with Norma Farber reciting and a chamber orchestra of members of the Boston Symphony.

The addition of two Holtkamp organs, the baroque one in the Chapel and the large one in the Kresge Auditorium, have added materially to the scope of musical life here. In the Chapel there were concerts by Melville Smith, Robert Pettitt, David Johnson, Lawrence Moe, Marion Boron, Frank Taylor, Evelyn Stevenson, and Salvador Arnita; Pierre Cochereau, organist of the Cathedral of Notre Dame de Paris, gave the inaugural recital on the new Holtkamp organ in the Kresge Auditorium, the great instrument we have through the generosity of former Governor Alvan T. Fuller. Salvador Arnita and David Johnson have also played recitals on the large organ.

The most ambitious of the M.I.T. musical efforts with local talent consists of the performances of the Choral Society under Professor Liepmann. This year the Society performed Hindemith's "Apparebit Repentina Dies" and the Brahms German Requiem in February and Honegger's "King David" in April, both with members of the Boston Symphony Orchestra. "King David" was repeated for the Boston Arts Festival on June 10 and again in the Kresge Auditorium just after the end of this academic year as part of the joint Harvard-M.I.T. Summer School programs. This was one day before the Choral Society emplaned for their European concert tour which will be reported next year.

In all this the music Faculty received the greatest of help from an imaginative and aggressive student organization, the Baton Society, which itself sponsored the successful performance of the first opera in the Kresge Auditorium: "Don Pasquale," by Donizetti, performed by Boris Goldovsky's New England Opera Theatre.

Altogether, it is hard to say too much for the effectiveness of Professor Liepmann's management of our musical affairs, and there has been no promotion to the full professorship in the School of Humanities in a long time which has been greeted with more acclaim.

The Lecture Series Committee, the student organization which manages almost entirely on its own a program of outside lecturers and motion pictures, continues to grow in competence and enterprise. Their programs are well chosen and successful, and the activity has clearly matured to the point where the fatherly eye of the Office of the Dean of Humanities is never focused except upon the request of the Committee itself.

The Debating Society under the enthusiastic supervision of David J. Hardy had its most active year. Twenty-seven students participated in twenty-one tournaments and 178 rounds of debate. Although the percentage of wins over losses was not as high this year as in some previous years, the record was a good one. For the first time since 1950 the M.I.T. team was invited to participate in the National Debate Tournament at West Point, which is the goal of all college debating teams. Our performance there was not spectacular, but it was very creditable. Three M.I.T. students were awarded individual speaking honors in the several tournaments. The members of the Debating Society were much pleased when their

request for the founding of an M.I.T. chapter of Tau Kappa Alpha, the national honorary forensic society, was acted upon favorably.

RESEARCH

In previous reports I have dealt extensively with research matters carried on by the staff. But the growth in size and quality of the Faculty of this School make such a detailed review practically impossible. In our senior staff are nearly two dozen professors, as many associate professors, and more assistant professors, and of these only a few are not engaged in research and publication of a serious kind. Any effort at a discriminating selection must fail. Fortunately, two of the largest enterprises, the Center for International Studies and the Industrial Relations Section, both issue their own annual reports which discuss their work in more detail; and our list of publications provides some sense of the total scope of our scholarly and creative efforts.

The Department of Modern Languages continues its vigorous post-war research effort. First came groping attempts to analyze speech sounds into measurable entities. Then, by a new approach to the understanding of how we discriminate between speech sounds, Professor Morris Halle has been successful in isolating several classes of sounds by machine. This year for the first time it seems safe to predict that machine identification of the sounds we make in our daily speech will be possible. This year for the first time, too, it is possible to say with some confidence that we shall one day see machines translating printed German and Russian scientific articles into English. It will take time to make the exhaustive, completely objective analysis of those languages necessary for programming a computer to do the translation, but it now seems to be only a matter of time before this will be done. Under the direction of Professor Victor H. Yngve four experienced linguists are taking German sentences apart, word by word, and putting them together again. From this process rules are derived for the ways in which German sentences can and cannot go together. Similar rules for English and transfer functions for passing from one set of rules to the other will constitute an operational grammar which should make possible a program for a computer.

In the Department of Economics Professor Padelford is studying regionalism and international politics; Professor Lucien Pye has completed his work on Communism in Malaya, which will be

published as a book; Professor Herbert M. Jenkins has a running start on his laboratory for the study of motivation and analyses of behavior in relation to "reinforcement"; Professor Joseph C. R. Licklider's laboratory for the study of problems in speech and hearing is essentially complete and several long-term studies are under way; Professor Herbert A. Shepard's studies on social and personal factors affecting productivity and creativity in scientific research continue to attract attention, and he will soon go to England as guest of the National Physical Laboratories at Teddington; Professor Charles A. Myers has been working on a monograph growing out of his study in India during 1954–55 of labor problems in Indian economic development; Professors Paul A. Samuelson and Robert M. Solow continue their work in linear programming; and Professor Harold A. Freeman has been engaged in research in the statistical theory of engineering tolerances.

In the Department of Humanities, Professor E. Neal Hartley completed his work on the early iron industry at Saugus, Massachusetts; Professor John B. Rae made strides in his study of business leadership in the automobile industry; and Professor Blum ran into a road block when the diaries of Henry Morgenthau, Jr., were classified as security documents by the United States government. Professor Levy continued to write significant music; his Cantata No. 3 was performed in Carnegie Hall in the spring by the Dessoff Choir.

All the major research projects of the Center for International Studies witnessed substantial progress. Professor Daniel Lerner had a profitable year in Europe, mostly in France. His study of the views of 1,500 prominent French leaders about the relation of their nation to the movement for European unification pioneered the use of large-scale interviewing among French social scientists and perhaps started an independent research institution in Europe. Before he returned to the United States, he edited (jointly with M. Raymond Aron) a book entitled "*The Defeat of E.D.C.*," published in France in June, 1956, and to be available in English in the autumn. Professor Lerner's original studies on European unification were confined to French attitudes; subsequently the Institut d'Etudes Européennes which he set up for this purpose received a separate grant from The Ford Foundation and has carried out parallel interviews in Germany and the United Kingdom. The second major study which Professor Lerner has in hand, a study of the impact of new communication

patterns on the society of the Middle East, was all but completed during the year. Mrs. Lucille Pevsner continued the work during Professor Lerner's absence and a publication of this study is expected early in 1957.

During the year Harold R. Isaacs has substantially completed his major study of American attitudes towards India. The second and parallel part of his study, American images of China, is well along towards completion and a book tentatively entitled *Scratches on Our Minds* is expected in 1957.

Professor Raymond A. Bauer began the study of the attitudes of American businessmen towards United States commercial policy in 1953; the work has steadily gone along this year despite Professor Bauer's leave of absence. Again, a book is expected in 1957.

Experimental studies on attitudes towards authority and towards foreigners have continued under the direction of Howard V. Perlmutter.

Despite the heavy administrative responsibilities involved in directing the whole communication program and in teaching, Professor Pool has also found time to study and publish. Among the most important accomplishments of the group has been the development of a new theoretical model of the communication process. Although still in a fairly simple and crude form, this possibly new way of looking at this process has offered some helpful ideas about the data gathered on several of the projects.

The second important area of Center research involves problems of economic development. For the past three years this research has concentrated on the growth problems of Italy, India, and Indonesia. During the year these economic studies, all financed by a five-year grant from The Ford Foundation made in 1954, were given a major extension by a grant of $150,000 from The Rockefeller Foundation for study of the social forces that give rise to strong economic motivations in pre-industrial societies. This three-year study will be directed by Professor Everett E. Hagen.

As for the country studies themselves, the period of heaviest field work in Italy and Indonesia was completed a year ago, and only one part-time staff member was needed in each of these countries during the year. In India, however, this has been the peak year for field work, and Professor Wilfred Malenbaum and three staff members have been there since August, 1955. Professor

Benjamin H. Higgins returned from Indonesia late last summer and devoted most of the next five months to completing the manuscript of a study on the role of the Standard Vacuum Oil Company in Indonesian growth. This study had been sponsored by the National Planning Association as one of its studies of relatively successful overseas operations of American firms. The final manuscript has been delivered and should be published later in 1956. The work on Italy by Professor Paul Rosenstein-Rodan has gone forward both here and abroad. Professor Rodan himself put the largest part of his energies into a major trip to India and Indonesia, with a stopover as consultant to the Economic Commission for Asia and the Far East in Bangkok. Returning to Italy in the spring, he has with the help of Dr. I. M. D. Little of Nuffield College studied atomic energy potentials in Italy. This study, done under contract to the National Planning Association as one in a series of similar studies, will be published late in 1956.

The American project, a three-year program supported by a grant from the Carnegie Corporation and directed by Professor Walt W. Rostow, is in its first year and has four hoped-for end products:

1. The development of materials for teaching, which will naturally emerge most clearly towards the end of the project.

2. A conference designed to formulate new concepts in the analysis of modern American history and contemporary American society. Plans for this are already well advanced, and the conference will be at Endicott House in late May, 1957. It has been planned by a committee made up of Harvard and M.I.T. Faculty chaired by Professor Max F. Millikan. The conference will be small, select, and closed.

3. Essays and monographs on aspects of American society and its performance.

4. A book by Professor Rostow on the United States in its world setting.

The fourth major program of the Center, dealing with United States-Communist Bloc relations, has produced several studies reported in previous years. The Center continues to study the quality of Soviet higher education in science and technology, the social, economic, political, and military measures necessary to

counter Communist attempts at subversion in less developed countries, the structure of the East German economy, and the nature of the Soviet Officer Corps. All of these are important, but the first-named is naturally of particular interest to M.I.T. Alexander G. Korol of the Center's staff has been trying to add a qualitative dimension to the quantitative picture we already have of Soviet achievements in this critical field of international competition. His study, which will be completed by the end of the summer, has already attracted much attention. Its progress was greatly aided by materials brought back from Russia by two consultants, Homer L. Dodge and Norton T. Dodge, and by a study of Soviet education in aeronautics contributed by Professor Leon Trilling of the Department of Aeronautical Engineering. One volume has already been published and two more are expected; one will deal with the state of technical education with special emphasis on mechanical engineering and physics, the other with documentary materials.

OTHER STAFF ACTIVITIES

It can now be taken for granted that members of this Faculty will have many posts on committees and in advisory capacities, and we can no longer report any but the most conspicuous of these.

Professor George P. Shultz has been on leave of absence to serve as specialist on labor economics and labor relations on the staff of the President's Council of Economic Advisers; Professor Robert E. MacMaster has been on leave of absence for work in the Russian Research Center at Harvard University; Professor Bauer has been on leave of absence for studies in the Center for Advanced Study in the Behavioral Sciences at Palo Alto; Professor Higgins had four months' leave to serve as Economic Adviser to the Government of the Philippines at the request of the United Nations; William Hollinger was on technical leave of absence to serve on the economics faculty of the University of Indonesia; Professor Hagen was absent for two months in Japan as a member of a six-man team to advise the Japanese government on investment priorities.

Professor Lerner was Scientific Director of the Institut d'Etudes Européennes in Paris; Professor Carvel Collins was Visiting Professor of American Literature at the Salzburg Seminar in American Studies in Austria in June and July, 1955, and Visiting Lecturer at the Université d'Aix-Marseille in August, 1955. Professor Pool was Guest Editor of a special issue of *Public Opinion Quarterly* devoted

to political communication, issued in the spring of 1956 and containing some ten articles by members of the M.I.T. staff. Professors Morris A. Adelman, E. Cary Brown, Hagen, Samuelson, Kindleberger, and Millikan all prepared papers and were witnesses for the Joint Committee on the Economic Report of the United States Congress. Professor Thomas H. D. Mahoney was elected First Vice President of the American Catholic Historical Association. Professor Lynwood S. Bryant directed fifteen television programs on the history of the automobile and its role in American life. Professors Millikan and Rostow prepared a "major policy paper" on United States Foreign Economic Policy. Professor Licklider was Chairman of the Committee on Psychological and Physiological Acoustics of the Acoustical Society of America. Professor Karl W. Deutsch attended and participated in many meetings in many parts of the world concerning many subjects, particularly the Third International Conference on Political Science at Stockholm in August, 1955.

I have been re-elected President of the American Academy of Arts and Sciences and to the Executive Committee of the Board of Trustees of Mount Holyoke College; and I have become Chairman of the Academic Advisory Board of the United States Merchant Marine Academy. During the year I delivered a series of seven Lowell Institute Lectures at the Boston Museum of Fine Arts, the keynote address at the convention of the American Institute of Architects, and a series of two lectures at Clemson College.

STAFF CHANGES

The full list of staff changes is published elsewhere in the President's Report. Here I will report only on major matters.

By the untimely death of Joseph N. Scanlon, M.I.T. lost a great teacher and a great friend. After distinguished work for labor unions during their most critical years, "Joe" Scanlon became a Lecturer in our Industrial Relations Section in 1947 and was widely known for his work with management and unions in the development of a labor-management cooperation plan. He was loved and respected by labor and management alike and played a prominent role in many international meetings. He died in February after an extended illness. His work will be carried on by his associate, Frederick Lesieur. A number of the firms and unions which benefited from Mr. Scanlon's work have taken steps to

establish a permanent Joseph N. Scanlon Fund at M.I.T. for research on experience with union-management cooperation plans. His work will go forward but his personality can never be replaced.

A major change has been made in our Library administration. Professor Locke was asked to accept the post of Director of Libraries while remaining as Head of the Department of Modern Languages. This could only be possible if we relieved him of some departmental duties and reinforced the Department with new appointments. Three have been authorized and two promising ones have already been made. Since the new incumbents begin their duties in July, they will appear in next year's report.

We have been assisted by a number of visiting professors: Richard A. Musgrave, Professor of Economics at the University of Michigan; John G. Turnbull, Professor of Industrial Relations at the University of Minnesota; and Robert S. Hartman, Associate Professor of Philosophy at Ohio State University. Philipp Frank, Professor Emeritus of Harvard College, gave courses in the Department of Humanities in the second semester, and Stephen C. Pepper, Professor of Philosophy at the University of California, offered our only colloquium in the Department of Humanities. A committee consisting of Dr. Henry P. van Dusen and Professors Paul Weiss, Sidney Hook, and Isaiah Berlin has been advising the Department of Humanities on new appointments in philosophy.

TROUBLES

This has been such a good year that it may seem ungrateful to point out the major difficulties that seem now to confront us. There are four, possibly not all of equal difficulty or even importance, but all significant:

1. The Center for International Studies has been with us now for five years. It has done some outstanding crash and long-range programs of research. It has been generously supported with funds. It has had aggressive and sensible direction by Professor Millikan. It has brought to the roster of the M.I.T. Faculty, mostly on a transient basis, a considerable number of distinguished scholars. It has inevitably had effects on some of the graduate teaching and a little of the undergraduate teaching here. But we cannot assert that in its first five years the Center has given the major teaching strength we hope it will ultimately provide. The time has come

when more positive steps must be taken to integrate this distinguished effort with the general programs of M.I.T.

Much has been accomplished. There is long-term financing for two posts in behavioral sciences as previously discussed. The Center does have its own active seminar program. It has produced the graduate program in economic development. But most of the hardest part of the integrative planning and accomplishment remains ahead. I cannot do better here than quote from the Director's report:

"For some time the Center has desired to stabilize its financial position by obtaining a substantial measure of long-term support. Important progress was made in this direction during the past year by means of the waning-capital grant from The Ford Foundation. . . . Long-term financial stability for the Center, however, demands the securing of an assured core income, independent of term grants, of about $100,000. High priority will be given this task in the year ahead. . . .

"The Center has come in contact this year with an important question which concerns the Institute as a whole—the question of how M.I.T. can best contribute to the development of a community of scientists and engineers in underdeveloped countries. On three separate occasions during the past year the Institute was approached through the Center about the possibility of accepting contracts which would associate the Center with newly-emerging foreign universities. A great deal of thought was given this problem of M.I.T.'s 'foreign policy'; the Institute's position is to consider each separate proposal on its own merits rather than to lay down any policy favoring or discouraging such arrangements. The chief difficulty in concluding contracts with foreign universities is the shortage of faculty members who possess the required technical and personal qualifications and who have an interest in accepting such assignments."

The Center also dramatizes a problem which is serious for many American universities. The "ivory-tower" professor has appropriately been replaced by the man who takes his ideas to the market place. Professors advise in almost all national and many international fields. Thereby they gain knowledge and experience which enhance their teaching. But the active role and the professorial role are competitive. Most of the extracurricular demands

are for worthwhile public services and usually serve legitimate professional interests as well. But the better the men, the more incessant the demands, and a sure-footed equilibrium is difficult to establish and maintain. This is, I believe, a national problem, and the Center does not present it in a particularly exaggerated form—though it would be blind to deny its threat.

The Center for International Studies is potentially the greatest asset for development of the social sciences at M.I.T., and it is of the utmost importance that all of us see to it that the potentialities of this asset are realized.

2. In several reports of recent years I have pointed out that we must find a way to solidify our position in psychology. For a long time now we have had enough first-class psychologists engaged in various research projects at M.I.T. to offer the basis for a strongly consolidated effort. For a long time we have had good introductory subjects in psychology among the upperclass elective sequences, and these have become increasingly popular. For a long time we have had the privilege of conferring the doctorate in psychology when a student earned it, and from time to time this has happened. All the elements of a thriving situation in psychology are present except a continuity of purpose and organization which would make a future in psychology at M.I.T. seem attractive to a talented young man.

This was noted by the Marquis Committee several years ago when it made recommendations for our action. The administration has looked favorably upon such a development and has asked the psychologists now on the Faculty for the exciting plan which it could support. But with less to go on initially it is the political scientists and not the psychologists who have found a way. I have no doubt that some new financing is needed to put psychology on a solid footing at M.I.T., but it is not of a different order of magnitude than that already obtained in political science and it should, if anything, be easier to get.

Psychology has, of course, suffered from some handicaps not imposed on political science. It has suffered particularly, I suppose, because it means so many different things to so many different people, so that the psychologists needed in the School of Industrial Management seem of a different type from those in demand at the Lincoln Laboratory, and both may be different from

those who might teach the general psychology which is very popular with our students.

The main thing needed by psychology at M.I.T. is a fund which will finance two to four additional permanent chairs on a long-term basis and some expressed continuity of purpose which would justify a patron in investing such funds. There will then be three main problems which have been well expressed by Professor Ralph E. Freeman, Head of the Department of Economics and Social Science, in his annual report:

"The development of our psychology program presents three main problems. (a) The number of students in our classes has been growing rapidly. During the spring term of 1956 there were about 750 enrolled in the various classes. As a result of this growth, the size of the classes has had to be increased with some impairment of teaching efficiency. . . . (b) Our second problem is that of integrating in some way the various types of psychological work now going on in different parts of the Institute. The School of Industrial Management, the Center for International Studies, the Lincoln Laboratory, and other laboratories and projects are engaged in psychological activity and have psychologists on their staffs. These scattered people should be encouraged to get together occasionally to exchange ideas and discuss their common problems. (c) If the staff of the Department were strengthened and the considerable resources of the Institute were mobilized, an excellent graduate program could be developed. Such a program, we believe, is necessary if psychology is to gain its place both in research and in teaching at M.I.T. Graduate studies are a stimulus to the staff —virtually a necessity if our present excellent psychologists are to be retained and competent men attracted to fill vacancies or meet the needs of expansion."

The future of psychology at M.I.T. must be resolved, and positively. It has become an inter-school matter, and in my opinion we can no longer delay grappling with it decisively. Psychology belongs at the Institute.

3. The third of our problems seems more pedestrian but may not be more easily solved. This is the problem of space. The Department of Economics and about half of the Center for International Studies are living on borrowed time in the Sloan Building, facing the imminent day when the growth of the School of Industrial

Management will force them to go elsewhere. The office space available in the Hayden building, which houses the Humanities Department, about half of the Center, and the Department of Modern Languages, is now occupied to more than capacity. No more doubling up is possible. We are short of modern classrooms and seminar spaces in which to teach the humanistic subjects as they should be taught. The Library can go in only one direction, and that is in the direction of expansion. There seem to be no practical ways to increase the floor areas in this building; the adjacent spaces on which building or remodeling might have occurred all seem committed now to a Graduate Center through the acceptance of the report of the Committee on Student Housing. What all this implies for the School of Humanities is not easy to predict, but it is at least clear that we can no longer wait for the problem is now squarely upon us.

4. Finally, there is a great piece of unfinished business. I refer to our institutional failure to make any progress in developing an art program either along the lines of the Hayes Report or otherwise. We do quite a good job in introducing the freshmen and sophomores in our core curriculum to the elements of the art surrounding the cultures they study, and for that we are indebted to the convenience of the Hayden Gallery and to the great guidance and management afforded us by Professors Herbert L. Beckwith and Albert Bush-Brown of the Department of Architecture. Thus we whet student appetites in some cases, but we have nothing beyond this of a curricular nature to satisfy this appetite. Thanks again to Professor Beckwith and the Museum Committee, we have a good set of temporary art shows for the whole Institute family, and many of these are first or only showings in Boston so that we also serve the community. But no undergraduate at M.I.T. who wants to study art further, either in subjects of history and criticism or in subjects of a laboratory nature, has any opportunity to do so unless he is an architectural student taking these subjects as part of his professional curriculum. Even for the architectural students the study of painting and sculpture is essentially absent.

This is a very serious lack in the whole program of general education at M.I.T., and it is no consolation to me to know that the visual arts are among the worst handled in many sister institutions, too. The visual arts are an important part of man's adven-

ture, and the interest in examining them, the ability to come to grips with them, and even the desire to participate in making them are not talents which should be left to chance. The School of Humanities should not try to do this alone; nor if it did try could it be expected to do it well. We have but two people on the present Faculty of this School who have even a developed amateur's interest in and knowledge of the subject; the School of Architecture has few senior professionals, not enough to take care even of its own needs. Again it is clear that funds are needed for a larger staff. I have no doubt that they can be readily found once there is an enthusiastic leadership for the program. I believe that that leadership should come from the School of Architecture, and I continue to pledge the support of this School to that leadership when it emerges. May it emerge soon!

JOHN E. BURCHARD

SCHOOL OF INDUSTRIAL MANAGEMENT

The year 1955–56 is the School of Industrial Management's fourth. It is the first year in which our plans have sufficiently matured so that we can see the shape of things to come. We are beginning to complete the program of long months of studying our mission and how best to achieve it, searching for qualified personnel for the staff, waiting for their arrival and then for their induction into the atmosphere of the School, and finally, for the initiation of the programs made possible by their presence.

Management of industrial enterprise in this country is in transition. Whether we are on the verge of a second industrial revolution or merely witnessing an extension or acceleration of our mechanical processes is subject to debate. Certain it is that the fruits of scientific research in recent years have had significant effects on the environment in which management operates and have brought us to the brink of a new era of industrial life. Increasingly apparent is the need for new systems and means of meeting the overbearing requirements of information-handling necessary for decision-making in business. The enormous growth in the size of our economy and the need to integrate its correspondingly large constituent parts into the whole complex which we describe as "business activity" is

demanding the help which these new systems promise to give us.

Of equal—or even greater—importance is our need for a better understanding of the structuring of human beings into organizational forms so that unrealized abilities and talents may be released.

And if industrial management itself is reaching out for new tools and demanding invention to better cope with its responsibilities, then the task of a school such as this is to study ways of developing management competence so that it may turn out more and better qualified men. After a decade of high and rising employment and economic activity our society is suffering a critical shortage of able men to perform the management function without which growth cannot be sustained.

The educational program, both as to content and method, received continuing attention during the year and the results became beneficial at all levels of instruction. The Faculty of the School, sitting as a committee in a long series of seminars, considered presentations made by the personnel of each subject area for a review of content and of teaching method. If we think of management as a composite of many complex and interrelated parts, it follows that the different functional areas studied require planned relationships. These time-consuming seminars were helpful to this end and strengthened the undergraduate, graduate, and executive development programs. By this device the new Faculty members could more quickly be assimilated and could bring their talents to bear on the objectives of the School.

UNDERGRADUATE PROGRAM

At the undergraduate level two new beginning courses in management are being designed to meet more specifically the needs of succeeding courses. A long-needed laboratory with necessary equipment is being provided for the work in statistics.

To encourage the exceptional student at the senior class level, each of ten men selected by the Faculty chose a member of the staff with whom to work on a tutorial or research assistant basis. This program enabled these outstanding students to work professionally with members of our Faculty, and the experience was so rewarding to the students and Faculty members that we propose further experimentation and possible extension of the program.

GRADUATE PROGRAM

Though the graduate program curriculum has reached some degree of maturity as to the areas to be covered, several changes have been made in the first year of the two-year program. These changes concerned principally the revision of material within existing courses based on our teaching experience over the past three years. Wide latitude of choice of subjects is permitted in the second year.

For the first time we required all entering graduate students to take the Admission Test for Graduate Study in Business prepared by the Educational Testing Service of Princeton, New Jersey. While no immediate use will be made of this data, its continued accumulation over the years with correlations with later performance may in the future help us select entering students.

The enrollment in the graduate program was limited to sixty students, an increase of 30 per cent from the year before. These men come from forty-eight American universities and twelve foreign countries. The increase in our staff makes possible the admission of a larger number of qualified students; the enrollment in the fall of 1956 is expected to be about one hundred.

EXECUTIVE DEVELOPMENT PROGRAMS

The Sloan Fellowship Program proceeded along the lines established in recent years with one important innovation: a visit to Ottawa, Canada, where the Fellows had the honor and opportunity of discussing with several Cabinet members and top government officials of Canada some of the economic, social, and political problems of our neighbor to the north. This experience, coupled with their visit to Washington where they had a similar opportunity for discussion with high government officials, afforded them an exceptional insight into the problems of government in the two countries.

A major event of the year was the Sloan Fellows' Reunion in April. The high regard which the former participants, dating back to 1931, have for their year of study at M.I.T. was manifested by the fact that 160 of the 220 living Fellows attended this reunion, 130 of them bringing their wives. Half of the former Sloan Fellows have had their experience here since the establishment of the School of Industrial Management in 1952.

The need for a program of study of management problems for men holding important positions in industry—but for a period less than the twelve months taken by the Sloan Fellowship Program—has long been felt and has been urged upon us. Not until our staff had been increased in numbers and in the areas covered could we accede to this pressure. Moreover, housing and group living for those attending was essential. With the arrival of the new staff members last year and with M.I.T.'s newly acquired Endicott House in Dedham available for housing, we were ready for the first time to plan an educational program. In December we announced what was to be a pilot plant course. Eleven representative industrial companies sent us twelve men for a ten-week session beginning in March.

The program was a success from the standpoints both of those attending and of the Faculty who had carefully prepared the courses. Two such programs are now planned for 1956–57, one in the fall and one in the spring. Based on our experience with this first group we shall be able to accept a larger number of students in succeeding programs. If the demand for this kind of program continues as it seems likely to do, the Program for Senior Executives will become a permanent part of our Executive Development Programs.

CONFERENCES AND SPECIAL PROGRAMS

We conceive our responsibilities to include service to the business community in various ways. To this end the School has increasingly turned to short programs offered during the academic year and particularly during the summer. These programs, varying in length from one day to several weeks, are designed to afford an opportunity for practicing managers to attend sessions in specific fields. The objective is to afford management personnel an opportunity to learn of new developments relevant to management practice which are the outcome of the studies of our own staff as well as those of others conducting research in the field of management.

Professor Robert H. Gregory's five-day seminar on Management and Electronic Data Processing appraised the characteristics and techniques of electronic data processing systems relevant to business

management and covered the most recent developments in both local and long-distance data processing that are of special importance to management.

Professors Albert H. Rubenstein and Herbert A. Shepard (of the Department of Economics) conducted two Workshops on Human Relations in Research Laboratories, each for two days, at Endicott House. This program on the human relations aspect of laboratory management was an informal workshop-discussion of the problems of managing research and development personnel.

Professor William A. W. Krebs conducted a five-day conference at Endicott House on the Atomic Industry, 1956, which explored the technical and economic background of United States atomic energy development. The focus of this conference was on the unique problems facing management as the result of the rapid growth of the atomic energy industry.

In addition, members of our staff conducted two symposia for the Industrial Liaison Office: Control of Research Expenditures (Professor Rubenstein), and Electronic Computers and Business Problems (Professors Thomas V. Atwater and Gregory).

The School conducted two Special Summer Programs: Electronic Computers and Business Problems, which described the characteristics and operation of electronic data processors and related equipment and emphasized problem programming, coding, and solution in a computer; and Business Management and Electronic Data Processing, which was planned for those already somewhat familiar with electronic data processing who seek additional information about the status of business computation methods and prospective development.

RESEARCH IN MANAGEMENT

The ultimate test of the innovative character of business education lies in the extent and quality of the research emanating from the staff members. In the early years of the School, our staff was beset with the difficulty of preparing the best possible curriculum and teaching program for management. Now the demand upon Faculty time for preparing course material is decreasing. The additions to our Faculty and the added free time available to the staff have enabled members to pursue their research interests. As a consequence, our research program has assumed larger propor-

tions and will undoubtedly grow even more rapidly in the next few years.

In the spring the Laboratory for Organizational Behavior was completed and put into operation, under the direction of Professor Douglas M. McGregor. We hope to gain greater insights into the problem of executive selection.

Professor Eli Shapiro is doing an analysis of post-war capital markets for the National Bureau of Economic Research.

Following an exploratory study by Professors Shapiro and Myron J. Gordon last year, Professors Gordon and Edwin Kuh have done an extensive study on common stock in manufacturing firms in order to determine the effect of rate of growth, of uncertainty, and of size on the price of common stocks.

Professor Elting Morison has nearly completed his research on a biography of Henry Stimson.

Professors Thomas M. Hill, Myron J. Gordon, and Herbert F. Goodwin, with Professor Shepard, have undertaken a three-year study of hospital operation under the sponsorship of the U. S. Department of Health, Education, and Welfare.

Professor Ross M. Cunningham has completed the first phase of his studies in brand loyalty which have received wide attention in the field of marketing. He is now pursuing some of the implications of his earlier studies on a much larger scale. His text on *Industrial Marketing* (in collaboration with two other authors) was published this year and was favorably received.

Professor Krebs continued his study on the role of state governments in atomic energy development. He has published several papers on the subject, including a draft of an act for coordinating development and regulatory activities.

Professor David Durand is nearing completion of his study of the growth factor in utility stock prices. In the course of his work he has also developed a program for matrix inversion by the square root method which should prove valuable to statisticians. His manuscript on bank stock prices is being reviewed by the staff of the National Bureau of Economic Research.

Professor Edward H. Bowman continues his work on models for manufacturing analysis. His book, *Analysis for Production Management*, written in collaboration with Professor Robert B. Fetter, is in the final stages and will be published early next year.

Professor Fetter is also working on the application of waiting-line theory to servicing problems. In addition, he has collaborated with Professor Thomas P. Goodman of the Department of Mechanical Engineering in the application of analog computation to business decisions.

Professor John L. Enos has concluded his research on innovation in the petroleum refining industry and his conclusions will be published this fall.

Professor Goodwin has completed most of his work on production line study and the results will be published shortly. In the spring he was awarded the Gilbreth Medal of the Society for the Advancement of Management for "noteworthy achievement in the field of motion, skill and fatigue study."

Professor Gregory has done extensive work in analyzing business data processing systems and case studies of computer installations.

The work of Professor Kuh in investment theory should provide new insights into investment decisions. His Wells Prize book, written in collaboration with John Meyer and entitled *The Investment Decision: An Empirical Study*, will be published next spring.

Professor Richard B. Maffei is using high-speed computers to make a study of the occupational and areal structure of American industry.

Professor Rubenstein has undertaken a long-term program of investigation into the management of industrial research.

Professor Warren Torgerson's work on high-aptitude public high school seniors is supported by the National Science Foundation. His book, *Theory and Methods of Scaling*, is nearing publication.

The work of Professor Thomson M. Whitin in the field of inventory management has received much favorable comment.

Professor William Letwin's manuscript on the Sherman Anti-Trust Act has been completed.

PERSONNEL

The appointment of Dr. Jay W. Forrester as Professor of Industrial Management is of major significance to the School's future growth in the areas of data processing and the business use of high-speed

computers. Dr. Forrester has for many years been associated with M.I.T.'s Servomechanisms Laboratory and more recently with the Lincoln Laboratory, where he was one of those primarily responsible for the development of the SAGE system. His presence on our staff will undoubtedly stimulate a great deal of research and interest in these vital areas.

Professor Sidney Alexander comes to the School from the Columbia Broadcasting System, where he has been economic advisor to the president. He was previously Chief of the Finance Division of the International Monetary Fund and has been associated with a number of government and academic organizations. He will be interested primarily in business economics and business policy and will conduct research in the interrelationships of the social sciences.

Professor Marvin E. Shaw joins our staff as Associate Professor of Industrial Management in the Human Relations group. He was formerly associated with the Johns Hopkins University.

Dr. Edgar H. Schein comes to the School as Assistant Professor of Industrial Management to work in the area of social psychology. Since completing his graduate work at Harvard, he has been a research psychologist with the U. S. Army at Walter Reed Institute of Research.

Dr. Donald A. Corbin joins our staff for one year as a Visiting Lecturer in Accounting. He is Assistant Professor of Economics at the University of California.

Dr. Daniel Holland joins us in the spring as a Visiting Lecturer in Taxation. He is a member of the research staff of the National Bureau of Economic Research.

We are pleased to announce the promotions of Professor Whitin to Associate Professor of Industrial Management and of Mr. Floyd E. Gillis to Assistant Professor of Industrial Management.

Professor Thomas M. Hill has been on a leave of absence since February to accept an appointment as visiting professor in the Department of Economics at the University of Leeds, England, in connection with that school's newly organized program in industrial management.

Professor Letwin has been on leave since February while doing research in England on his forthcoming book on the origins of modern economic thought.

Professor Whitin has been on leave since August to accept an appointment as Chief of the Economic Branch of the Office of Operation Analysis and Planning of the Atomic Energy Commission.

We must also record personnel attrition. Professor Atwater resigned to accept a position in industry. Messrs. Barnes, Hamman, and Stewart have resigned in order to devote full time to their graduate work. Professor Krebs resigned to accept a position in industry, but he will continue his association with the School on a part-time basis. The resignation of Professor Alex Bavelas, who has undertaken a very challenging assignment for the Bell Laboratories, will be sorely felt.

LOOKING AHEAD

The creation of the School of Industrial Management and the build-up in staff and teaching programs was made possible by a generous grant from the Alfred P. Sloan Foundation. This financial support was not in the form of an endowment but was planned to provide the financing for the establishment and early development of such a school. After four years of operation we see more clearly the future scope of our activities. It is now necessary to secure additional financial support in order to complete plans for expansion in programs and research and to secure the staff needed to do both these things. A major problem for the next few years is to obtain continuing financial support. This problem now becomes one of major concern to the administration of the School.

E. P. BROOKS

SCHOOL OF SCIENCE

The School of Science has the responsibility of providing the basic scientific education and training for all students enrolled in the Institute. The necessity for teaching physics, chemistry, and mathematics to every freshman and to almost every sophomore gives rise to serious problems of scheduling and of over-crowding in laboratories. Superposed on this, the School has the responsibility of educating bodies of professional scientists in each of six disciplines, some of which are very broad.

The six departments of the School of Science fall into two groups: the three large departments—Chemistry, Mathematics, and Physics —which in addition to having large professional undergraduate and graduate enrollments assume the principal load of instruction for all freshmen entering the Institute in any field; and three smaller departments—Biology, Food Technology, and Geology and Geophysics—which do not have major service commitments. Al-

though all science departments are responsible for the production of professionals in their own fields, and all increasingly emphasize graduate study leading to the doctorate, the problems of the two groups are somewhat dissimilar. The individual problems of the six science departments are considered below in the reports of the several department heads. However, in addition, all are faced with the general problems of modern scientific education.

The changing of objectives to keep up with the changing needs for scientists by industry, government, and education poses special problems. It is becoming increasingly true that a professional scientist cannot be satisfied with four years of college training and a Bachelor's degree. Working through to the Doctor's degree is becoming the normal course of education in science, involving as it does approximately seven years of college work instead of the previous four. With this increase in the duration of the average college education superposed on the foreseeable growth in enrollments over the next decade, it is increasingly important that we select for special attention those portions of our curriculum which make contributions least readily available elsewhere. The magnificent plant and research facilities of the Institute make desirable a shift in the center of gravity of our curriculum increasingly toward advance work. While we have very great contributions to make to students in their beginning college years of education, a wave of such admissions should not be permitted to engulf our facilities to the detriment of education in the upper undergraduate and graduate years. Yet this trend must be balanced by the realization that one of our greatest contributions to American education is the amalgamation of elementary and advanced teaching with research, so that a science student, from the day he enters college, can find himself close to the firing line on any of the more important advancing fields of science.

Demand for our graduates, especially those with Doctor's degrees, is at an all-time high, and almost all external pressures are for expansion of our output. Even more important, however, is the need for a continued increase in quality. With the rising importance of science on the national and international scenes, it becomes mandatory to add continuously to the attainments of our graduates. Even more is it important that the occasional young

genius be given the opportunity to come to self-awareness, and be aided in raising himself to the peak of his possible accomplishment.

To discuss these and other problems of the School, a meeting of delegates of the School of Science was held at Endicott House on January 21, 1956. Some thirty professors and department heads of the School, under the chairmanship of the Dean, met with the President and the Provost. An extended discussion of the desirability of making the various schools of the Institute more autonomous was resolved with the conclusion that autonomy was not so much what was needed as increased self-awareness. One of the strong points of the Institute has always been the cohesion among the various disciplines represented in its Faculty, and it was felt that the monolithic structure of a single Faculty should be preserved as much as possible. However, since this Faculty is growing rather unwieldy to cope satisfactorily as a whole with the problems of the individual schools, it was felt that a middle path among these problems of growth should be carefully sought.

It was agreed that a somewhat increased degree of self-determination of the individual school faculties was particularly important at the graduate level. Many of those present reported that they felt the hampering effect of uniform policies in regard to all graduate students, whether engineers, architects, or scientists. At the undergraduate level it appeared desirable to maintain the present high degree of cohesion, one of the great strengths of M.I.T. in the past. We are faced, therefore, with the problem of steering a middle course between the organization of a typical university with its wide gulfs between professional schools, and an over-coherent structure in which, because of tradition, students in widely variant disciplines are required to take the same courses as the majority. No matter what we do, cohesion at all levels is likely to be increased by the rapidly increasing requirements for pure science instruction in the engineering curricula even at advanced levels.

An important aid to the planning of the School was the appointment by President Killian of an *ad hoc* committee to make recommendations on the education of science teachers for secondary schools. The committee consisted of a selected group of principals, headmasters, and school superintendents of various secondary schools, under the chairmanship of Professor John A. Finger,

Assistant Professor of Education at Colgate University. In March, 1956, this committee submitted to the President a report which has been carefully considered by the Science Council.

The committee verified the frequently expressed opinion that the numbers of persons teaching physics and chemistry in the high schools will need to be more than doubled in the next ten years. The committee urged that the Institute take a vigorous stand in insisting that the problem of meeting the salary differential between careers in secondary school science teaching and other careers in science be brought up for wide discussion among all groups concerned. The committee also recommended that the Institute urge that the problems of certification and tenure be re-examined to determine what steps need to be taken to protect our educational system in the coming years, and that the Institute help liberal arts colleges to become aware of their role in the preparation of science teachers. It is planned to hold a conference at the Institute in the near future on this subject.

The committee also suggested that a four-year program be added at M.I.T. to the present five-year program of training for secondary school teachers. This is now under consideration, in connection with the transfer of the teacher-training program at the Institute to the Department of Humanities.

As one of our major contributions to the improved science education of secondary school science teachers, a very successful summer program was again held this year—the Westinghouse Science Teachers' Program, under the direction of Professor Irwin W. Sizer. More than 200 secondary school science teachers applied to take the course, of which sixty-four were admitted and enrolled. This represented a falling off in numbers from recent years, probably because many other colleges and universities are offering comparable programs, some of these with fellowships up to twice as large as those offered at M.I.T. The emphasis on biology in the course was increased this summer, and laboratory work in biology, as well as in chemistry and physics, was emphasized. The fact that secondary-school science teachers often have poor backgrounds in mathematics has made it necessary to abandon the mathematics part of the course.

RESEARCH

Research in the science departments continues to be great in quantity and of outstanding quality. Although our Faculty are selected primarily for their abilities as teachers and for their interest in students, they are, almost without exception, scholars with a consuming interest in expanding the boundaries of some chosen discipline.

Support of fundamental research at the Institute, particularly by government agencies, continues to be extensive, but varies from field to field in a somewhat undesirable way. Physics, with its tremendous current importance in international affairs, is well supported by various government bureaus through research contracts in such important fields as nuclear science, electronics, and spectroscopy. In chemistry—though it is a field which is still much larger industrially than physics and one of top importance—support is somewhat less satisfactory. This is perhaps because chemistry came of age in the United States some twenty-five years ahead of physics, and the newer field often presents more glamor for a time. Nevertheless, the number of chemists in this country is still about five times as great as the number of physicists, and this important and expanding field deserves fuller support.

The research problems of the Department of Geology and Geophysics are similar to those in chemistry, though different in degree. While a certain amount of government research support is available, particularly in geophysical fields, further support is needed, especially to assist in attracting outstanding graduate students.

Excellent support is available in biology, not only from such government agencies as the National Institutes of Health but from the various foundations which in the past decade have been shifting much of their support from the physical sciences to the life and social sciences. In food technology—where our department exists because of the demands of a particular industry for graduates of the Institute—the problem is somewhat different. Current research is well supported by grants from foods industries as well as through contracts from the Quartermaster Corps and other government agencies. A great need exists, however, for capital support to make the Department stable on a long-term basis.

The School of Science welcomes the transfer, as of July 1, 1956,

of the Department of Meteorology to the School from its previous location in the School of Engineering. Professor Henry G. Houghton, Head of that Department, attended all meetings of the Science Council after the impending change was announced.

Professor Francis O. Schmitt, for the past fourteen years Head of the Department of Biology, has been appointed to an Institute Professorship, a distinguished academic post which recognizes outstanding achievement and permits him to devote his energies to any research field or combination of disciplines that he may choose. Professor Schmitt is now embarked on a greatly expanded research program in pursuit of his long-sought goal, elucidation of the mechanisms of living cells, particularly those of nerve and muscle.

As Acting Head of the Department of Biology, Professor Sizer has actively taken over its direction, and his plans for its extended and continued growth are being given close and merited attention and support.

DEPARTMENT OF BIOLOGY

With the change in departmental administration during the past year, the long-term goals of the Biology Department were re-examined. Plans are under way to expand its outlook in the area of life sciences and in particular to more closely integrate the work of the Department with the research in biology and medicine going on in other laboratories at M.I.T. Without attempting to cover all aspects of the wide field of biology, the Department will concentrate its efforts on molecular biology, with special emphasis on biochemistry, biophysics, and general physiology.

The seminar room on the seventh floor of the Dorrance Building has been converted into the Loofbourow Lounge, named in honor of the late Professor John R. Loofbourow, former Professor of Biophysics, Executive Officer of the Department, and Chairman of the Faculty. Furnishings for the room include comfortable chairs, a radio, and kitchenette facilities. Except when this lounge is used for seminars and small classes, it will be available at all times for study and recreation by our students, both graduate and undergraduate, as well as Department staff.

The addition of the latest RCA model to the Department's array of electron microscopes gives us the finest facilities in the world for teaching and research in electron microscopy.

Biophysics has been introduced as an elective in the under-

graduate curriculum as a course entitled "Introduction to Biophysics" to be taught by Professor Richard S. Bear.

For a considerable time wise counsel on an informal basis has been given to M.I.T. undergraduates by the staff of the M.I.T. Medical Department. This situation has been formalized with the appointment of Dr. James M. Faulkner as advisor to all M.I.T. premedical students.

The effectiveness of the premedical school curriculum has been appraised on the basis of the admission of biology graduates to medical school and the records made by these students on the Medical Aptitude Test. For the last five years, practically all the students who have applied have been accepted by medical schools. A survey of 531 colleges and universities over a period of three years with reference to records on the medical aptitude examinations indicates that M.I.T. premedical students are in the top 4 per cent of all students throughout the country who take the examination.

A new advanced course in biochemistry, "Intermediary Metabolism" under Professor John M. Buchanan's supervision, is available primarily to chemists and biologists who have already had a graduate course in enzymology.

In view of the shortage of students going into graduate work in biology, it seemed necessary to take special steps to build up the graduate program in this field at M.I.T. A special flyer concerning graduate education was prepared and distributed to colleges and universities throughout the country. In particular, this flyer described the large number of scholarships, fellowships, and teaching and research assistantships now available to graduate students in biology. Funds are still being sought to further strengthen this fellowship program.

For the past five years the postdoctoral training program for medical doctors has been handsomely supported by the Commonwealth Fund. This Fund has supported medical men who were working on Ph.D. programs as well as those devoted solely to teaching or research activities of the Department. This program of postdoctoral education has been extremely successful, and in recognition of this fact the Commonwealth Fund has presented M.I.T. with a terminal grant which should support this program for another four to five years.

Under the auspices of the Industrial Liaison Office, the Department presented a symposium on the subject of Biosynthesis, directed by Professor Sizer and including Professors Sizer, Gene M. Brown, Buchanan, David F. Waugh, Francis O. Schmitt, Bear, and Bernard S. Gould as participants. Professor Buchanan presented a Society of Arts lecture on "Radioactive Tracers and the Synthesis of Body Tissues" for students and teachers from secondary schools. An Alumni Day symposium on Medicine and Health included Professor Schmitt, who spoke about the contributions of biophysics to the field of medicine and public health. In addition, the Department of Biology held an open house for all visiting alumni.

A two-week Special Summer Program in instrumentation, directed by Professor Kurt S. Lion with able assistance from other members of the staff, was given for about fifty scientists from hospital, industrial, and research laboratories as well as from other academic institutions.

The Department suffered the loss of three of its professors during the past year. Professor Charles H. Blake has resigned in order to devote full time to his research in ornithology. Professor Roland F. Beers, Jr., has accepted a post as director of an enzyme research laboratory at the Johns Hopkins Medical School. Professor Myles Maxfield has accepted a position in medical physics at the Brookhaven National Laboratory.

New appointees include Professor Paul Weiss, Head of the Department of Growth and Development at the Rockefeller Institute, as Visiting Professor of Biology for the fall term. Professor Weiss will teach a seminar on embryology for graduate students and staff, during which one lecture demonstration will be held at the Rockefeller Institute. Dr. Eugene Bell has been appointed Assistant Professor of Biology to assist in teaching the embryology course. He will hold a joint appointment in the Bio-Acoustics Laboratory at the Massachusetts General Hospital.

Of special interest in the field of research during the past year were the following contributions:

Professor Cecil E. Hall has developed a technique for preparing specimens on thin sheets of mica for examination with the electron microscope. This has enabled him to view structures in viruses and proteins down to dimensions of 10 Angstrom units.

Professor Bear has constructed a model of the collagen molecule

which is consistent with the data obtained from x-ray crystallographic and physical chemical techniques.

Professor Gould has identified a precursor of collagen in healing wounds which is gradually converted to collagen during the repair process.

Professor Buchanan in his studies of nucleic acid biosynthesis has found the reactions involved can be prevented by certain drugs which are relatively effective in the chemo-therapy of cancer.

Professor Waugh has isolated a new protein in the casein fraction of milk which is the major component modified during the clotting of milk.

Professors Schmitt and Herman W. Lewis have isolated and dissolved giant chromosomes from the salivary glands of flies. By chemical techniques they have succeeded at least partially in reconstituting these chromosomes from dissolved components.

DEPARTMENT OF CHEMISTRY

During this academic year major attention was focused on teaching the course in General Chemistry offered to freshmen. Seven experienced members of the staff with the rank of Associate Professor to Instructor participated in the course for the first time by conducting recitation sections. These men joined the eight members of the Faculty who have lectured, conducted recitation sections, and supervised the laboratory work in General Chemistry in previous years.

This major addition of Faculty to the teaching program in freshman chemistry this year provided an excellent opportunity to review the subject matter of the course. As a result of this review and conferences of the entire chemistry Faculty, we will undertake a major revision of the subject matter for the 1956–57 academic year. Chemical equilibrium, inorganic chemistry, and the principles of qualitative analysis will continue to be central features of the course, but in addition more comprehensive treatment of structural chemistry, organic chemistry, and nuclear chemistry is planned. These changes are being made with the object of presenting to the freshmen subject matter taken from the major fields of chemistry (analytical, inorganic and nuclear, organic and physical), so that in addition to a thorough understanding of chemical principles the beginning student will gain more appreciation of the scope of the science of chemistry.

The Faculty action limiting general chemistry to six instead of seven contact hours per week was implemented during the year by reducing the number of three-hour laboratory periods offered each semester. The Faculty members engaged in teaching first-year chemistry are of the opinion that this reduction in laboratory time is unfortunate, since chemistry is an experimental science dealing with phenomena with which students have an opportunity to gain familiarity only through laboratory work. For approximately two-thirds of the students at the Institute, first-year chemistry is the terminal course in that subject.

The following itemization indicates the teaching programs of men added to the Faculty of the Chemistry Department during the past three years:

Professor Carl W. Garland has lectured in junior physical chemistry, in addition to sharing the responsibility for the corresponding laboratory courses with Professor David P. Shoemaker; he taught statistical mechanics during the absence of Professor Walter H. Stockmayer (on leave).

Professor Frederick D. Greene has lectured in junior organic chemistry, shared responsibility for the corresponding laboratory courses, and taught the course in theoretical organic chemistry offered to seniors and entering graduate students.

Professor Herbert O. House has lectured in junior organic chemistry, shared the responsibility for the corresponding laboratory courses, and taught an advanced course in synthetic organic chemistry offered to graduate students.

Professor Norman A. Nelson has lectured in junior organic chemistry and shared the responsibility for the corresponding laboratory courses.

Professor John S. Waugh has lectured in general chemistry and taught a graduate course in molecular spectra and molecular structure usually given by Professor Richard C. Lord.

Dr. Roy A. Whiteker has taught sophomore courses in qualitative and quantitative analysis and a graduate course in analytical chemistry dealing with the determination of organic functional groups.

These assignments, for all but one of these men, are in addition to the participation in the course in general chemistry noted above. All are conducting active research programs.

An important curriculum addition during the year was an

advanced course in physical-organic chemistry (Professor C. Gardner Swain), which was offered for the first time in several years and which will be continued annually. Professor George H. Buchi continued to offer a graduate course in organic chemistry in the field of natural products, and he has participated in recent years in teaching junior organic chemistry.

Professor Isador Amdur has been on leave of absence during the past academic year as the holder of a Guggenheim Memorial Foundation Fellowship at the University of California and the California Institute of Technology. His normal teaching assignments have been carried in his absence by Professors Stockmayer and James A. Beattie.

Professor H.C. Longuet-Higgins, the distinguished theoretical chemist from the University of Cambridge (England), delivered a series of lectures during the second semester as the fourth Arthur D. Little Visiting Professor of Chemistry. His lectures were most stimulating and were attended by a large audience of graduate students, members of the M.I.T. staff, and guests from other academic institutions and industrial laboratories in the Boston area.

Fields of research of Faculty members and students in the Department of Chemistry include the following:

Analytical chemistry: simple and mixed-ligand complex ion studies; electrodeposition from very dilute solutions; rates of electrode reactions; coulometry; polarography; the theory and application of photometric and thermometric titrations; titrations in non-aqueous solutions; applications of ion exchange; precipitations and separations with thioacetamide; fluoremetry and flame photometry.

Inorganic and nuclear chemistry: interhalogen compounds; lower valence states of metals; stability relationships of concentrated hydrogen peroxide; thermodynamics of chelate formation; structures and bonding of carbonyl compounds; application of crystal field theory to structure determination of transition metal complexes; chemistry of the fission products and fission process; β-decay energetics; thermodynamics of ion exchange; generalized acidity; solvent extraction and anion exchange studies; electrolyte behavior in non-aqueous solvents; deuteron excitation functions.

Organic chemistry: carbohydrates; heterocyclic compounds; organic peroxides; organometallic compounds; amino acids;

synthetic alkaloids; polymerization; reactions of active methylene compounds; reaction mechanisms; synthetic methods; tracer studies; relation of structure to reactivity; vitamins; terpenes; sterols; other natural products and physiologically active compounds.

Physical chemistry: pressure-volume-temperature relations of gases and liquids; the absolute temperature scale; heat capacities and latent heats at low temperatures; properties of gases at low pressures; diffusion of gases; scattering and other properties of molecular beams; electromotive force in concentration cells, and oxidation-reduction potentials; freezing points of liquid solutions; vapor pressures of liquid solutions; infra-red, ultra-violet and Raman spectroscopy; precision photometry; kinetics of thermal and photochemical reactions; properties of high polymers; properties of protein solutions; optical and electrical properties of thin metal deposits; study of crystal structure by X-ray diffraction; kinetics of very fast reactions; nuclear resonance studies of the constitution of molecules and crystals; lattice dynamics and low temperature elastic constants; absorption spectra of adsorbed molecules.

DEPARTMENT OF FOOD TECHNOLOGY

The Department of Food Technology has had an extremely active year both in teaching and research. Enrollment has increased both in the undergraduate and graduate sections. A great deal of effort has been spent on publicizing to high school students the advantages of a career in the food industries, which form the largest single facet of our national economy. Experience has shown that most high school students are unaware of the opportunities awaiting technically trained young people in the food industries.

The pioneering researches of the Department in both radiation preservation and in the application of modern electronic technic to the evaluation of the rheological properties of foodstuffs have attracted to the Department a number of highly capable graduate students as well as distinguished post-graduate visitors from other institutions and from industry.

Professor Bernard E. Proctor, Head of the Department, was appointed a member of the Official Delegation of the United States to the Geneva Conference on Atomic Energy last summer, where he presented one of the papers of the conference. In addition, he delivered a number of addresses at food research institutes throughout Europe. Dr. Proctor received the Nicolas Appert Award for

outstanding achievement in food technology from the Institute of Food Technologists in June in recognition of his researches in food technology.

The annual Special Summer Program, last year dealing with "Perspectives in Food Technology," achieved the greatest enrollment since its inception. This course has been extremely well received by those segments of our armed forces charged with the feeding of troops, and each year a number of different officers and civilians are sent to take this annual summer program. It has been gratifying also to have more food manufacturers send key people each year to take this course.

Sponsored research in the Department, as well as grants-in-aid, increased during the past year. Both the departmental Visiting Committee and the administration recognize the need for permanent endowment of the Department, and steps are being taken towards this end.

During the past year the Department has conducted two all-day seminars, devoted to consideration of the recent research activities of the Department, for departmental research sponsors and for the Industrial Liaison Office. In addition, the Department was host to the National Confectioners' Association for their annual meeting, and Professor Proctor participated in the annual meeting of the Association of Food and Drug Officials marking the fiftieth anniversary of the passage of the Wiley Act which created our modern food and drug laws.

Through the generosity of the X-Ray Department of General Electric Company, the Department of Food Technology has acquired its own electron accelerator for food irradiation. This will aid materially in the research activities of the Department as well as in graduate teaching and research.

A new sophomore course has been given during the past year for the first time. This is in line with the new program of undergraduate instruction which was adopted in the Department during the past academic year.

DEPARTMENT OF GEOLOGY AND GEOPHYSICS

The largest sophomore class ever to enroll in Geology and

Geophysics, together with a few upperclass transfers, raised the total undergraduate enrollment to a record sixty-six at the beginning of the year. Graduate enrollment was permitted to rise to fifty, the maximum number now considered desirable. The degrees granted during the year were about the same in number and distribution as in the past three years.

A new four-year and a new five-year program in Geology *and* Geophysics, to replace existing Courses XII-A (Geology) and XII-B (Geophysics), were approved and went into effect for all students in September, 1956. These curricula, which stress the basic sciences in the first three years and include an advanced and varied group of professional subjects, a longer summer field camp (increased from eight to ten weeks), and wider choice of both professional and non-professional subjects in the later years, were designed to attract more students into the earth sciences, a field in which there is a growing demand for graduates. To assist students in developing their programs and particularly in selecting elective subjects, the Department has set up an advisory system whereby each undergraduate and graduate student will have a staff member as an adviser.

In the four-year program the student may terminate his work at the end of the fourth year by presenting the usual thesis, at which time he will receive the degree of Bachelor of Science in Geology and Geophysics. However, if he can qualify for graduate work by the end of the seventh term and wishes to do so, he will be permitted to bypass the Bachelor's thesis and submit a single thesis at the end of the fifth year, at which time he will receive simultaneously the degrees of Bachelor of Science and Master of Science, both in Geology and Geophysics.

The Department offered for the first time a freshman elective subject in astronomy during the Spring Term, in which 120 students enrolled. Because such a large group was awkward to handle in night observations with our small telescopes on the roof of Building 24 and on the trips to the Harvard observatories, it has been decided to offer this subject during both terms next year. Dr. William H. Pinson will continue to have charge of the subject.

A new laboratory for mass spectrometry was created by bringing together several smaller laboratories and supplementing existing equipment to allow a broader program in this field. This move, along with additions to the Cabot Spectrographic Laboratory, was

part of a long-range plan to consolidate all major geophysical research laboratories on the ground floor of Building 24.

The eighth summer school was held at the Nova Scotia Centre for Geological Sciences with Professor Walter H. Whitehead as Director and Professor William H. Dennen in charge of geological surveying. Twenty M.I.T. students, six students from other U.S. colleges, and two students from Canadian schools received basic field instruction. In addition, eight students worked on thesis problems.

Four junior geophysicists, along with seventeen other students from fifteen other colleges, participated in the student cooperative plan of Geophysical Service, Inc., working during the summer as field assistants on geophysical field parties in the western United States. An outstanding feature of this carefully planned program is a series of forty lectures delivered to the student group by professional geologists and geophysicists during the orientation week at Dallas before the students go to their field assignments.

The Advisory Committee of the Geophysical Analysis Group met at Endicott House on April 16, 1956, with fifteen representatives from the nine supporting petroleum companies and five M.I.T. staff members present. The work of the year was presented and the Committee voted favorable consideration on the continuation of the project for another year, with the decreased budget and program requested by the Department.

Following the meeting just described, the third of the spring series of Industrial Liaison symposia, "Research Techniques for the Earth Sciences," was presented by six members of the Department and enthusiastically received by the invited guests.

A two-term sequence of lectures and a bi-weekly colloquium in physical oceanography are being planned for the coming school year. Several regular staff members from the Woods Hole Oceanographic Institution will deliver the lectures, and special speakers will be brought to M.I.T. for the colloquia, which will represent a cooperative effort by M.I.T., Woods Hole, and Harvard. It is hoped that these cooperative efforts will stimulate additional staff and student interest in oceanography.

Professor Roland D. Parks was on leave of absence from February, 1955, through January, 1956, to serve as Guest Professor at the Indian School of Mines and Applied Geology, Dhanbad, India. Professor

Ely Mencher was Visiting Lecturer in Petroleum Geology at Harvard College for both terms of the school year.

Professor Martin J. Buerger served his second year as Chairman of the Faculty and was appointed Institute Professor and Director of the new School for Advanced Study.

Research activities increased during the year as a record group of undergraduate and graduate students joined with staff members to carry on a varied program of thesis, project, and individual staff research. Most of the program was supported by outside funds, which came from the Office of Naval Research, Atomic Energy Commission, National Science Foundation, Rockefeller Foundation, and nine petroleum and geophysical companies.

Considerable use was made of the Whirlwind digital computor in studying the relationships between observed statistics and the physical interpretation of ground motions in seismic exploration. In this work further study was devoted to discrete linear operators as time domain filters. Whirlwind facilities were also used in further solutions in the X-ray analysis of crystal structures.

In the Cabot Spectrographic Laboratory, principal effort was devoted to developing new methods and techniques of analysis and new standards in preparation for a major study of the distribution of minor elements in sediments and sedimentary rocks. Studies of the natural variations in isotopic abundances by mass spectrometric methods led to the direct measurement of the age of certain sedimentary rocks and confirmation of the validity of age measurements on certain minerals in igneous rocks. A study of radiation damage in zircon collected from fifty localities in New England and the Maritime Provinces of Canada was completed during the year. A new method was devised for the direct radiometric determination of uranium and thorium in geological materials by gamma-ray spectrometry.

The stability of minerals at extreme pressures was investigated with special reference to the constitution of the earth's interior. Theoretical investigation of the stability of minerals under non-hydrostatic stress was carried out and application of theory made to problems of the origin of metamorphic rocks.

Following initial field successes last summer, further studies were conducted on an improved method of prospecting for sub-surface

conductive mineral deposits, utilizing frequency dependent effects that result from localized polarization.

Procurement of new staff for the Department is proceeding on schedule, and plans for an expanded program in geophysics and geochemistry are well under way. Recent additions to the staff include men especially selected for ability to apply the latest methods of the basic sciences to the difficult problems of the earth sciences.

DEPARTMENT OF MATHEMATICS

In the Department of Mathematics the year was marked by changes in the content of several mathematics subjects, a revision of the undergraduate curriculum for mathematics majors, another peak in enrollment in mathematics subjects, the addition of several new staff members, and the opening of a new office for undergraduate mathematics.

During the year a number of discussions were held concerning the content of several of the mathematics subjects. In the basic subjects in Modern Algebra (M62) and Analysis (M831, M832), changes were made which the Department feels will strengthen these subjects and will also help them to serve as better preparation for the subjects which follow in later years. In Differential Equations (M22), a subject which is taken by almost all second-year students at M.I.T., three new topics were introduced: Laplace transforms, partial differential equations, and series solutions. With these topics included in the program of Differential Equations, the Department was able to make substantial changes in Advanced Calculus (M351–2), which is now taken by a large number of third-year students as well as by many graduate students who come from other universities. The revised program in advanced calculus starts with vector analysis, a topic which electrical engineering students need early in their third year; since less time is needed for subjects now covered in Differential Equations, more work on complex variables and equations of mathematical physics can be given. The new programs will permit the coverage of several topics not treated previously as well as more thorough coverage of topics previously treated with less detail. These changes were decided on after discussions with staff in other departments and after evaluating the results of an experimental program which the Department of Mathematics has been conducting during the past two years.

During the Spring Term members of the Department held discussions with representatives of the Physics Department concerning possible changes in the second- and third-year mathematics program for physics majors. As a result, the Department has made plans for an experimental program for second- and third-year physics students. The program will take into account the fact that these students all take three years of undergraduate mathematics, and a completely coordinated program for the second and third years is planned. It will start next fall on an experimental basis for second-year students in physics and if it proves successful will be carried over to third-year students the following year. It is also believed that other departments which require three years of mathematics in their undergraduate programs may wish to shift to this type of program if it becomes formally established.

During the year a departmental committee made a thorough study of the curriculum for undergraduate mathematics majors, and as a result of the recommendations of this committee several changes were made in the curriculum. The new curriculum has several parts: (1) subjects, common to all M.I.T. curricula, in physics, chemistry, mathematics, and humanities; (2) basic mathematics subjects, primarily for mathematics majors, to be taken during the third and fourth years; (3) elective subjects which are divided into two groups. Students will be allowed during each semester to take some electives in any department of the Institute, but they will also be required to take elective subjects of a professional nature, chosen either from mathematics or from engineering and science. The Department feels that this curriculum gives greater flexibility to the individual student, while at the same time it makes up an integrated, broad, and well-rounded program and guarantees a strong core of mathematics training.

Enrollment in mathematics subjects during the year again reached a new high. During the fall semester a total of 3,293 students enrolled in mathematics subjects in 117 sections. These figures compare with 3,089 students in 108 sections for the fall semester of the preceding year and 2,908 students in 100 sections during the fall of 1953. The increase in enrollment, which has been taking place almost steadily during the past decade, is a reflection not only of the increased enrollment at M.I.T. but also of the larger percentage of students who take mathematics beyond the freshman and

sophomore years. More departments are requiring a third year of mathematics and more students are electing mathematics beyond the required courses both as undergraduates and as graduate students. The Department continues to offer a wide variety of advanced undergraduate and graduate subjects, and it serves as the minor department for the Doctorate for a large number of graduate students.

In last year's report appropriate mention was made of the resignation of Professor Raphael Salem and the death of Assistant Professor Irvin S. Cohen. To handle the increased enrollment in mathematics the Department not only obtained replacements for these two former members of the Faculty but also continued slowly to enlarge its staff. Three new Faculty members, Associate Professor Alberto P. Calderon and Assistant Professors Nesmith C. Ankeny and Louis N. Howard, joined the Department at the beginning of the academic year. In addition, Visiting Lecturers during the year were Dr. Jacob J. Levin, formerly of Purdue University; Dr. Hartley Rogers, Jr., formerly of Harvard University; and Dr. Roy C. T. Smith of the University of New England, Armidale, Australia. Dr. Levin has accepted a position as mathematician at the Lincoln Laboratory at M.I.T.; Dr. Rogers has been appointed to an Assistant Professorship in this Department; and Dr. Smith is returning to the position from which he has been on leave while on a Fulbright Travel Grant to the United States.

Professor Philip Franklin is in charge of a new undergraduate office, and with the help of the departmental committees concerned with the first two years and with the third year he has very effectively coordinated the work of the first three years.

The Mathematics Colloquium met regularly each week, usually with a guest speaker from another university. Various members of our Faculty spoke at colloquia of other universities and at symposia and meetings of scientific societies. Professor Norbert Wiener spent the year on leave from M.I.T. During most of the year he was lecturing and pursuing research work at universities in India, but both on the way to India and on the way back he lectured extensively in mathematical centers in England, other parts of Europe, Japan, and more recently at the University of California. Associate Professor George W. Whitehead was on leave while holding a Guggenheim Fellowship and a Fulbright Grant for research

in mathematics at Oxford University. Associate Professor Kenkichi Iwasawa was an invited participant and speaker at the International Symposium on Algebraic Number Theory held at the University of Tokyo from September 8 to 13, 1955. Professor Chia-Chiao Lin of this Department, together with Professor William R. Hawthorne of the Department of Aeronautical Engineering and Professor Victor P. Starr of the Department of Meteorology, organized a series of lectures on the fluid mechanics of hurricanes arranged by the Department of Meteorology. Professor Eric Reissner received the 1956 Clemens Herschel Award of the Boston Society of Civil Engineers for a paper published in the Journal of the Society.

DEPARTMENT OF PHYSICS

The past year has brought the anticipated increase in the number of undergraduates majoring in physics and growing popularity of the junior and graduate subjects in modern physics for non-physics majors. These factors, taken with the increased service load in freshman and sophomore physics, have generated a serious need for space and for extra staff time, and they make desirable a sizeable expansion of our junior staff.

In view of the increasing demands on staff time for our undergraduate teaching effort, some way needs to be found for limiting non-teaching and non-research demands on the Faculty (especially on the younger members). Under no conditions can we afford to deny our staff adequate time for research, and it would be unfortunate to have to abandon the new experiments in teaching which have led to such outstanding contributions as our undergraduate laboratory program and Professor Francis Bitter's exciting new sophomore course for which a textbook will shortly appear.

The teaching program of the Department faces even greater difficulties in that the teaching services of Professors Philip M. Morse, M. Stanley Livingston, Albert G. Hill, and Clark Goodman will not be available in the next few years because of new assignments. Professor Morse's new duties as Director of the M.I.T. Computation Center and Professor Livingston's duties as Director of the new Cambridge Electron Accelerator project are typical examples of the competition for staff time between teaching and forward-looking research. Professor Hill is on leave to serve as Director of Research of the Weapons Systems Evaluation Group, and Professor Goodman is on leave to serve as Assistant Director

of the Reactor Development Division of the Atomic Energy Commission. While it is possible to hire teaching replacements for these men, it is not possible, at junior staff level, to replace their skill and experience in teaching.

A program of overhauling and strengthening the junior laboratory for physics students is being initiated and this will be a four or five year effort. The need for additional space for this laboratory continues, and the problem of initiating a strong third-year laboratory program for non-physics majors referred to in last year's report looms larger than ever.

The research program of the Department is in a most healthy state, and the outlook for the future is bright. The high-energy physics program, which will grow in significance with the advent of the new accelerator, has brought into being one of the most stimulating and active research groups. Plans for generating a healthy and strong experimental solid-state physics research program to supplement the excellent theoretical research in this field are moving ahead, and the neutron diffraction program will provide a major first step to this end.

Professor Wayne B. Nottingham's annual Conference on Physical Electronics continues its successful course. The Summer Program for Science Teachers, sponsored by the Westinghouse Educational Foundation, had as lecturers from the Department Professors Jerrold R. Zacharias, Martin Deutsch, and Livingston, each presenting a phase of modern physics. This proved highly successful, and it is planned to repeat this type of program. Nine high school teachers were hired as summer research assistants in physics for service in various research laboratories, and this turned out to be highly beneficial both to the teachers and to the laboratories.

Professor Victor Weisskopf has been awarded the Max Planck Medal; he is the third recipient of this distinguished award. In addition, Professor Weisskopf attended the Moscow Conference on High-Energy Physics.

The Department was, as usual, host to a number of distinguished visitors. Among those who addressed the Physics Colloquium were: Professor A. von Engel, Oxford University, England; Professor J. Sayers, University of Birmingham, England; Professor A. Pais, Institute for Advanced Study, Princeton, New Jersey; Dr. Per-Olov Löwdin, University of Uppsala, Sweden; Professor André Guinier,

Conservatoire des Arts et Metiers, Paris, France; Dr. J. R. Haynes, Bell Telephone Laboratories; and Professor L. LePrince-Ringuet, Ecole Polytechnique, Paris, France.

LABORATORY FOR NUCLEAR SCIENCE

The program of the Laboratory for Nuclear Science centers currently about the following general activities: nuclear inorganic chemistry (Professors Charles D. Coryell, John W. Irvine, Jr., and George Scatchard); nuclear organic chemistry (Professors John C. Sheehan and Swain); chemistry of the fission elements (Professors David N. Hume and Lockhart B. Rogers); cosmic ray research (Professors Bruno B. Rossi, Robert W. Williams, George W. Clark, William L. Kraushaar, and John B. Linsley and Drs. Herbert S. Bridge, Stanislaw Olbert, and David O. Caldwell); photo-meson and photo-nuclear research using M.I.T.'s synchrotron and linear accelerator (Professors Bernard T. Feld and David H. Frisch and Drs. Louis S. Osborne, David M. Ritson, Albert Wattenberg, Peter T. Demos, and Charles P. Sargent); theoretical nuclear physics (Professors Weisskopf, Herman Feshbach, Felix M. H. Villars, Francis L. Friedman, and S. Drell, and Drs. Marvin H. Friedman and F. Zachariasen); nuclear energy level studies using the M.I.T.-O.N.R. Van de Graaff generator (Professors William W. Buechner and Harald A. Enge, Drs. C. P. Browne and Frederic J. Eppling, and A. Sperduto); coulomb excitation and gamma ray angular correlation studies using the Rockefeller Van de Graaff generator (Professor Deutsch, Dr. Benjamin Goldring, and Rolf P. Scharenberg); elastic scattering of alpha particles, protons, and deuterons from nuclei using M.I.T.'s Markle cyclotron (Professor Deutsch and Dr. Nathan S. Wall); radioactivity research and positronium studies (Professors Robley D. Evans and Deutsch and Constantine J. Maletskos and H. W. Kendall); high-energy nuclear emulsion studies (Drs. Ritson, A. Pevsner, Osborne, and Robert A. Schluter); and bubble chamber studies (Dr. Irwin A. Pless).

Persons active in the work of the Laboratory during the past year, not including visitors, totalled 285. These included fifty-two academic staff members of the Departments of Chemistry and Physics, twenty-six D.I.C. staff members, thirty-eight graduate students from the Department of Chemistry, sixty-four graduate students from the Department of Physics, sixty-eight full-time non-

staff employees, and thirty-seven part-time non-staff employees. Theses carried by students working in the Laboratory involved four B. S. degrees, six M. S. degrees, and thirteen Ph.D. degrees. Publications submitted to scientific journals numbered seventy-two, and ninety-three addresses were delivered to various scientific conferences and meetings. Foreign scientists from twenty universities were active in the researches of the Laboratory.

The activities of the Cosmic Ray Group have been concerned with high energy nuclear interactions and with high energy air showers. Both "natural" cosmic rays and artificially accelerated particles from the Brookhaven cosmotron have been used for the first of these, supplemented by theoretical work in the interpretation of the "strange" particles. Extensive experimental work has been done on the energy distribution of air showers, supplemented also by theoretical computations relating the observable properties of the showers to the primary particle energies and the character of their nuclear interactions. A significant advance in the air shower experiment was achieved by Professor Clark during the year through the development of extremely large but relatively inexpensive plastic scintillators up to fifty inches in diameter. The program of the group currently includes operation of multiplate cloud chambers in Colorado and at the Brookhaven National Laboratory, photometric ionization measurements, operation of an air shower monitor in India, the construction of a very large meson telescope, operation of the large air shower experiment at the Harvard Agassiz Observatory, calculations of high energy cosmic ray cascades, development of a structured picture of the new unstable particles, and a search for long-lived K-mesons using the Brookhaven cosmotron.

Considerable work was done through the year using nuclear emulsions to study the relatively intense, well-focussed K-meson beams which have become available at Brookhaven and Berkeley. The method is ideal as an exploratory technique and was used to examine the general properties and inter-relationships of the K-meson family. Specifically explored were: the masses of the K-mesons based on range-momentum measurements, secondary mass values and relative frequencies of occurrence of the various modes of decay using the ranges and identities of the secondaries, lifetimes from decays occurring in flight, absence of high mass

secondaries from the K-meson beam, spin-parity properties of the tau meson, and the interaction properties with nucleons of K-mesons in flight and relative scattering cross sections for tau and theta particles.

Experiments have been initiated to extend the measurement of K-interaction cross sections to higher energies and to look for the long-lived neutral "strange" particles required by current theory. Absence of the latter particles would lead to a radical revision of current basic concepts. On the technical side a pulsed magnet of about 300,000 gauss is being developed in the hope of focussing very short-lived particles in distances of a few centimeters. The use of emulsions immersed in liquid hydrogen (or deuterium or helium) is also being investigated as a means of stopping K-particles or antiprotons by simple nuclei.

Work throughout the year with the synchrotron has continued at a very active pace. The proposed new Van de Graaff injector has been tested and is in the process of being installed. A hundred-fold increase in beam intensity is expected which should allow the performance of secondary scattering experiments: for example, polarization measurements of secondary nucleons and the use of secondary mesons for scattering and absorption experiments. Research throughout the past year included: the photoproduction of π^+ mesons from hydrogen at 265 Mev, π° production from a number of elements, a study of the momentum of nucleons in nuclei, the photoproduction of mesons from complex nuclei, measurement of the energy spectrum of neutrons emitted in coincidence with positive mesons, a study of the photoproduction of mesons from deuterium, investigation of the electric-dipole "giant resonance" in terms of the quasi-deuteron model, completion of the experiments in nuclear γ-ray scattering, the development of a fast coincidence-anticoincidence telescope detector for ionizing particles, and what it is hoped will be a higher resolution γ-ray detector using lead glass chips in conjunction with scintillating liquid.

Research with the linear accelerator has been directed towards scintillation spectrometer measurements of photoproton energy distribution, measurement of cross sections for the coulomb excitation of nuclei by electrons, and time-of-flight measurement of photoneutron energy distributions. Quantitative measurements have been made incidentally of the bremsstrahlung beam produced

by the linear accelerator, including a method for determining the shape of the high-energy end of the spectrum.

The work of the Theoretical Group has spanned a wide gamut, ranging from low-energy nuclear physics through meson phenomena, high-energy nucleon scattering, and "strange" particles. In the low-energy nuclear field, a great deal of emphasis has been put on the Bohr-Mottelson model, which still suffers from some logical difficulties. In particular, the question of what the moment of inertia is, the behavior of the quadrupole moments, and the relation of the unified model to a more fundamental nuclear Hamiltonian are still not understood. The recent successes of the Chew-Low theory have prompted further meson calculations. In particular, the Chew-Low theory does not give a discussion of s-wave phenomena, and a phenomenological s-wave theory has been proposed and compared with experiment. Two-meson phenomena in which p-wave mesons are involved have been explored via the Chew-Low theory. The connection of p-wave meson effects and the spin-orbit forces in nuclei is also being explored. Finally, the model for nucleon-nucleon scattering has been developed which explains qualitative features of that scattering and gives a qualitative fit to the data running from 0 to 275 Mev. Additional investigations have included: the "cloudy crystal ball" model of the nucleus, the optical model potential, the nature of the spin-orbit coupling, the direct interaction in inelastic neutron scattering, photodisintegration of the deuteron, nuclear saturation, relativistic wave mechanics, proton polarizability, and the inelastic scattering of 30-Mev protons by heavy nuclei.

The general program of nuclear spectroscopy using the M.I.T.-O.N.R. Van de Graaff generator has continued. The level schemes of a large number of nuclei have been investigated and clarified; many of these nuclei have not been studied previously. Studies have been continued of means of obtaining spin and parity confirmation of individual levels. The mechanisms of certain reactions have been investigated with particular emphasis on coulomb excitation and the role of the isotopic quantum number.

Work with the M.I.T. cyclotron has centered about an investigation of the general properties of nuclear reactions as determined by the measurement of elastic scattering angular distributions and of a study of the mechanisms of nuclear reactions. The elastic scat-

tering of protons, deuterons, and alpha particles has been examined in an effort to interpret the data in terms of the "cloudy crystal ball" nuclear model. Effort is being made to increase the intensity of the cyclotron beam with a view to performing magnetic analysis on the emergent beam and the reaction products.

The Radioactivity Group during the past year has continued to be concerned primarily with studies of radioactive decay processes and investigations of the properties of positronium. A systematic program to investigate the properties of excited 0^+ states in medium-weight nuclei has been undertaken. The decay schemes of Al^{26} and Co^{57} have been studied, and work is continuing on the resonance absorption of γ rays.

All research with the Rockefeller Van de Graaff generator in the past year was in the electric excitation field, the major project being the measurement of relative transition probabilities for two excited states in odd-A nuclei. Since late last year work has been in progress in cooperation with the Radioactivity Group on the measurement of magnetic moments of excited rotational states.

In association with scientists from Harvard University, members of the Laboratory have participated over the past two years in preliminary design studies on a 6-Bev electron accelerator to be located on Harvard University grounds. Responsibility for the construction contract with the A.E.C. will be assumed by Harvard University; however, a joint committee of scientists and administrators from Harvard and M.I.T. will supervise the construction and operation of the accelerator as a research facility. Detailed design of the machine has begun and construction of some of the buildings should be underway by fall.

SPECTROSCOPY LABORATORY

The past year has seen results of more than passing importance from several of the Laboratory's research programs. The ruling engine under Professor George R. Harrison produced several eight-inch diffraction gratings having resolving powers near the ultimate for this large size and with ghost and satellite intensities lower than any previously ruled elsewhere. Unprecedented resolution in the vacuum ultraviolet has been obtained with the echelle spectrograph recently developed in the Laboratory. A new investigation of the infrared spectra of adsorbed substances under Professor Lord has already shown the feasibility of this method of studying mole-

cules held on the surface of certain metallic catalysts and indicates that the course of surface reactions may also be followed with this technique. The study of molecular structure by means of infrared and Raman spectra showed that two molecules of considerable interest—disiloxane and cycloheptatriene—have structures rather different from those currently accepted, with important implications for the structure and reactivity of these and related molecules.

The echelle spectrograph and comparator have been developed and refined so that wavelengths in the visible and ultraviolet regions can be quickly and easily measured with an accuracy approaching one part in five million. Using these instruments, the Zeeman effect in the spectra of the rare earths erbium and praseodymium have been photographed and measured by Dr. Sumner P. Davis. The data are being used to construct energy-level diagrams of these atoms. Use of the Whirlwind computer has simplified some of the arithmetic computations. Spectra of three other rare earths—terbium, dysprosium, and holmium—are being prepared for similar analyses.

A detailed study of the hyperfine structure of excited states of atoms is being undertaken by Professor Lee C. Bradley, making use of coincidence-counting techniques. The method will allow observation of any excited state of an atom rather than only those reached by optical excitation from the ground state. It is based on the observation of coincidences between optical quanta emitted in cascade.

A project under the direction of Professor Scatchard for the spectroscopic measurement of vapor pressures of alloys extended its studies to the system silver-zinc-cadmium.

Results of research in molecular spectroscopy came from a variety of investigations. A study of the structure of soda-silica glasses by Raman spectra, supported by the Owens-Illinois Glass Company, was completed during the year. Structural studies were carried out by means of infrared and Raman spectra on the molecules cycloheptatriene, disiloxane, spiropentane, cyclopropane and methyl amine. All but the first of these molecules were prepared in deuterated form to aid in the interpretation of the spectra. The last two were also studied under high resolution in the infrared and their geometrical parameters determined. The

parameters for methyl amine agree with those determined by microwave studies, as does the barrier height restricting internal rotation.

An investigation of the nature of adsorption on metal surfaces by means of the infrared spectra of adsorbed molecules has been started by Professor Carl Garland and Mr. Andrew C. Yang. Carbon monoxide, ammonia, ethylene, and other simple molecules have been adsorbed on finely divided alumina and silica coated with thin metal films. The metals were cobalt, nickel, copper, rhodium, palladium, and platinum. Reasonably good spectra of the adsorbed materials have been obtained in the range of high-frequency fundamentals. The spectra provide evidence for the effect of the adsorption on the chemical bonds of the adsorbed molecules.

The Special Summer Programs in Infrared Spectroscopy were attended in 1956 by some 130 persons. The Programs were presented with the help of five lecturers from other institutions: Dr. F. A. Miller, Mellon Institute; Professor E. R. Lippincott, University of Maryland; Dr. M. K. Wilson, Tufts University; Dr. Norman Sheppard, Trinity College, Cambridge, England; and Dr. L. J. Bellamy, British Ministry of Supply.

Other research scholars from American and foreign institutions working in the Laboratory during the past year included Dr. Ryumyo Onaka, University of Tokyo; Mr. Stanley Baker, New South Wales University, Australia; Dr. René Zurcher, Swiss Institute of Technology, Zurich; and Professor Y. Tanaka, Tokyo University of Education.

The research work of the Laboratory during the year led to about a dozen published papers which are listed under those of the Departments of Physics and Chemistry.

SOLAR ENERGY PROGRAM

Work continues actively in the Godfrey L. Cabot Solar Energy Program, in which four projects occupy our main efforts. Study of solar house heating is to be accelerated by the construction of a new solar-energy heated house, which we plan, after completion of the initial tests, to sell for family use. Work continues on light-catalyzed organic syntheses, on the economic possibilities of solar distillation of sea water, and on the photo-chemical decomposition of water by the use of cerium and uranium salts.

GEORGE R. HARRISON

REPORT OF THE TREASURER

The principal changes in the Institute's financial position and activities during the fiscal year 1955–56 are summarized in the following exhibit:

	Change	*1955–56*	*1954–55*
Academic operations	+$ 2,286,000	$ 17,099,000	$ 14,813,000
Endowment funds	+ 3,028,000	51,084,000	48,056,000
Total funds	+ 8,847,000	82,680,000	73,833,000
Gifts and grants	+ 3,312,000	10,387,000	7,075,000
Plant assets	+ 1,894,000	37,980,000	36,086,000
Investments — market value	+ 14,339,000	123,683,000	109,344,000
Investments — book value	+ 7,461,000	79,292,000	71,831,000
Division of Industrial Cooperation	— 269,000	9,299,000	9,568,000
Division of Defense Laboratories	+ 6,085,000	33,793,000	27,708,000

OPERATIONS

The following table compares the Institute's operations during the past two fiscal years:

	1955–56	*1954–55*
Revenues and Funds		
Tuition and other income	$ 4,964,000	$ 4,673,000
Investment income	1,890,000	1,259,000
Gifts and other receipts	3,859,000	3,560,000
Contract allowances for indirect expenses	4,580,000	3,543,000
Auxiliary activities	1,806,000	1,778,000
Total	$17,099,000	$14,813,000
Expenses		
Academic	$ 6,901,000	$ 6,142,000
General and administration	5,237,000	3,919,000
Plant operations	3,014,000	2,975,000
Auxiliary activities	1,947,000	1,777,000
Total	$17,099,000	$14,813,000

Academic expenses for the year under review reflected primarily increased Faculty salaries and compensation to Institute employees, along with increased departmental expenses for teaching and research. The increase in salaries and wages was met in part by a special distribution set aside a year ago from unallocated investment income. Gifts and other receipts and tuition income supplied a substantial proportion of the additional income required for the programs of the academic departments. The expense of the improved staff retirement plan and other employee benefits are included in general and administration expenses for the year. The expansion in general, administration, and plant expenses brought about the increase in contract allowances for indirect expenses.

Sponsored research continued during the year as an important and growing responsibility of the Institute, and the financial volume of activity exceeded the level of the highest year during the war. Many sponsored research projects are closely integrated with the teaching programs of the departments and contribute very materially to academic operations, particularly to the strength of the Graduate School. A substantial proportion of the Institute's general, administration, and plant operating expense is made up of

indirect expenses of activities required by the sponsored research program. The deficiency of auxiliary activity revenues to meet expenses was occasioned in part by a change in reporting procedures as described elsewhere in this financial review.

GIFTS

This table shows the continuing growth of gifts to the Institute:

	1955–56	*1954–55*
Gifts for endowment	$ 2,404,000	$ 611,000
Gifts for buildings	1,134,000	1,531,000
Gifts for current use — invested	2,176,000	1,893,000
Industrial Liaison support	1,105,000	818,000
Other funds for current use	3,568,000	1,947,000
Gifts of real estate	.....	275,000
Total gifts	$10,387,000	$7,075,000

Gifts for the year exceeded the peak year during the great Development Program, with 1955–56 at $10,387,000 compared to $9,145,000 in 1950–51.

Gifts for endowment were higher than in any year since the end of the war, with $1,360,000 received from the Ford Foundation for Faculty salaries. Endowment funds of $500,000 for research included $200,000 given by the Estate of Alfred H. Caspary and $300,000 from the Estate of Edith Carson Wilder. Undergraduate scholarships were endowed with total gifts of $433,000. Principal donors were the Estate of Katherine Noble; the family of W. Danforth Compton in his memory; Mrs. Marie G. Dennett for the Carl Pullen Dennett Fund; Godfrey L. Cabot, Inc., for the Cabot Endowed Scholarships; Mr. Paul W. Litchfield for the Litchfield Fund; Merrill Lynch, Pierce, Fenner & Beane for the Charles E. Merrill Fund; Transoceanic Marine, Inc., for the Niarchos Merchant Seamen Memorial; Redfield Proctor for the Vermont Scholarships; and the Boston Stein Club for the New England Scholarships.

In the gifts received for buildings, major support to the Compton Laboratory and the nuclear reactor was provided by Ireneé du Pont, Mr. and Mrs. Alfred P. Sloan, Jr., the Edwin Sibley Webster Foundation, the Rockefeller Foundation, and John L. Pratt. Alvan

T. Fuller contributed generously toward the organ for the Kresge Auditorium.

In the invested gifts for current use are included the bequest of David Flett du Pont of $1,006,000 for athletic facilities, the Alumni Fund of $355,000, and $430,000 as an expendable capital fund supplied by the Ford Foundation for professorships in economics.

The Sloan Foundation and the Ford Foundation made very large contributions for the continuation of programs financed by annual grants over a period of years, and these grants are included in other gifts for current use.

FUNDS

Endowment and other funds continued to increase during the year:

	June 30, 1956	*June 30, 1955*
Endowment for general purposes	$33,994,000	$33,569,000
Endowment for designated purposes	17,090,000	14,487,000
Total endowment funds	$51,084,000	$48,056,000
Other funds	31,595,000	25,777,000
Total funds	$82,679,000	$73,833,000

Total endowment funds at the year end included as new endowment resources $1,692,000 for Faculty salaries, $660,000 for departments and research, and $433,000 for undergraduate scholarships. The increase of $3,028,000 for endowment contrasts with the increase of $5,818,000 in other funds, largely expendable for current purposes. Funds for additions to the academic plant, for student athletic programs, for the funding of faculty tenure salaries and other expenses now met with current revenues, and for the support of the academic departments, together with the net realized gain on investment transactions composed the principal additions to other funds during the year.

To start a fund to finance new appointments to the Faculty, $101,000 was transferred from unrestricted funds. Building funds at $3,478,000 and the reserve for academic plant of $514,000 on June 30, 1956, were indicative of the construction in progress and to be completed and financed largely in the next year. Including retire-

ment funds, the book value of all funds at the close of the year was $89,653,000.

PLANT FACILITIES

The construction of the nuclear reactor and reactor building was started in June, 1956. Further progress was made on the Karl Taylor Compton Laboratories, scheduled for completion and occupancy by the Departments of Physics and Electrical Engineering in the early part of 1957. The Computation Center, as a part of the Compton Building, is under construction and will be financed in part by the International Business Machines Corporation through grants made over a period of years. Since the close of the fiscal year, commitments have been entered into to purchase, initially as an investment, the building and land at 640 Memorial Drive. In addition approximately 31,000 square feet of land on Main Street, north of the Sloan Building, is being purchased from First National Stores as an addition to the academic plant of the Institute.

A grant of $500,000 received after the close of the year from the National Science Foundation assured the ultimate financing of the nuclear reactor and building, but other funds have yet to be secured to complete the project.

The program of progressive building maintenance was continued during the year, with the greater part of the expenditures devoted to improved maintenance of the basic building structures and utilities. Total expenditures for special alterations, maintenance, and equipment were $919,000, compared to $730,000 last year, while regular plant operating expenses increased from $1,599,000 to $1,828,000 in line with the expanded physical plant of the Institute and the increase in costs of building operations. In recent years increased funds have been made available to the academic departments for equipment and space alterations.

The book value of the educational plant of the Institute was $37,980,000 on June 30, 1956, up from $36,086,000 on June 30, 1955.

INVESTMENTS

The investment position of the Institute on June 30, 1956, and June 30, 1955, is presented in the following table, which is exclusive

of the investments of the M.I.T. Pension Association and the Supplementary Retirement Plan:

	June 30, 1956		*June 30, 1955*	
	Book Value	*Market Value*	*Book Value*	*Market Value*
General Investments				
Bonds	$38,704,000	$ 38,183,000	$31,696,000	$ 31,675,000
Stocks	22,457,000	63,649,000	20,348,000	54,772,000
Real estate	10,503,000	10,503,000	10,496,000	10,496,000
Cash and commercial paper	1,477,000	1,477,000	3,711,000	3,711,000
Total	$73,141,000	$113,812,000	$66,251,000	$100,654,000
Special investments	4,765,000	8,387,000	4,347,000	7,457,000
Student notes receivable	1,484,000	1,484,000	1,233,000	1,233,000
Total	$79,390,000	$123,683,000	$71,831,000	$109,344,000

Funds sharing in the income from the general investments earned 6.29 per cent on the average book value compared to 5.69 per cent last year, and 5 per cent was allocated to the funds compared to 4.5 per cent in 1954–55 and 4.0 per cent in 1953–54. In addition, 1 per cent was distributed in 1955–56 from investment income earned in 1954–55. The total income on the general and special investments was $4,070,000. Of this amount $1,889,000 was used for current expenses, $470,000 was added to principal of endowment funds, and $173,000 was added to unallocated investment income. The remainder was added to funds available for current use. Total unallocated investment income at June 30, 1956, was $3,216,000, of which $595,000 was set aside for distribution in 1956–57. The general investment gain and loss account was $5,401,000 on June 30, 1956, compared to $4,498,000 on June 30, 1955.

ORGANIZATION

The office of the Vice President and Treasurer was greatly strengthened during the year by the appointment of Philip A. Stoddard as Assistant Treasurer of the Institute to join Paul V. Cusick and the Treasurer in carrying the responsibilities for financial

and business administration. He will have executive responsibility for the physical plant, new construction, housing, dining, and certain other services provided the Institute community. Mr. Stoddard brings to his new post a wide and useful experience at M.I.T.; a member of the Class of 1940, he was formerly Associate Placement Officer and has served as Acting Director of the Industrial Liaison Office.

By amending the Bylaws the Corporation clarified the responsibilities of the Finance Committee and of the Treasurer for the investments of the Institute. The total market value of all investments under the supervision of the Committee and the Treasurer exceeded $132,000,000 on June 30, 1956. In managing the investment property of the Institute in accordance with the policies of the Finance Committee, the Treasurer has the able assistance of Frederic W. Watriss of the Class of 1941, a member of the financial staff since 1952.

John A. Little, C.P.A., the Institute's Accounting Officer, has recently assumed further important duties for accounting matters related to the Institute's operating budget. Wolcott A. Hokanson, Bursar, with forty-two years of M.I.T. service, succeeded to D. L. Rhind's former responsibilities. The manager of the Research Fiscal Office, Thomas J. Crane, supports the research and financial administration through his broad knowledge of contractual fiscal affairs.

THE NEW STAFF RETIREMENT PROGRAM

During the year improvements in the retirement and life-insurance plans for members of the staff were undertaken through the M.I.T. Pension Association, which commenced operations in 1926, and through the Supplementary Retirement Plan. The new program was reviewed by the Staff-Administration Committee and was voted favorably by the Pension Association membership and approved by the Executive Committee of the Corporation. For members retiring after July 1, 1955, pensions are increased, life-insurance benefits are increased, death and disability benefits are included, improved vesting privileges are made available, and provision is made for early retirement. While no increase in the contributions of the members of the staff is required, the Institute has approximately

doubled its contributions for retirement and life insurance. The Institute's current rate of contributions provides for the funding of past service obligations over a period of about twelve years.

President Killian, Professor Ralph E. Freeman, Professor Thomas K. Sherwood, Marshall B. Dalton, and Joseph J. Snyder are trustees of the program and of the funds held for the benefit of the members of the staff.

The investments of the Pension Association were $8,694,000 at market and $6,259,000 at book value on June 30, 1956; and the investments of the Supplementary Retirement Fund were $725,000 at market value and $661,000 at book value on the same date.

ACCOUNTING AND REPORTING PROCEDURES

Continuing the practice of recent years, investment income, gifts and other receipts, and contract allowances for indirect expenses were used as required to meet current expenses.

During the year, several modifications were made to improve accounting and reporting procedures, none of which had a material effect on the financial statements. All bond premiums on general investment bonds above par value were written off against investment income of the year, which reduced investment income by approximately $95,000. Investment income included 3 per cent on the book value of the investment of general funds in dormitories and housing facilities. $139,000 was included in investment income from this source, whereas the greater part of this income in prior years was allocated to the reserve for dormitory amortization.

The budgeting and accounting procedures of dormitory operations were modified to provide for increased maintenance, equipment replacement, and allocation of certain other costs properly chargeable to these operations. Heretofore these charges were made partly against the unrestricted income or funds of the Institute. The deficit for the year in auxiliary activities shown by the statement of revenues and funds used to meet expenses of current operation was largely a result of increased dormitory maintenance costs charged directly to operations. The Corporation Committee on Student Housing has made definite proposals that, when implemented, will eliminate the operating loss on the dormitories.

GENERAL

The financing of the Institute's operations illustrates its close relationship with the current problems of industry and government that provide valuable support for education at M.I.T. Well over half the Institute's current revenues for academic operations are provided by industry and government. After fifteen years of heavy sponsored research responsibilities, the Institute's business operations, fiscal organization, and plant facilities have come to reflect the importance of the continuing support of industry and government. Private philanthropy is making an increasing contribution to the invested capital resources of the Institute for Faculty salaries, as is shown by the gifts received in 1955–56; but unrestricted funds and income have been the principal sources of capital for funding salaries of the senior teaching staff during the past five years. Over that period the growth in general endowment and other capital funds for Faculty salaries has not kept pace with the increase in salary expenses, and yet Faculty salaries need to be further increased. The higher rate of investment income distributed on the funds of the Institute during the past two years has offset to some extent the deficiency in capital growth.

To fund on an actuarial basis the proportion of the salaries of senior members of the Faculty now met with current year-to-year revenues and to provide a reserve for associated expenses would require approximately $7,500,000 if the capital were immediately available. If accumulated over ten years, nearly $850,000 per year would be needed to build up the fund. At the close of the fiscal year $1,045,000, including accrued investment income, has been provided from current revenues of the past three years toward the establishment of a fund for these purposes.

During the five years 1951 to 1956, the total assets at book value of the Institute have grown from $17,500 to $22,000 per student. This represents an average annual rate of growth in the order of 5 per cent, a very moderate rate in the light of the services the Institute is rendering the industrial community and the nation.

Respectfully submitted,

JOSEPH J. SNYDER
Vice President and Treasurer

September 12, 1956

BALANCE SHEET June 30, 1956

Schedule A

INVESTMENTS		
General investments:		
U. S. Government bonds	$14,613,741	
Other bonds	24,090,446	
Preferred stocks	486,751	
Common stocks	21,970,041	
Real estate (including $5,118,280 devoted to Institute use) and mortgages	10,503,493	
Commercial paper	1,476,499	
(A-1)		$ 73,140,971
Investments of funds separately invested (A-2)		4,765,319
Students' notes receivable (A-13)		1,483,827
Total investments		79,390,117
Less temporary investment of general-purpose cash		97,845
		$ 79,292,272
CURRENT AND DEFERRED ASSETS		
Cash:		
General purposes	$ 2,597,258	
Restricted to certain research contracts	79,596	
Students' safe-keeping deposits	73,741	$ 2,750,595
Temporary investment of general-purpose cash		97,845
Accounts receivable:		
U. S. Government (A-14)	$ 1,240,259	
Other (A-14)	891,488	2,131,747
Contracts in progress, principally U. S. Government (A-15)		2,027,007
Inventories, deferred charges, and other assets (A-16)		893,483
Advanced to the Division of Defense Laboratories		63,181
		$ 7,963,858
DIVISION OF DEFENSE LABORATORIES ASSETS		
Cash ($338,784 in restricted accounts)		$ 1,535,815
Accounts receivable		1,393,025
Contracts in progress		5,475,415
Deferred charges		84,070
		$ 8,488,325
EDUCATIONAL PLANT		
Land, buildings and equipment (A-20)		**$ 37,979,971**
		$133,724,426

BALANCE SHEET June 30, 1956

Schedule A

INVESTED FUNDS			
Endowment funds:			
Income for general purposes	(A-3)	$33,993,733	
Income for designated purposes	(A-4)	17,089,980	$ 51,083,713
Student loan funds	(A-5)		3,083,339
Building funds	(A-6)		3,478,670
Other expendable funds:			
General purposes	(A-7)	$ 606,068	
Designated purposes	(A-8)	10,109,508	10,715,576
Unexpended endowment income for designated purposes	(A-4)		1,254,009
Agency and annuity funds	(A-9 & A-10)		1,059,234
General investments—gain and loss account	(A-11)		5,401,472
Unallocated investment income ($595,000 designated for distribution in 1956-57)	(A-12)		3,216,259
			$ 79,292,272
CURRENT LIABILITIES AND FUNDS			
Accounts payable and accrued wages		$ 599,522	
Students' advance fees and deposits	(A-17)	526,688	
Students' safe-keeping deposits		73,741	
Withholdings, deposits, and other credits	(A-18)	775,089	
Advances by the U. S. Government for certain research contracts		2,601,451	
Total current liabilities			$ 4,576,491
Gifts and other receipts for current expenses	(A-19)		3,387,367
			$ 7,963,858
DIVISION OF DEFENSE LABORATORIES LIABILITIES			
Accounts payable and accrued wages			$ 1,404,866
U. S. Government advances			7,020,278
Advanced from Institute funds			63,181
			$ 8,488,325
EDUCATIONAL PLANT CAPITAL			
Endowment for educational plant	(A-21)		**$ 37,979,971**
			$133,724,426

SOURCES OF REVENUES AND FUNDS USED TO MEET EXPENSES OF CURRENT OPERATION
for the Year Ended June 30, 1956

Schedule B

SOURCES OF REVENUES AND FUNDS USED

Tuition and other income	(B-1)	$ 4,963,672
Investment income	(B-2)	1,889,725
Gifts and other receipts	(B-2)	3,858,908
Reimbursement of direct costs of research contracts of the Division of Industrial Cooperation [1]	(B-3)	9,298,605
Contract allowances for administration and plant operation	(B-3)	4,580,565
Auxiliary activities	(B-7)	1,805,889
		$26,397,364

EXPENSES OF CURRENT OPERATION

Academic departments	(B-4)	$ 6,900,444
Direct costs of research contracts of the Division of Industrial Cooperation [1]	(B-3)	9,298,605
General and administration	(B-5)	5,237,092
Plant operation	(B-6)	3,014,076
Auxiliary activities	(B-7)	1,947,147
		$26,397,364

[1]Includes only contracts under the supervision of academic departments. Costs and revenues under all research contracts are shown on Schedule B-3.

STATEMENT OF FUNDS For the year ended June 30, 1956

Schedule C

	Balance June 30, 1955	*Gifts and Other Receipts*	*Investment Income*	*Transfers In — (Out)*	*Expenses*	*Other Charges*	*Balance June 30, 1956*
Endowment funds:							
Income for general purposes (A-3)	$33,569,279	$ 61,502	$2,014,087	$(201,050)	$1,450,085	.....	$33,993,733
Income for designated purposes (A-4)	14,486,704	2,453,827	*	149,449	.....	.....	17,089,980
Student loan funds (A-5)	2,968,438	15,101	100,442	2,550	.....	$ 3,192	3,083,339
Building funds (A-6)	3,095,733	1,134,125	179,274	660,638	40,000	1,551,100	3,478,670
Other expendable funds:							
General purposes (A-7)	960,187	191,826	62,226	(379,346)	2,806	226,019	606,068
Designated purposes (A-8)	7,077,588	3,778,269	531,050	(152,873)	565,103	559,423	10,109,508
Unexpended endowment income for designated purposes (A-4)	1,188,869	14,886	947,452	(201,273)	439,100	256,825	1,254,009
Agency and annuity funds (A-9 & A-10)	943,237	117,294	61,866	(2,500)	8,529	52,134	1,059,234
General investments — gain and loss account (A-11)	4,497,868	903,604	.....	.....	.....	.....	5,401,472
Unallocated investment income (A-12)	3,042,826	.....	173,433	.....	.....	.....	3,216,259†
Total invested funds	**$71,830,729**	**$ 8,670,434**	**$4,069,830**	**$(124,405)**	**$2,505,623**	**$2,648,693**	**$79,292,272**
Gifts and other receipts for current expenses (A-19)	2,002,061	5,306,256	.....	124,405	3,243,010	802,345	3,387,367
	$73,832,790	**$13,976,690**	**$4,069,830**	.....	**$5,748,633**	**$3,451,038**	**$82,679,639**
Gifts received during year		$10,387,287					
Appropriations from research contract allowances		977,851					
Net realized gain on investments		1,455,820					
Other		1,155,732					
Investment income used to meet expenses of current operation					$1,889,725		
Gifts and other receipts used to meet expenses of current operation					3,858,908		
Expenditures for buildings added to educational plant						$1,847,120	
Scholarship and fellowship awards						585,547	
Direct research costs charged against gifts designated therefor						487,109	
Other charges to funds not representing operating expenses						531,262	

*Investment income on endowment funds for designated purposes is included under the caption "Unexpended endowment income for designated purposes."

†This figure includes $595,000 designated for allocation in 1956–57.

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, 1956.

Schedule B — Sources of Revenues and Funds Used to Meet Expenses of Current Operation for the Year ended June 30, 1956.

Schedule C — Statement of Funds for the Year ended June 30, 1956.

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.

In our opinion, said statements present fairly the financial position of Massachusetts Institute of Technology at June 30, 1956, and the results of its operations for the year then ended.

LYBRAND, ROSS BROS. & MONTGOMERY

Boston, Massachusetts, September 12, 1956

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, 1956, and their certificate is submitted herewith.

Respectfully,

HORATIO L. BOND
RALPH LOWELL
HAROLD B. RICHMOND, *Chairman*

GENERAL INVESTMENTS

Schedule A-1

Par Value		*Book Value*	*Net Income*
	U. S. GOVERNMENT BONDS		
	Treasury Bills		
$ 930,000	2.25%, 8-16-56	$ 927,384.37	$ .....
500,000	2.31%, 9-20-56	497,433.33	.....
	Treasury Notes		
2,000,000	1⅝%, Series B, 5-15-57	2,000,000.00	32,500.00
1,000,000	2⅞%, Series A, 6-15-58	1,000,000.00	6,342.19
	Treasury Bonds		
1,000,000	2⅜%, 6-15-58	998,763.42	23,750.00
1,200,000	2¾%, 9-15-61	1,191,875.00	11,468.41
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	59,592.44
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	33,265.03
10,000	3¼%, 6-15-83/78	10,000.00	(511.00)
	Small Holdings	4,398.72	102.60
	Income from bonds sold or matured	.....	23,566.19
	Total U. S. Gov't bonds...	**$14,613,740.59**	**$ 303,025.86**
	CANADIAN BONDS		
	Industrial		
$ 168,000	Aluminum Co. of Can. Deb., 3⅞%, 5-1-70	$ 168,000.00	$ 5,390.00
192,000	Aluminum Co. of Can. Deb., 4½%, 3-1-73	192,000.00	3,906.70
	Public Utility		
200,000	Bell Tel. of Can., 1st Jr., 4½%, 12-15-67	200,000.00	5,584.38
200,000	Interprov. Pipe Line, 1st A, 3½%, 1-1-70	197,375.00	7,043.75
1,000[1]	Westcoast Trans. Co., Deb. A, 5½%, 4-1-88	115,000.00	(447.20)
	Financial		
500,000	Can. Acceptance Corp., 4½%, 11-1-68	500,000.00	14,041.07
500,000	G.M.A.C. of Canada Deb., 4¾%, 12-15-69	500,000.00	12,472.66
	Income from bonds called.	.....	348.78
	Total Canadian bonds....	**$ 1,872,375.00**	**$ 48,340.14**

[1] Units.

GENERAL INVESTMENTS ***Schedule A-1*** — *continued*

Par Value		*Book Value*	*Net Income*
	INDUSTRIAL BONDS		
$ 250,000	Commonwealth Oil Refining Co. Deb., 6%, 12-31-66	$ 250,000.00	$ 9,266.67
300,000	General Electric Co. Deb., 3½%, 5-1-76	300,000.00	(2,160.24)
1,000,000	General Motors Corp. Deb., 3¼%, 1-1-79	1,000,000.00	28,500.00
200,000	LaGloria Oil & Gas Co. Deb., 5½%, 5-1-74	199,999.00	11,000.00
150,000	McMurrey Refining Co. Deb., 6%, 8-1-74	150,000.00	9,000.00
77,000	Shamrock Oil & Gas Corp. Deb., 3½%, 4-1-67	77,000.00	2,695.00
300,000	Southern Production Co. Note, 3½%, 11-1-62/69	300,000.00	10,500.00
250,000	Union Tank Car Co. Deb., 3¾%, 10-15-75	250.000.00	4,401.04
174,000	United States Steel Corp. Deb., 1.80–2.65%, 8-1-56/64	174,000.00	3,874.50
	Income from bonds sold	.....	4,440.75
	Total industrial bonds	**$ 2,700,999.00**	**$ 81,517.72**
	PUBLIC UTILITY BONDS		
	Electric and Other		
$ 200,000	Amer. & For. Power Co. Deb., 5%, 3-1-2030	$ 197,182.41	$ 10,000.00
50,000	Amer. Gas & Electric Co. Deb., 3⅜%, 6-1-77	50,000.00	1,687.50
500,000	American Tel. & Tel. Co. Deb., 3¼%, 9-15-84	500,000.00	4,650.00
200,000	Consolidated Edison Co. of N. Y. 1st, 3⅝%, 5-1-86	200,000.00	(3,436.20)
200,000	Duke Power Company 1st, 3⅝%, 5-1-86	200,000.00	(4,740.83)
300,000	Florida Power & Light Co. 1st, 3⅝%, 4-1-86	300,000.00	(3,281.97)
200,000	Niagara Mohawk Power Corp., 3⅝%, 5-1-86	200,000.00	(3,217.19)
300,000	So. California Edison 1st G, 3⅝%, 4-15-81	297,318.00	(513.54)
200,000	Wisconsin Electric Power Co. 1st, 3⅞%, 4-15-86	200,000.00	(4,115.97)

GENERAL INVESTMENTS *Schedule A-1* — *continued*

Par Value		*Book Value*	*Net Income*
	PUBLIC UTILITY BONDS — *continued*		
	Gas Transmission		
$ 200,000	Columbia Gas System, Inc., Deb. D, 3½%, 7-1-79 . . .	$ 200,000.00	$ 4,250.00
200,000	Columbia Gas System, Inc., Deb. E, 3⅝%, 9-1-80 . . .	200,000.00	2,900.99
200,000	Columbia Gas System, Inc., Deb. F, 3⅞%, 4-1-81 . . .	200,000.00	(1,204.35)
105,000	Northern Natural Gas Co., Deb., 3⅝%, 11-1-73	105,000.00	3,056.25
200,000	Northern Natural Gas Co., Deb., 3¼%, 11-1-74	200,000.00	5,700.00
250,000	Oklahoma Natural Gas Co., 1st, 3½%, 5-1-81	250,000.00	(298.61)
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	5,692.50
500,000	Tennessee Gas Trans. Co. 1st, 3⅞%, 2-1-76	500,000.00	1,714.74
	Income on bonds sold	. . . . .	2,852.02
	Total public utility bonds . .	**$ 4,078,680.41**	**$ 24,975.34**
	COMMON CARRIER BONDS		
$ 142,000	Great Lakes Pipe Line Co., Deb. 3¼%, 6-15-57	$ 142,000.00	$ 4,615.00
574,000	Great Lakes Pipe Line Co., 4%, 2-1-74	574,000.00	22,960.00
250,000	New York Central R.R. Eq. Tr., 2¾%, 11-15-57	248,560.66	6,875.00
128,000	Northern Pacific Railway Co., 4%, 1-1-97	119,608.29	5,020.00
200,000	Pennsylvania R.R. Eq. Tr., 2½%, 7-1-56	199,789.75	5,000.00
158,000	Southern Pacific Co., 4½%, 5-1-81	156,081.75	6,997.50
250,000	Southern Railway Eq. Tr., 2⅜%, 10-1-56	249,263.26	5,937.50
	Income on bonds sold	. . . . .	14,375.73
	Total common carrier bonds	**$ 1,689,303.71**	**$ 71,780.73**
	FINANCIAL BONDS		
$2,000,000	Associates Invest. Co. Note, 3%, 12-1-64	$ 2,000,000.00	$ 60,000.00

GENERAL INVESTMENTS ***Schedule A-1*** — *continued*

Par Value		*Book Value*	*Net Income*
	FINANCIAL BONDS — *continued*		
$ 500,000	Associates Invest. Co. Note, 4¾%, 10-1-68	$ 500,000.00	$ .....
500,000	Associates Invest. Co. Note, 3¼%, 2-15-70	500,000.00	16,204.86
500,000	C.I.T. Financial Corp. Note, 3½%, 4-15-59	500,000.00	17,500.00
500,000	C.I.T. Financial Corp. Note, 3¼%, 7-15-63	500,000.00	7,944.44
500,000	C.I.T. Financial Corp. Note, 3%, 2-15-64	500,000.00	15,000.00
250,000	Commercial Credit Co., 2¾%, 2-1-57	250,000.00	6,875.00
500,000	Commercial Credit Co., 3½%, 6-1-65	495,000.00	17,500.00
500,000	Fed. Nat. Mortgage Assoc. Note, 2½%, 1-20-58	500,000.00	12,500.00
1,000,000	G.M.A.C. Deb. 4%, 7-1-58	1,000,000.00	40,000.00
1,500,000	G.M.A.C. Sub Note, 3%, 11-1-59	1,490,625.00	45,000.00
750,000	G.M.A.C. Deb., 3%, 4-1-60	750,000.00	22,500.00
1,752,000	G.M.A.C. Deb., 3⅞%, 9-15-61	1,752,000.00	46,840.60
1,195,000	G.M.A.C. Deb., 2¾%, 7-15-64	1,183,112.53	32,862.50
235,000	G.M.A.C. Deb., 3%, 7-15-69	235,000.00	6,350.00
300,000	G.M.A.C. Deb., 3½%, 3-15-72	300,000.00	9,900.00
500,000	G.M.A.C. Jr. Sub. Note, 3¾%, 4-1-73	500,000.00	14,895.83
500,000	G.M.A.C. Deb., 3⅝%, 9-1-75	491,250.00	9,029.74
300,000	Int'l Bank for Recon. & Dev., 3%, 3-1-76	300,000.00	9,000.00
	Income from bonds sold	.....	17,111.91
	Total financial bonds	**$13,746,987.53**	**$ 407,014.88**
	Small holdings	**$ 2,100.00**	**$ 2.50**
	PREFERRED STOCKS		
1,000	Anderson Pritchard Oil Corp. 4½% Cum. Conv.	$ 51,657.52	$ (1.88)
100	Armstrong Furnace Co. 5% Cum.	10,000.00	500.00

GENERAL INVESTMENTS *Schedule A-1* — *continued*

Shares		*Book Value*	*Net Income*
	PREFERRED STOCKS — *continued*		
655	Kaiser Aluminum & Chemical Corp. 4⅛%, Cum.Cv.	$ 65,500.00	$ (2.46)
1,422	Lennox Industries, Inc. 4% Cum.	14,220.00	568.80
900	Arthur D. Little, Inc. 6%	90,000.00	5,400.00
602	Merck & Company, Inc. $4 Cum. Conv.	64,373.97	2,408.00
1,800	Tropical Gas Co., Inc. $5.24 Cum.	180,000.00	8,907.00
100	H. K. Webster Company 5% Cum.	10,000.00	500.00
	Small holdings	1,000.00	70.00
	Income from preferred stocks sold	.....	300.60
	Total preferred stocks	**$ 486,751.49**	**$ 18,650.06**
	INDUSTRIAL COMMON STOCKS		
	Agricultural Equipment		
3,000	International Harvester Co.	$ 39,956.12	$ 6,000.00
	Automobile		
2,000	Chrysler Corporation	70,243.10	8,000.00
5,540	Ford Motor Company	357,330.00	6,648.00
193,430	General Motors Corporation	3,505,887.86	458,337.50
	Building Supplies		
14,280	Johns-Manville Corporation	268,003.61	33,810.00
12,604	National Lead Company	118,223.14	42,223.40
7,350	Pittsburgh Plate Glass Co.	138,604.46	22,435.00
300	Sherwin Williams Company	15,148.22	1,350.00
	Chemical and Drugs		
4,304	Allied Chemical & Dye Corp.	181,000.53	12,450.75
360	Christiana Securities Corp.	1,825,474.35	197,740.00
529	Diamond Alkali Company	21,754.37	535.51
4,373	Dow Chemical Company	83,335.67	4,320.50
1,831	E. I. du Pont de Nemours & Co.	254,750.20	13,005.00
21,000	Hercules Powder Company	344,959.94	23,100.00
19,540	Merck & Company, Inc.	139,688.72	15,040.00
12,748	Monsanto Chemical Co.	102,745.42	12,623.00
14,377	Union Carbide & Carbon Corp.	327,594.60	49,865.75

GENERAL INVESTMENTS ***Schedule A-1*** — *continued*

Shares		*Book Value*	*Net Income*
	INDUSTRIAL COMMON STOCKS — *continued*		
	Containers		
16,448	American Can Company...	$ 455,870.99	$ 30,399.10
10,061	Owens-Illinois Glass Co....	290,970.64	23,797.51
	Electrical Equipment		
15,568	Thomas A. Edison, Inc. B..	166,127.58	21,411.75
28,537	General Electric Company.	291,165.29	51,074.00
6,440	General Radio Co., Conv...	74,830.00	3,220.00
575	Sprague Electric Company.	33,000.00	690.00
8,040	Westinghouse Electric Corp.	224,748.46	14,060.00
	Food and Beverages		
3,150	Liquid Carbonic Corp.....	53,551.11	5,827.50
6,020	United Fruit Company....	105,434.52	18,030.00
	Machinery		
8,653	Caterpillar Tractor Co....	92,204.43	14,710.10
6,167	Draper Corporation.....	100,327.98	9,192.05
	Non-Ferrous Metal		
4,000	International Nickel Co. of Canada.....	134,488.60	15,800.00
4,036	Kennecott Copper Corp...	257,638.67	35,941.50
	Office Equipment		
2,020$\frac{3}{8}$	International Business Machines Corporation.....	101,436.97	6,784.76
10,509	National Cash Register Co..	96,785.73	11,559.92
	Oil		
18,750	Commonwealth Oil Refining Co., Inc.....	4,500.00	.....
353	Continental Oil Co.....	24,998.31	1,041.35
8,703	Gulf Oil Corporation.....	227,590.01	20,952.52
5,000	LaGloria Oil & Gas Co....	1.00	.....
10,970	Ohio Oil Company.....	221,282.75	16,832.00
10,787	Phillips Petroleum Co.....	486,452.09	31,787.25
20,421$\frac{1}{4}$	Socony Mobil Oil Company, Inc.....	303,277.00	40,842.50
25,030	Standard Oil Co. of Calif...	343,870.15	36,651.00
14,518	Standard Oil Co. (Indiana)	299,378.70	34,884.14
102,056	Standard Oil Co. (N. J.)...	922,811.78	194,211.00
10,510	Texas Company.....	176,231.55	23,819.50
26,100	Tropical Gas Company, Inc.	6,475.00	.....
	Paper		
12,143	International Paper Co....	181,113.05	35,988.00

GENERAL INVESTMENTS *Schedule A-1* — *continued*

Shares		*Book Value*	*Net Income*
	INDUSTRIAL COMMON STOCKS — *continued*		
	Retail Trade		
5,125	J. C. Penney Company....	$ 165,618.55	$ 20,756.25
22,549	Sears, Roebuck & Company	203,250.22	22,752.85
	Rubber		
300	B. F. Goodrich Company..	14,325.00	600.00
160	Goodyear Tire & Rubber Company.....	10,140.00	192.00
	Soap		
15,304	Procter & Gamble Co.....	274,196.10	26,782.00
	Steel		
6,000	Inland Steel Company.....	198,474.49	28,500.00
6,600	National Steel Corporation.	149,488.34	24,750.00
	Miscellaneous		
2,500	Consolidated Rendering Co.	169,500.00	11,875.00
31,874	Eastman Kodak Company.	388,863.74	77,963.55
185	Halliburton Oil Well Cementing Company.....	10,059.38	277.50
620	Minneapolis-Honeywell Regulator Company....	33,172.50	826.00
10,592	Minnesota Mining & Manufacturing Company.....	150,398.00	9,500.80
2,000	Texas Instruments, Inc.....	24,922.57	.....
	Income on stocks sold.....	.....	40,431.85
	Total industrial stocks.....	**$15,263,671.56**	**$1,872,199.66**
	PUBLIC UTILITY COMMON STOCKS		
28,113	American Gas & Electric Company.....	$ 358,533.72	$ 36,027.05
1,266	American Tel. & Tel. Co..	164,167.44	10,325.25
4,240	Boston Edison Company...	155,396.99	11,872.00
525	Central Maine Power Co...	13,059.38	367.50
7,000	Commonwealth Edison Co.	172,198.06	14,000.00
4,500	Florida Power & Light Co.	161,613.60	4,050.00
6,400	General Public Utilities Corporation.....	182,475.34	11,360.00
5,040	Illinois Power Company...	202,166.83	12,552.00
10,600	Middle South Utilities, Inc.	293,301.33	15,900.00
5,000	Montana Power Company.	169,075.59	8,500.00
5,000	Ohio Edison Company....	245,000.00	9,300.00
8,500	Public Service Co. of N. H.	151,187.50	8,287.50
4,000	Southern Calif. Edison Co..	138,089.14	9,600.00

GENERAL INVESTMENTS *Schedule A-1* — *continued*

Shares		*Book Value*	*Net Income*
	PUBLIC UTILITY COMMON STOCKS — *continued*		
2,275	Southern Company	$ 34,957.50	$ 2,082.50
6,366	Texas Gas Trans. Corp.	102,721.84	6,304.00
12,000	Transcontinental Gas Pipe Line Co.	207,934.67	3,895.00
3,000	Utah Power & Light Co.	145,750.00	3,300.00
19,699	Virginia Elec. & Power Co.	462,483.98	32,481.35
	Income on stocks sold	.....	542.70
	Total public utility stocks	**$ 3,360,112.91**	**$ 200,746.85**
	RAILROAD COMMON STOCKS		
4,296	Atchison, Topeka & Santa Fe Railway	$ 207,203.11	$ 34,368.00
2,062	Great Northern Railway Co.	51,195.56	5,155.00
	Total railroad stocks	**$ 258,398.67**	**$ 39,523.00**
	BANK COMMON STOCKS		
3,785	Bankers Trust Co., N. Y.	$ 191,906.25	$ 10,174.00
3,638	Continental Illinois Nat'l Bk. & Trust Co., Chicago	174,614.92	12,731.00
5,549	First Nat'l Bank of Boston	307,790.41	15,259.75
7,189	First Nat'l City Bank of N.Y.	295,919.04	18,331.95
6,062	Guaranty Trust Co., N. Y.	343,243.79	24,168.00
5,711	Hanover Bank, New York	233,521.57	11,422.00
297	Wilmington Trust Company	55,093.50	1,485.00
	Income on stocks sold	.....	3,156.60
	Total bank stocks	**$ 1,602,089.48**	**$ 96,728.30**
	INSURANCE COMMON STOCKS		
8,334	Boston Insurance Company	$ 197,914.51	$ 14,167.80
4,250	Continental Insurance Co. of New York	68,383.05	7,968.75
8,652	Fireman's Fund Ins. Co. of California	209,379.20	15,573.60
3,720	Hartford Fire Ins. Co.	127,949.44	11,160.00
9,216	Ins. Co. of North America	161,635.55	19,200.00
	Total insurance stocks	**$ 765,261.75**	**$ 68,070.15**
	OTHER COMMON STOCKS		
10,250	Bond Investment Trust of America	$ 193,011.50	$ 8,712.50
12,578	Century Shares Trust	192,466.22	6,432.29
360	Cochran Foil Company	6,680.00	504.00

GENERAL INVESTMENTS *Schedule A-1* — *continued*

Shares		*Book Value*	*Net Income*
	OTHER COMMON STOCKS — *continued*		
28,994	Colonial Fund, Inc.	201,335.92	22,336.64
1,000	National Research Corp.	30,000.00	.....
781	Photon, Inc.	12,276.28	.....
500	Rockwell Mfg. Co.	10,000.00	1,050.00
735	J. P. Stevens & Co., Inc.	25,325.00	1,102.52
1,000	Stone & Webster, Inc.	29,507.65	2,000.00
	Small holdings	19,904.30	962.81
	Total other common stocks.	**$ 720,506.87**	**$ 43,100.76**
	MORTGAGE NOTES		
	Common Street, Belmont	$ 4,140.00	$ 200.36
	Bay State Road, Boston	3,000.00	361.28
	Collincote Street, Stoneham	500.00	20.00
	Maude Terrace, Watertown	1,387.77	56.66
	Summer Street, Watertown	4,042.20	172.86
	Alpha Tau Omega	5,900.00	340.00
	Beta Theta Pi	12,500.00	662.50
	Delta Kappa Epsilon	5,000.00	260.89
	Kappa Sigma	6,800.00	348.75
	Lambda Chi Alpha	7,932.23	331.93
	Phi Kappa	9,975.00	539.38
	Sigma Chi	3,500.00	218.75
	Income on paid up mortgages	.....	1,306.03
	Total mortgage notes	**$ 64,677.20**	**$ 4,819.39**
	REAL ESTATE DEVOTED TO INSTITUTE USE		
	Dormitories and Housing		
	120 Bay State Road, Boston	$ 26,000.00	$ 780.00
	Graduate House	647,951.94	19,440.00
	Baker House	$ 2,064,180.53	$ 61,926.00
	Burton House	1,453,380.37	43,602.00
	Westgate veterans' housing	459,492.60	13,784.78
	Total dormitories and housing	**$ 4,651,005.44**	**$ 139,532.78**
	Research		
	565 Memorial Drive, Camb.	$ 200,560.50	$ 12,034.00
	209 Mass. Ave., Cambridge	100,000.00	6,000.00
	Wood Street, Lexington	66,714.04	4,045.00
	68–92 Albany Street Camb.	100,000.00	6,000.00
	Total for research	**$ 467,274.54**	**$ 28,079.00**

GENERAL INVESTMENTS *Schedule A-1* — *continued*

		Book Value	*Net Income*
	OTHER REAL ESTATE		
	36–44 Memorial Drive, Cambridge	$ 1,073,266.35	$ 50,683.28
	80 Memorial Drive, Camb.	850,680.29	42,474.20
	100 Memorial Drive, Camb.	153,510.85	6,399.96
	333 Memorial Drive, Camb.	40,000.00	.....
	500 Memorial Drive, Camb.	51,070.76	2,701.09
	540–550 Memorial Drive, Cambridge	351,524.51	15,315.24
	628 Memorial Drive, Cambridge (land)	9,211.94	.....
	76–94 Mass. Ave., Camb.	418,678.74	11,140.54
	Bexley Hall, Cambridge	125,280.61	8,697.49
	Gloversville, New York	218,281.04	10,952.01
	New London, Connecticut	209,825.57	10,112.60
	Plattsburg, New York	144,361.61	6,694.01
	Taunton, Massachusetts	171,531.76	7,832.21
	Waltham, Massachusetts	630,254.12	31,600.33
	Willimantic, Connecticut	140,960.36	6,381.43
	Main Street, Worcester	169,984.77	7,760.30
	Federal St., Worcester	315,241.11	15,352.29
	Royalite Oil Co., Ltd., purchase lease back	246,871.03	3,819.30
	Total other real estate	**$ 5,320,535.42**	**$ 237,916.28**
Par Value			
	COMMERCIAL PAPER		
$ 500,000	G.M.A.C., 3%, 8-14-56	$ 492,416.67	$ .....
500,000	Industrial Accept. Corp., Ltd., 3⅜%, 7-12-56	491,169.53	.....
500,000	Seaboard Finance Company, 3¼%, 8-30-56	492,913.20	.....
	Income from maturities	.....	46,573.54
	Total commercial paper	**$ 1,476,499.40**	**$ 46,573.54**
	Total general investments	**$73,140,970.97** (Schedule A)	**$3,732,596.94**

INVESTMENTS OF FUNDS SEPARATELY INVESTED

Schedule A-2

Par Value or Shares		*Book Value*	*Net Income*
	ANONYMOUS R.S. FUND		
200	Mico Instrument Company 5% Cum. Pfd.	$ 20,000.00	.....
	AVOCA FUND		
7,200	General Radio Company	$ 76,200.00	$ 3,600.00
	BABSON FUND		
	U. S. Government Bonds		
$ 2,000	Treasury, 2¼%, 9-15-59/56	$ 2,000.00	$ 45.00
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
2,000	Treasury, 2½%, 8-15-63	2,000.00	58.42
1,950	Treasury, 2½%, 9-15-72/67	1,906.13	48.75
	Preferred Stocks		
80	United Stores Corp. $6 Cum.	8,034.54	480.00
80	United Stores Corp. $4.20 2nd	1,284.62	48.00
	Common Stocks		
20	E. I. du Pont de Nemours & Co.	1,722.86	150.00
60	Standard Oil Company (Indiana)	1,413.36	143.46
	Total of the Babson Fund	$ 20,361.51	$ 1,023.63
	CLASS OF 1919 FUND		
$ 750	U. S. Savings Bonds, 1956-57	$ 555.00	$ 851.50
	CLASS OF 1920 FUND		
$ 5,325	U. S. Savings Bonds, 1957-58	$ 3,940.50	.....
	DRAPER FUND		
	U. S. Government Bonds		
$ 24,000	Treasury Notes, 2%, 8-15-57	$ 24,000.00	$ 480.00
10,000	Savings Bonds, 2½%, 9-1-59	10,000.00	250.00
21,000	Savings Bonds, 2½%, 2-1-60	21,000.00	525.00
	Other Bonds		
30,000	G.M.A.C. of Canada, 4¾%, 12-15-69	30,400.00	1,238.36
5,000	Northern Pacific R.R., 4%, 1-1-97	4,598.31	200.00
5,000	Southern Pacific Company, 4½%, 5-1-81	5,000.00	225.00

FUNDS SEPARATELY INVESTED *Schedule A-2 — continued*

Par Value or Shares		*Book Value*	*Net Income*
	DRAPER FUND — *continued*		
	Common Stocks		
100	E. I. du Pont de Nemours & Co.	$ 4,731.05	$ 750.00
180	Standard Oil Company (N. J.).	2,010.78	345.00
	Income from bonds called.....	.....	200.00
	Total of the Draper Fund.....	**$ 101,740.14**	**$ 4,213.36**
	JOSEPH HEWETT FUND		
	U. S. Government Bonds		
$ 15,500	Treasury Bonds, 2¼%, 6-19-62/59	$ 15,355.47	$ 348.75
10,000	Savings Bonds, 2½%, 4-1-58...	10,000.00	250.00
5,000	Savings Bonds, 2½%, 9-1-60...	5,000.00	125.00
2,000	Savings Bonds, 2½%, 7-1-61...	2,000.00	50.00
	Other Bonds		
15,000	Alabama Power Company, 3½%, 1-1-72.....	15,000.00	525.00
50,000	G.M.A.C. of Canada, 4¾%, 12-15-69.....	50,500.00	1,997.27
10,000	Northern Pacific R.R., 4%, 1-1-97	10,000.00	300.00
10,000	Southern Pacific Co., 4½%, 5-1-81.....	10,000.00	400.00
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	814.00
200	E. I. du Pont de Nemours & Co.	8,271.55	1,500.00
900	General Electric Company.....	8,107.50	1,620.00
600	National Cash Register Company	5,461.53	660.00
400	Standard Oil Company (Indiana)	9,392.40	959.98
1,368	Standard Oil Company (N. J.).	10,045.39	2,616.50
300	Union Carbide & Carbon Corp.	6,944.20	1,050.00
300	United Fruit Company.....	7,120.00	900.00
	Bank Common Stocks		
120	Bankers Trust Co., New York...	4,775.00	324.00
110	Guaranty Trust Co., New York.	5,078.70	440.00
	Insurance Common Stock		
200	St. Paul Fire & Marine Insurance Co.....	4,812.50	225.00
	Income from bonds called.....	.....	480.00
	Total of the Hewett Fund.....	**$ 208,434.24**	**$ 15,990.50**

FUNDS SEPARATELY INVESTED *Schedule A-2 — continued*

Par Value or Shares		*Book Value*	*Net Income*
	INDUSTRIAL MANAGEMENT RESEARCH FUND		
	Bonds		
$500,000	G.M.A.C., 3%, 11-1-59.....	$ 491,269.07	$ 3,750.00
200,000	G.M.A.C., 3%, 4-1-60.....	197,000.00	(1,583.33)
150,000	G.M.A.C., 2¾%, 7-15-64.....	145,875.00	(492.71)
	Common Stocks		
47,000	General Motors Corporation...	801,984.14	117,500.00
	Income from securities sold....	.....	24,377.81
	Total of Industrial Management	.....	
	Research Fund.....	**$1,636,128.21**	**$143,551.77**
	MUSEUM OF SCIENCE COOPERATIVE FUND		
$ 500	Textron American, Inc.....	**$ 12,343.75**	**$ 200.00**
	RICHARD LEE RUSSEL FUND		
	Mortgage		
	111 Bay State Road, Boston....	$ 2,000.00	$ 93.26
	Common Stocks		
20	General Electric Company.....	930.00	36.00
30	General Public Utilities Corp...	1,038.75	53.25
30	Standard Oil Company (N. J.).	1,095.00	57.50
	Income from paid-up mortgage.	.....	25.00
	Total of the Russel Fund.....	**$ 5,063.75**	**$ 265.01**
	SOLAR ENERGY FUND		
	U. S. Government Bonds		
$ 50,000	Treasury Bonds, 2⅛%, 11-15-60	$ 50,000.00	$ 1,062.50
37,000	Treasury Notes, 2%, 8-15-57...	37,000.00	740.00
	Common Stocks		
5,000	Godfrey L. Cabot, Inc.....	647,700.00	41,687.17
1,950	General Electric Company.....	32,468.22	3,510.00
324	Mission Corporation.....	6,291.00	969.26
	Total of the Solar Energy Fund.	**$ 773,459.22**	**$ 47,968.93**
	TECHNOLOGY LOAN FUND		
	U. S. Government Bonds		
$ 70,000	Treasury Bills, 2.25%, 8-16-56..	$ 69,803.13	$ .....
96,000	Treasury Bonds, 2¼%, 6-15-62-59	96,000.00	2,160.00
50,000	Savings Bonds, 2.76%, 7-1-66...	50,000.00	1,380.00
100,000	Savings Bonds, 2½%, 7-1-57...	100,000.00	2,500.00
100,000	Savings Bonds, 2½%, 4-1-58...	100,000.00	2,500.00
100,000	Savings Bonds, 2½%, 2-1-60...	100,000.00	2,500.00

FUNDS SEPARATELY INVESTED *Schedule A-2 — continued*

Par Value or Shares		*Book Value*	*Net Income*
	Other Bonds		
$ 35,000	Am. Tel. & Tel. Co., 2¾% 8-1-80	$ 35,000.00	$ 962.50
15,000	Pacific Gas & Electric Company, 3%, 6-1-74	15,000.00	450.00
	Public Utility Common Stocks		
2,250	Public Service Co. of Indiana	61,233.06	4,500.00
	Industrial Common Stocks		
1,980	American Can Company	40,814.83	3,663.00
2,000	Burroughs Corporation	39,830.94	2,000.00
800	E. I. du Pont de Nemours & Co.	29,304.00	6,000.00
3,000	General Electric Company	25,813.25	5,400.00
1,463	Gulf Oil Corporation	32,667.19	3,587.48
1,530	Monsanto Chemical Company	46,346.30	1,515.00
3,993	National Cash Register Co.	38,458.96	4,392.28
1,050	Pittsburgh Plate Glass Co.	53,780.85	3,205.00
1,500	Procter & Gamble Company	29,511.45	2,625.00
1,250	Socony-Mobil Oil Company	44,156.46	2,500.00
3,858	Standard Oil Company (N. J.)	24,864.43	7,394.50
1,200	Union Carbide & Carbon Corp.	27,726.00	4,200.00
	Bank Common Stocks		
1,302	First Natl. City Bank of New York	46,228.91	3,320.10
885	Guaranty Trust Company, New York	50,333.82	3,540.00
	Insurance Common Stocks		
835	Hartford Fire Insurance Co.	44,879.08	2,505.00
280	St. Paul Fire & Marine Insurance Company	6,737.50	315.00
	Income from bonds matured	.....	4,095.39
	Total of Technology Loan Fund	**$1,208,490.16**	**$ 77,210.25**
	JONATHAN WHITNEY FUND		
	U. S. Government Bonds		
$ 90,000	Treasury Notes, 2%, 8-15-57	$ 90,000.00	$ 1,800.00
100,000	Treasury Notes, 2⅛%, 6-15-58	100,075.00	696.41
31,000	Savings Bonds, 2½%, 4-1-58	31,000.00	775.00
50,000	Savings Bonds, 2.76%, 7-1-66	50,000.00	1,380.00

FUNDS SEPARATELY INVESTED *Schedule A-2* — *continued*

Par Value or Shares		*Book Value*	*Net Income*
	JONATHAN WHITNEY FUND — *continued*		
	Other Bonds		
$ 40,000	American Tel. & Tel. Co. Deb., 3¼%, 9-15-84	$ 40,800.00	$ 1,200.00
40,000	G.M.A.C. of Canada, 4¾%, 12-15-69	40,700.00	1,617.81
40,000	Pacific Gas & Electric Co. 3%, 6-1-74	40,000.00	1,200.00
	Public Utility Common Stocks		
200	Boston Edison Company	7,405.22	560.00
	Bank and Insurance Common Stocks		
410	Bankers Trust Company, N.Y.	18,937.50	1,107.00
748	Boston Insurance Company	19,145.78	1,271.60
270	First National Bank of Boston	11,465.90	742.50
468	First Natl. City Bank of New York	20,641.73	1,193.40
330	Guaranty Trust Company, New York	18,087.30	1,320.00
	Industrial Common Stocks		
300	Chrysler Corporation	16,594.85	1,200.00
400	E. I. du Pont de Nemours & Co.	15,279.10	3,000.00
1,500	General Electric Company	13,188.05	2,700.00
400	Inland Steel Company	16,120.12	1,900.00
911	International Paper Company	14,782.90	2,699.51
1,932	Standard Oil Company (N. J.)	12,311.87	3,703.00
450	United Fruit Company	10,690.25	1,350.00
	Income from bonds matured	.....	2,500.00
	Total of the Whitney Fund	$ 587,225.57	$ 33,916.23
	GEORGE S. WITMER FUND		
	U. S. Government Bonds		
$ 4,000	Savings Bonds, 2½%, 9-1-59	$ 4,000.00	$ 100.00
4,000	Savings Bonds, 2½%, 9-1-60	4,000.00	100.00
4,000	Savings Bonds, 2½%, 7-1-61	4,000.00	100.00
	Other Bonds		
5,000	Am. Tel. & Tel. Co., 2¾%, 2-1-71	4,949.55	137.50
5,000	G.M.A.C. of Canada, 4¾%, 12-15-69	5,000.00	139.72
5,000	Northern Pacific Railway, 4%, 1-1-97	4,903.79	200.00
4,000	Southern Pacific Company, 4½%, 5-1-81	3,942.68	180.00

FUNDS SEPARATELY INVESTED *Schedule A-2* — *continued*

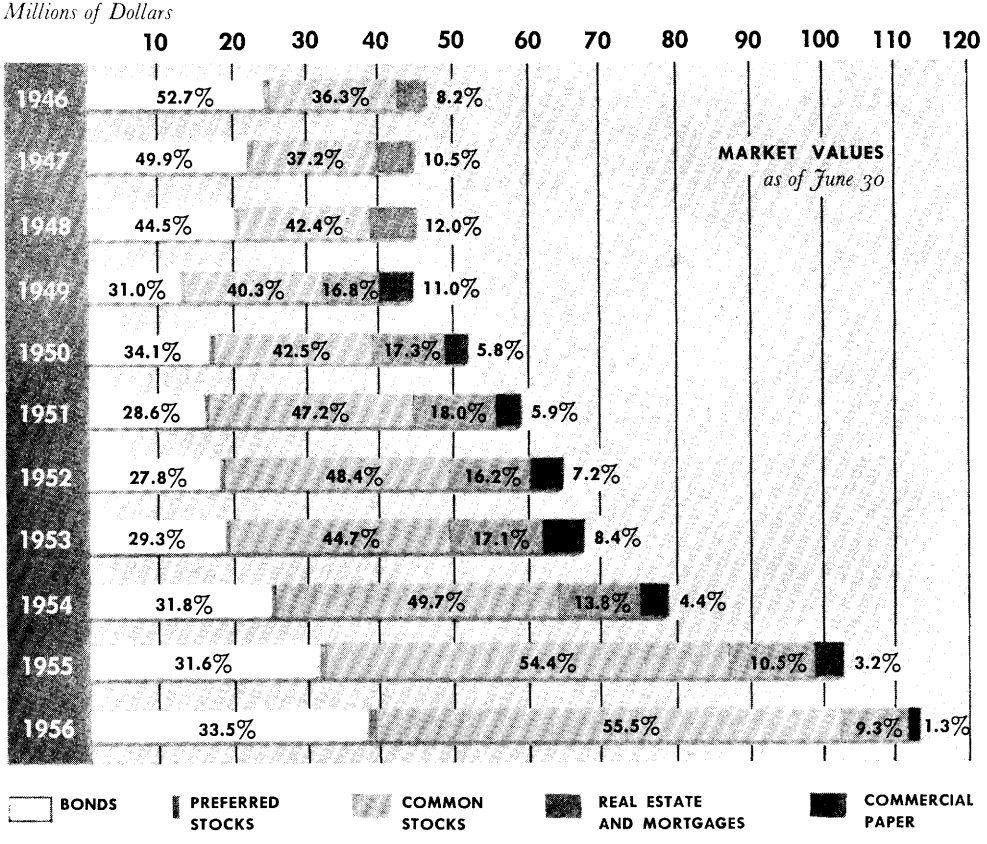
Par Value or Shares		*Book Value*	*Net Income*
	GEORGE S. WITMER FUND — *continued*		
	Industrial Common Stocks		
100	American Home Products Corp.	$ 5,468.00	$ 360.00
210	General Electric Company	3,235.75	378.00
285	General Motors Corporation	2,890.86	712.50
200	Minneapolis-Honeywell Regulator Company	5,494.69	330.00
100	Shell Oil Company	5,928.54	200.00
125	Socony-Mobil Oil Company, Inc.	6,168.75	250.00
682	Sperry Rand Corporation	2,486.88	518.32
300	Standard Oil Company (N. J.)	2,684.08	575.00
100	Union Carbide & Carbon Corp.	2,713.10	350.00
	Insurance Common Stocks		
120	St. Paul Fire & Marine Insurance Co.	2,887.50	135.00
	Public Utility Common Stocks		
150	Commonwealth Edison Company	4,388.57	300.00
200	General Public Utilities Corp.	6,950.00	355.00
269	Middle South Utilities Co.	3,241.58	390.77
190	Pacific Gas & Electric Company	7,125.34	405.00
300	United Gas Corporation	2,125.01	450.00
	Bank Common Stocks		
65	Bankers Trust Company, N.Y.	3,071.50	175.50
110	Guaranty Trust Company, N.Y.	5,920.20	440.00
	Railroad Common Stocks		
225	Denver & Rio Grande Western R.R.	4,500.00	562.52
	Other Common Stocks		
100	C.I.T. Financial Corporation	3,300.00	255.00
	Income from stock and real estate sold	.....	341.77
	Total of the Witmer Fund	**$ 111,376.37**	**$ 8,441.60**
	Total of funds separately invested	**$4,765,318.42** (Schedule A)	**$337,232.78**

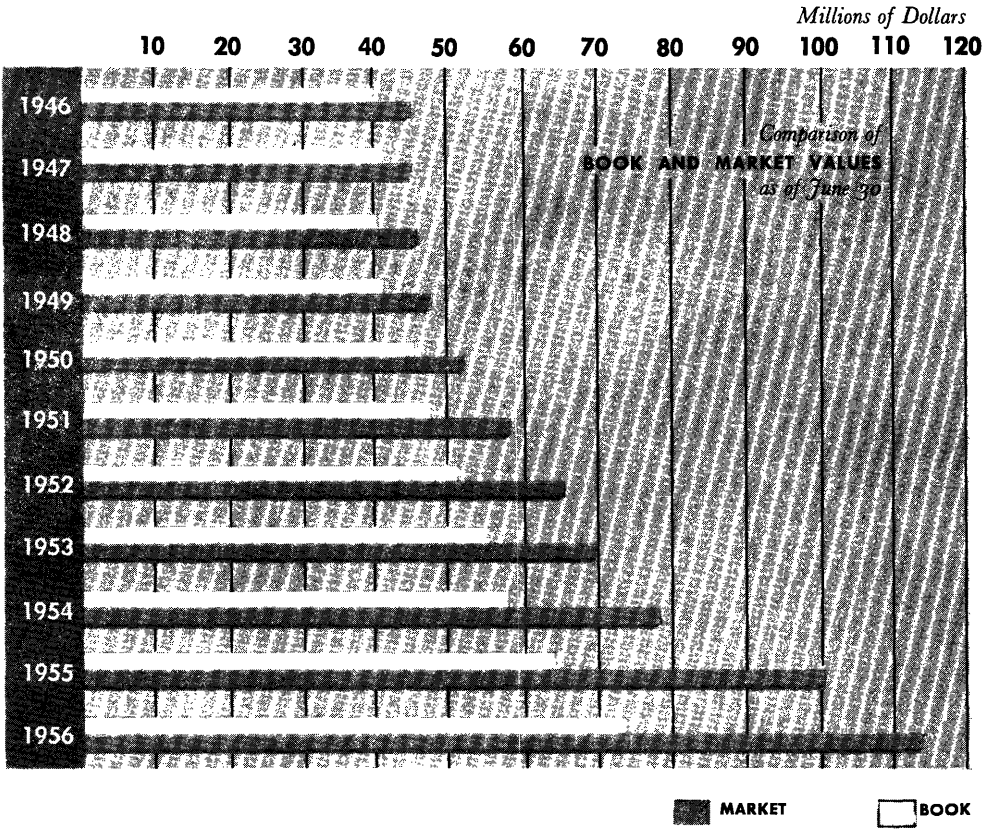
SUMMARY OF INVESTMENTS — JUNE 30, 1956

	Book Value	*Market Value*		*Net Income*	
		Amount	*Per Cent*	*Amount*	*Per Cent*
GENERAL INVESTMENTS					
Bonds					
U. S. Government	$14,613,741	$ 14,383,839	12.6	$ 303,026	8.1
Canadian	1,872,375	1,921,190	1.7	48,340	1.3
Industrial	2,700,999	2,694,569	2.4	81,518	2.2
Public utility	4,078,680	4,066,270	3.6	24,975	.7
Common carrier	1,689,304	1,709,713	1.5	71,781	1.9
Financial	13,746,988	13,407,546	11.7	407,015	10.9
Other	2,100	.....	....	2	....
Total	**$38,704,187**	**$ 38,183,127**	**33.5**	**$ 936,657**	**25.1**
Preferred Stocks	**$ 486,751**	**$ 499,436**	**.4**	**$ 18,650**	**.5**
Common Stocks					
Industrial	$15,263,671	$ 51,462,898	45.2	$1,872,200	50.2
Public utility	3,360,113	5,145,374	4.5	200,747	5.4
Railroad	258,399	760,324	.7	39,523	1.1
Bank	1,602,089	2,151,314	1.9	96,728	2.6
Insurance	765,262	2,324,411	2.1	68,070	1.8
Other	720,507	1,305,383	1.1	43,101	1.1
Total	**$21,970,041**	**$ 63,149,704**	**55.5**	**$2,320,369**	**62.2**
Mortgage Notes	**$ 64,677**	**$ 64,677***	**0.1**	**$ 4,819**	**.1**
Real Estate					
For Institute use	$ 5,118,280	$ 5,118,280*	4.5	$ 167,612	4.5
Other property	5,320,536	5,320,536*	4.7	237,916	6.4
Total	**$10,438,816**	**$ 10,438,816**	**9.2**	**$ 405,528**	**10.9**
Commercial paper	**$ 1,476,499**	**$ 1,476,499**	**1.3**	**$ 46,574**	**1.2**
Total general investments	**$73,140,971**	**$113,812,259**	**100.0**	**$3,732,597**	**100.0**
OTHER INVESTMENTS					
Specially invested funds	$ 4,765,319	$ 8,386,705		$ 337,233	
Students' notes receivable	1,483,827	1,483,827		†	
Total investments	**$79,390,117**	**$123,682,791**		**$4,069,830**	
Less: Temporary investment of general purpose cash	97,845				
Investments (Schedule A)	**$79,292,272**				

*Book value used. †Interest credited directly to student loan funds.

GENERAL INVESTMENTS 1946-1956





INCOME ON THE GENERAL INVESTMENTS, 1946-1956

	Income	*Per cent yield on market value*[1]	*Per cent yield on book value*[1]
1946	$1,303,206	3.17%	3.65%
1947	1,403,367	3.32	3.80
1948	1,492,068	3.66	4.09
1949	1,656,903	3.83	4.19
1950	1,802,440	3.82	4.21
1951	2,362,941	4.18	4.86
1952	2,411,222	3.82	4.69
1953	2,507,522	3.81	4.76
1954	2,681,229	3.69	4.78
1955	3,007,868	3.59	5.14
1956	3,722,597	3.49	5.38

[1]Based on the average of the book or market values at the beginning and end of each year.

RESEARCH CONTRACTS

Schedule B-3

		Division of Industrial Cooperation		*Division of Defense Laboratories*
REVENUES FROM RESEARCH CONTRACTS				
Revenues from research contracts.		$11,661,040[1]		$37,003,210
Less appropriations therefrom:				
Reserve for use of facilities	$ 384,491		$ 206,941	
Industrial Fund	69,271		102,890	
Investment income for use of funds	18,034		10,045	
Reserve for faculty salaries	100,000	571,796	100,000	419,876
		$11,089,244		$36,583,334
DIRECT EXPENSES ON RESEARCH CONTRACTS:				
Salaries and wages	$ 6,552,570		$15,151,980	
Materials and services	1,874,401		11,465,584[1]	
Subcontracts	36,253		4,925,807	
Travel	233,632		751,592	
Other	101,939		840,433	
	$ 8,798,795		$33,135,396	
DIRECT EXPENSES OF THE DIVISIONS:				
Salaries and wages	290,835		291,775	
Vacation allowances — hourly employees	54,000		222,000	
Materials and services	24,733		27,591	
Depreciation on equipment	30,196		21,411	
Insurance	8,189		23,095	
Laboratory indirect expenses	13,065		6,242	
Occupational medical service	30,222		15,843	
Unallowable contract expense	16,439		30,147	
Travel	7,280		10,700	
Other	24,851		9,208	
	$ 499,810		$ 658,012	
Total expenses (Schedule B)		$ 9,298,605		$33,793,408
Contract allowances for expenses of administration and plant operation (total $4,580,565 Schedule B)		**$ 1,790,639**		**$ 2,789,926**

[1] These amounts include $461,700 for work performed by the Division of Industrial Cooperation for the Division of Defense Laboratories.

GIFTS, GRANTS AND BEQUESTS

Received during the year ended June 30, 1956

GIFTS FOR ENDOWMENT

Income for general purposes

AMERICAN CAN COMPANY Gift for Faculty salaries, added to the Faculty Salary Endowment	$	1,200.00
ESTATE OF ARTHUR H. HERSCHEL '99 Residuary bequest for general endowment		53,754.12
MARY ELIZABETH LADD Additional for the Charles C. Ladd ('30) Fund		75.00
ESTATE OF HARRIET P. LAWS Additional for the Frank A. Laws ('89) Fund		18.80
ESTATE OF ALICE METCALF Additional for the Leonard Metcalf ('92) Memorial Fund		3,315.33
ESTATE OF HARRIETTE F. NEVINS Additional for the George Blackburn Memorial Fund		519.19
ESTATE OF EVERETT WESTCOTT Additional for the Everett Westcott Fund		1,800.00
ESTATE OF MARION WESTCOTT Additional for the Marion Westcott Fund		540.29
ESTATE OF H. SYLVIA A. H. G. WILKS Additional for the H. Sylvia A. H. G. Wilks Fund		40.95
	$	**61,263.68**

Income for designated purposes

JULIAN M. AVERY '18 Additional for the Julian M. Avery Fund	$	5,431.24
ESTATE OF JASON S. BAILEY Additional for the Jason S. Bailey Scholarship Fund		4,436.78
JOHN W. BARKER '41 For the M.I.T. Club of New York		10.00
BELL AIRCRAFT CORPORATION For the Jerome C. Hunsaker ('12) Professorship		5,000.00
GORDON Y. BILLARD '24 Additional for the Gordon Y. Billard Fund		1,045.00
GODFREY L. CABOT, INC. For the Cabot Foundation Scholarship Fund		25,000.00
ESTATE OF ALFRED H. CASPARY '98 Bequest for an endowment fund for research in fields with human medical implications		200,000.00
THOMAS L. CLARK ('59) MEMORIAL Contributions to endow a scholarship fund		1,131.57
COLE HERSEE COMPANY Added to the general undergraduate scholarship endowment		1,000.00
RANDOLPH P. COMPTON AND FAMILY For the W. Danforth Compton ('47) Memorial Scholarship Fund		30,573.30

MARIE G. DENNETT	
Gift to create the Carl Pullen Dennett Memorial Scholarship	$ 60,318.00
EASTERN DEVICES	
For the Allan Winter Rowe ('01) Fund	100.00
DEAN S. EDMONDS, JR. '50	
For the Benjamin Franklin Scholarship Fund	75.00
WILLIAM M. FOLBERTH, JR. '41	
For the Allan Winter Rowe ('01) Fund	30.00
FORD FOUNDATION	
An endowment fund for faculty salaries	1,360,000.00
ESTATE OF EVERT W. FREEMAN '20	
Bequest to endow a scholarship fund	850.00
CECIL H. GREEN '23	
Additional for the the Cecil H. and Ida Green Fund	12,250.00
DUGALD C. JACKSON, JR. '21	
Additional for the Dugald C. Jackson Professorship	60.00
IRVING D. JAKOBSON '21	
For the Allan Winter Rowe ('01) Fund	250.00
DR. JAMES R. KILLIAN, JR. '26	
For the Thomas L. Clark Memorial Scholarship	200.00
JOHN LAWRENCE '32	
For the Allan Winter Rowe ('01) Fund	100.00
PAUL W. LITCHFIELD '96	
Additional for the Paul W. Litchfield Scholarship Fund	10,140.00
ROYAL LITTLE	
For a Museum of Science Cooperative Fund	12,343.75
LOCKHEED LEADERSHIP FUND	
For the Jerome C. Hunsaker ('12) Professorship	10,000.00
MCDONNELL AIRCRAFT CHARITABLE TRUST	
For the Jerome C. Hunsaker ('12) Professorship	2,000.00
M.I.T. BOSTON STEIN CLUB	
For the M.I.T.Boston Stein Club Karl T. Compton Prize Fund	
Eugene R. Eisenberg '43	80.00
Herbert W. Eisenberg '52	40.00
David Olken '28	60.00
For the M.I.T. Boston Stein Club New England Freshman Scholarship Fund	
David W. '31 and Irene Bernstein	750.00
Eugene R. '43 and Shirley Eisenberg	100.00
Charles Robert Gens Memorial	1,000.00
Samuel Glaser '25	200.00
Morris J. '22 and Anna Gordon	250.00
Groisser and Shlager Iron Works	500.00
Oscar H. '22 and Mary C. Horovitz	100.00
Owen J. McGarrahan Company	1,000.00
George '24 and Betty T. Neitlich	100.00
Herman Vershbow family	1,000.00
Robert '27 and Ethel P. Wise	100.00
Other contributions	625.00

For the M.I.T. Boston Stein Club National Freshman Scholarship Fund	
Richard J. '32 and Diana L. Marcus	$ 250.00
Robert G. '31 and Natalie Marcus	500.00
MAYMAR CORPORATION	
For the William E. Chamberlin Fund	50.00
MERRILL LYNCH, PIERCE, FENNER AND BEANE	
For the Charles E. Merrill Scholarship Fund	10,000.00
ESTATE OF KATHERINE B. NOBLE	
Bequest for the Howard A. Noble ('97) Scholarship Fund	219,209.52
PHI BETA EPSILON MEMORIAL FUND	
Added to the general undergraduate scholarship endowment	100.00
REDFIELD PROCTOR '02	
Additional for the Vermont Scholarships	26,122.37
MRS. R. T. ROBERTS	
Added to the general undergraduate scholarship endowment	10.00
GLADYS R. TARTIERA	
Added to the Irving Shaknov ('43) Memorial Scholarship Fund	25.00
TEXAS INSTRUMENTS — GEOPHYSICAL SCIENTIFIC INSTRUMENTS FOUNDATION	
Additional for the Texas Instruments Fund	1,000.00
ESTATE OF MRS. KATHERINE R. THOMAS	
Additional for the William B. S. Thomas Fund	552.04
TRANSOCEANIC MARINE, INC.	
For the Niarchos Merchant Seamen Memorial Scholarship Fund	30,000.00
WALWORTH COMPANY	
Added to the general undergraduate scholarship endowment	1,000.00
MRS. FREDA W. WILCOX	
Added to the Edward F. Miller ('86) Fund	25.00
ESTATE OF EDITH CARSON WILDER	
Additional for the Stephen H. Wilder ('74) Fund	299,040.37
JOHN J. WILSON '29	
Additional for the Mary I. Wilson Scholarship Fund	6,212.50
OTHER GIFT	5.00
	$2,342,351.44

GIFTS FOR STUDENT LOANS

GEORGE A. CHUTTER '21	
Additional for the William H. Timbie Loan Fund	$ 200.00
M.I.T. BOSTON STEIN CLUB	
For the M.I.T. Boston Stein Club Freshman Loan Fund	
Anonymous	500.00
George A. '28 and Ruth D. Bernat	250.00
Morris H. Gens '22	500.00
Hyman G. '19 and Augusta R. Spector	250.00
Albert A. '21 and Pearl K. Wechsler	500.00
	$ 2,200.00

GIFTS FOR BUILDINGS

CONTRIBUTIONS FOR THE KARL TAYLOR COMPTON LABORATORY

Anonymous	$ 3,000.00
Barnstead Still and Sterilizer	300.00
Bath Iron Works Corporation	1,000.00
Boston Insulated Wire and Cable Company	500.00
The Bush Foundation	500.00
Vannevar Bush ('16) Trust	5,000.00
Cannon-Muskegon Corporation	25.00
Philip Coleman '23	250.00
Commonwealth Research Laboratories	100.00
Continental Can Company	5,000.00
F. H. Daniels '11	1,000.00
Thomas C. Desmond '09	5,000.00
Bradley Dewey '09	1,007.04
Robert C. Erb '17	100.00
Ferguson Electric Construction Company	500.00
Ferrocute Machine Company	20.00
W. Cameron Forbes	500.00
Horace S. Ford	250.00
Crawford H. Greenewalt '22	15,000.00
W. C. Hamilton and Son	100.00
Hycon Manufacturing Company	1,000.00
Mervin J. Kelly	4,000.00
Kimberly Clark Foundation	10,000.00
George J. Leness '26	4,500.00
Lichter Foundation, Inc.	500.00
Ralph Lowell	1,000.00
Howard H. McClintic, Jr. '19	3,150.00
Metals and Controls Corporation	2,500.00
Morgan Worcester, Inc.	1,000.00
National Biscuit Company	1,500.00
Elizabeth Pigott	150.00
John L. Pratt	50,000.00
Redfield Proctor '02	5,000.00
Raymond Concrete Pile Company	5,000.00
Roberts-Gordon Appliance Corporation	100.00
Stowe-Woodward, Inc.	250.00
Warner Company	100.00
Edwin S. Webster ('88) Foundation	70,000.00
Western Waterproofing Company	100.00

CONTRIBUTIONS FOR OTHER PURPOSES

DEAN E. P. BROOKS '17 For the Henry Greenleaf Pearson Room	1,000.00
IRENEE DU PONT '97 For capital	234,000.00
ALVAN T. FULLER For the Kresge Auditorium Organ	50,000.00
LEON A. KOLKER '31 Additional for the John Picker Kolker Room Fund	10,487.50
NEWCASTLE CORPORATION For the Reactor Building Fund	499,500.00
ROCKEFELLER FOUNDATION For the Reactor Building Fund	125,000.00

WESTINGHOUSE EDUCATIONAL FOUNDATION	
For the Reactor Building Fund	$ 15,000.00
	$1,133,989.54

OTHER GIFTS — PRINCIPAL AVAILABLE

Added to the unexpended endowment income for designated purposes

CHARLES HAYDEN FOUNDATION	
For current use by the Charles Hayden ('90) Memorial Fund	$ 5,000.00
M.I.T. CLUB OF CHICAGO	
Contributions for a scholarship	1,450.00
	$ 6,450.00

For general purposes

CONTRIBUTIONS TO THE KARL T. COMPTON MEMORIAL FUND SUBSEQUENTLY TRANSFERRED TO THE KARL T. COMPTON LABORATORY FUND	
Acushnet Process Company	$ 2,500.00
C. Bowen, Inc.	100.00
Delbrook Ventilating Company	500.00
Horace S. Ford	250.00
Mitchell B. Kaufman Charitable Foundation	500.00
R. J. King '03	1,000.00
Lee S. Landon	100.00
Lightolier Fund, Inc.	500.00
Northwest Paper Foundation	5,000.00
Skidmore, Owings and Merrill	1,000.00
William L. Stewart, Jr. '23	1,000.00
Whitehead Metal Products, Inc.	1,000.00
Other	435.00
AMERICAN RADIATOR AND STANDARD SANITARY CORPORATION	
For general purposes	5,000.00
ANONYMOUS	
Additional for the Anonymous J Fund	500.00
ANONYMOUS	
Additional for the Anonymous ST Fund	2,000.00
ESTATE OF JOSEPH WHEELER AYLSWORTH '03	
Bequest for general purposes	1,000.00
LOUIS BARNETT '09	
For general purposes	300.00
BETHLEHEM STEEL COMPANY	
For general purposes	6,000.00
C.B.S. FOUNDATION, INC.	
For general purposes	2,000.00
COLGATE PALMOLIVE-PEET COMPANY	
For general purposes	5,000.00
ESTATE OF ARTHUR J. CONNER '88	
Residuary interest in a trust created by his will	6,462.68
DEVELOPMENT FUND	
Other contributions	4,300.00
EASTMAN KODAK COMPANY	
For general purposes	2,000.00

BRADFORD M. ENDICOTT '49	
For general purposes	$ 9,855.00
HARRY GOODMAN ('24) FOUNDATION	
For the Class of 1924 Fund	100.00
ESTATE OF PROFESSOR ERNST A. HAUSER	
Bequest for general purposes	4,432.90
William T. Henry ('70) Trust	
Income of a trust	29,600.00
ESTATE OF ALICE G. MARTIN	
Added to the Augustus B. Martin, Jr., Fund	75.00
THE KENDALL COMPANY	
For general purposes	1,000.00
McCLINTIC ENDOWMENT	
Added to the Development Fund	500.00
E. MORTIMER NEWLIN ('14) TRUST	
Income of a trust	1,024.90
RICHARD N. PALMER ('28) TRUST	
For general purposes	698.56
H. NELSON SLATER	
Added to the Development Fund	4,136.50
STANDARD OIL COMPANY OF CALIFORNIA	
For general purposes	7,500.00
STONE AND WEBSTER ENGINEERING CORPORATION	
For general purposes	2,500 00
OSCAR G. THURLOW '04	
For general purposes	14,000.00
UNITED CARR FASTENER CORPORATION	
Added to the Development Fund	2,000.00
ESTATE OF VERNOR F. WORCESTER '86	
Bequest	65,955.47
	$ 191,826.01

For designated purposes

ESTATE OF CHARLES E. ADAMS	
Additional for the Frank W. and Carl S. Adams Memorial Fund	$ 17,000.00
ALUMNI FUND	
Contributions	355,421.19
SAMUEL BERKE '15	
For the Samuel Berke Humanities Fund	5,000.00
BOSTON CAMERA CLUB	
Added to the Oscar H. Horovitz ('22) Fund	100.00
BENJAMIN COOPER '23	
For the M.I.T. Boston Stein Club — Benjamin Cooper Fellowship	3,700.00
RALPH E. CURTIS '15	
Additional for the Ralph E. Curtis Scholarship Fund	2,000.00
ESTATE OF DAVID FLETT DU PONT '56	
Bequest for the improvement of athletic facilities	1,006,397.99

FORD FOUNDATION Grant to support Faculty appointments associated with the international communications program in the Center for International Studies	$ 430,000.00
DEAN M. FULLER MEMORIAL FUND Contributions	372.00
GERBER BABY FOODS FUND For the Food Technology Research Fund	5,000.00
GOODYEAR TIRE AND RUBBER COMPANY For an industrial fellowship in economics	2,500 00
OSCAR H. HOROVITZ '22 Additional for the Oscar H. Horovitz Fund	900 00
INDUSTRIAL RELATIONS FUND Contributions from industrial concerns	16,300.00
INTERNATIONAL BUSINESS MACHINES CORPORATION For an industrial fellowship in economics	1,000 00
JOHN W. KILDUFF '18 Additional for the John W. Kilduff Fund	6,800.00
LEE CRANE SERVICE, INC. Added to the Oscar H. Horovitz ('22) Fund	225.00
LEE EQUIPMENT CORPORATION Added to the Oscar H. Horovitz ('22) Fund	100.00
OSCAR MAYER & COMPANY For the Food Technology Research Fund	10,000.00
ESTATE OF C. LILLIAN MOORE Additional for the John A. Grimmons ('21) Fund	5,935.00
SPRAGUE ELECTRIC COMPANY For the Servomechanisms Laboratory	40.00
WESTINGHOUSE EDUCATIONAL FOUNDATION For an industrial fellowship in economics	2,500.00
	$1,871,291.18

UNINVESTED FUNDS

Industrial Liaison Program

Support of the Program	**$1,105,059.38**

A partial list of companies making payments in 1955–56:

Aircraft-Marine Products, Inc.
Allegheny-Ludlum Steel Corporation
Aluminium Laboratories Limited
Aluminum Company of America
American Can Company
American Machine and Foundry Company
Anaconda Copper Mining Company
Associated Factory Mutual Fire Insurance Companies
Bell Telephone Laboratories, Inc.
Chance Vought Aircraft, Inc.
Cities Service Research and Development Company
Continental Can Company, Inc.
Electrolux Corporation
Federal Telecommunication Laboratories, Inc.
Ford Motor Company
The Foxboro Company

General Dynamics Corporation
General Motors Corporation
The Gillette Company
Grumman Aircraft Engineering Corporation
Gulf Research and Development Company
John Hancock Mutual Life Insurance Company
Hercules Powder Company
Hughes Aircraft Company
Latrobe Steel Company
Lever Brothers Company
Liberty Mutual Insurance Companies
Merck and Company, Inc.
Merrill Lynch, Pierce, Fenner and Beane
Minneapolis-Honeywell Regulator Company
National Research Corporation
North American Aviation, Inc.
Owens-Corning Fibreglas Corporation
Philco Corporation
Pittsburgh Plate Glass Company
Radio Corporation of America
Raytheon Manufacturing Company
A. O. Smith Corporation
Socony Mobil Oil Company, Inc.
Sperry Gyroscope Company
Standard Oil Company of California
Standard Oil Company (Indiana)
Stewart-Warner Corporation
Texas Company
United Aircraft Corporation
Whirlpool-Seeger Corporation

Gifts for student aid

THOMAS C. DESMOND '09
For undergraduate scholarships ..... $ 1,200.00

PHILIP B. DOWNING TRUST
For the Philip B. Downing Scholarship Fund 430.00

FLUOR FOUNDATION
For undergraduate scholarships 3,000.00

ERNEST A. GRUNSFELD ('18) FUND
For the Grunsfeld European Fellowship 2,200.00

HOUSTON ENDOWMENT, INC.
For the William S. Knudsen Fellowship 2,500.00

INTERNATIONAL BUSINESS MACHINES CORPORATON
For an automatic control fellowship 4,400.00
For an electronics fellowship 3,400.00
For a ferro-electric and ferro-magnetic materials fellowship 3,400.00

KENNECOTT COPPER CORPORATION
For the Kennecott Copper Scholarship 2,000.00

KNAPP FUND
For undergraduate scholarships 1,500.00

ELLEN F. LOOMIS
For the Foreign Student Fund 1,200.00

M.I.T. Club of Northern New Jersey		
For undergraduate scholarships	$	468.00
James C. Melvin Trust		
For the Melvin Trust Scholarship Fund		11,250.00
New England Foundrymen's Association		
For undergraduate scholarships		1,000.00
Ernest L. Osborne '14		
For the Ernest L. Osborne Scholarship Fund		50.00
Alfred P. Sloan ('95) Foundation, Inc.		
For student travel		1,060.00
For the Sloan National Scholarship		74,200.00
Teagle Foundation, Inc.		
For scholarships		16,020.00
United States Steel Foundation, Inc.		
For a fellowship		6,000.00
Visking Corporation		
For a fellowship		2,700.00
Leonard Warren '54		
Additional for the John R. Loofborrow Memorial Scholarship Fund		25.00
Westinghouse Educational Foundation		
For the Science Teachers' Fellowships		20,000.00
Added to the undergraduate scholarship awards fund:		
Air Force Aid Society Educational Fund		330.00
Alloy Steel Products Company		1,200.00
American Brake Shoe Company		1,800.00
American Smelting and Refining Company		1,000.00
American Society for Metals Foundation		700.00
American Society of Tool Engineers		250.00
George W. and Carrie L. Barbier Scholarship Fund, Inc.		250.00
The Bell Foundation		1,400.00
Ezra Blount		500.00
Borden Company Foundation, Inc.		1,000.00
Chemical Club of New England		300.00
Clevite Foundation		500.00
Cole-Hersee Company		1,000.00
Morgan A. Collins, Jr. '27		200.00
Carle C. Conway		1,000.00
Dow Corning Corporation		900.00
Frank Memorial Corporation		500.00
Eleanor G. Frasher		900.00
The Gardner Foundation		500.00
General Motors Corporation		31,050.00
The Felix and Cecile Gouled Foundation		1,250.00
Richarl W. Ince		1,000.00
Jakobson Shipyard, Inc.		1,000.00
C. O. Kienbusch		500.00
Kuljian Corporation		1,000.00
Lockheed Leadership Fund		7,600.00
Magnus Products Company		700.00
M.I.T. Club of Cleveland		500.00
M.I.T. Club of Los Angeles		500.00

M.I.T. Club of Rochester	$ 300.00
Edna McConnell Clark Foundation, Inc.	5,640.00
John J. Murphy '23	1,000.00
National Association of Engine and Boat Manufacturers	1,800.00
Perkin Elmer Corporation	200.00
Carl and Lilly Pforzheimer Foundation, Inc.	500.00
Procter and Gamble Company	3,290.00
Sanborn Company	1,000.00
Skidmore, Owings and Merrill	1,200.00
David M. Sutter '26	400.00
Symington Gould Corporation	1,500.00
Tee-Pak Foundation	900.00
Mildred Tsai	100.00
Union Carbide and Carbon Company	2,200.00
Wappler Foundation, Inc.	500.00
Robert Winthrop Trust	4,000.00
Other	1,000.00
	$ 242,863.00

Gifts for designated purposes

A C Spark Plug Division of General Motors Corp.	
For a fellowship in aeronautical engineering	$ 4,200.00
Acushnet Process Company	
For research in high voltage laboratory	2,500.00
Allied Chemical and Dye Corporation	
For a fellowship in chemistry	2,400.00
Allison Division — General Motors Corporation	
For turbo machine research in aeronautical engineering	20,000.00
American Bosch-Arma Corporation	
For a fellowship in aeronautical engineering	3,000.00
American Brake Shoe Company	
For a professorship in metallurgy	12,500.00
For research in metallurgy	3,500.00
American Can Company	
For general purposes	1,000.00
American Cancer Society	
For fellowship expenses in biology	500.00
American Chemical Society	
For research in chemistry	6,400.00
American Chicle Company	
For a fellowship in good technology	2,500.00
American Cyanamid Company	
For soil stabilization research in civil engineering	4,583.36
For a fellowship in chemistry	2,700.00
American Iron and Steel Institute	
For research in metallurgy	10,000.00
For research in civil engineering	4,000.00
American Metal Company	
For a fellowship in metallurgy	1,000.00
American Oil Company	
For a practice school fellowship in chemical engineering	2,500.00

AMERICAN SOCIETY OF MECHANICAL ENGINEERS	
For research in chemistry	$ 2,500.00
AMERICAN SOCIETY OF REFRIGERATING ENGINEERS	
For research in mechanical engineering	500.00
AMERICAN VISCOSE CORPORATION	
For research in food technology	10,000.00
For a fellowship in chemical engineering	3,100.00
ANONYMOUS	
For the School of Industrial Management	2,617.44
ANONYMOUS	
For the Department of Electrical Engineering	3,000.00
ANONYMOUS	
For medical research	5,000.00
ANONYMOUS	
For the preparation of the Karl T. Compton biography	3,750.00
ARMCO FOUNDATION	
For a fellowship in metallurgy	3,600.00
ARMOUR & COMPANY	
For research in biology	6,666.00
JARRELL ASH COMPANY	
For research in biology	7,678.10
THE ASIA FOUNDATION	
For the Asia Fund in the Center for International Studies	500.00
ATLANTIC REFINING COMPANY	
For research in geology	4,000.00
ATWOOD FOUNDATION	
For the Joseph N. Scanlon Memorial Fund	1,000.00
BABCOCK AND WILCOX COMPANY	
For research in mechanical engineering	10,000.00
JAMES M. BARKER '07	
For general purposes	509.80
BAUSCH AND LOMB OPTICAL COMPANY	
For research in the Spectroscopy Laboratory	5,000.00
BEAR CREEK MINING COMPANY	
For research in geology	300.00
BRISTOL LABORATORIES, INC.	
For research in chemistry	7,000.00
BUFFALO ELECTRO-CHEMICAL COMPANY	
For research in civil engineering	5,000.00
BULLARD COMPANY CHARITY FUND	
For the Department of Civil Engineering	500.00
For the Department of Mechanical Engineering	690.00
CALIFORNIA RESEARCH CORPORATION	
For research in geology	4,000.00
CAMPBELL SOUP COMPANY	
For research in food technology	2,500.00
CARBIDE AND CARBON CHEMICAL COMPANY	
For a fellowship in chemical engineering	1,350.00
For research in mechanical engineering	100.00
For the Miller Room in mechanical engineering	100.00

CARBORUNDUM COMPANY	
For research in mechanical engineering	$ 11,070.03
CARNATION COMPANY	
For research in food technology	5,000.00
CARNEGIE CORPORATION	
For research and conferences on American studies in the Center for International Studies	50,000.00
WILLIAM K. CARPENTER	
For the R. R. M. Carpenter ('01) Scholarship in chemical engineering	2,500.00
CENTRAL LABORATORIES DIVISION, GENERAL FOODS CORP.	
For research in biology	3,500.00
For a fellowship in biochemistry	2,500.00
CHANCE VOUGHT AIRCRAFT, INC.	
For general purposes	500.00
CHILDREN'S MEDICAL CENTER	
For research in metallurgy	1,800.00
For research in biology	300.00
CHORAL SOCIETY	
Contributions for the Society's European trip:	
Allen Abrams '15	10.00
Edward L. Bowles '22	5.00
Donald F. Carpenter '22	500.00
William A. Coolidge	2,000.00
Philip N. Cristal '17	25.00
Marshall B. Dalton '15	100.00
Alice C. Desmond	100.00
Horace S. Ford	100.00
Pierre F. Lavedan '20	25.00
Duncan R. Linsley '22	100.00
Adelaide H. Marquand	100.00
George W. Merck	5,000.00
Redfield Proctor '02	500.00
Vernon N. F. Tallman '14	10.00
T. North Whitehead	25.00
Others	3,001.00
COFFEE BREWING INSTITUTE, INC.	
For research in food technology	15,000.00
For a fellowship in food technology	2,700.00
COMMONWEALTH FUND	
For research in biology	35,000.00
CONSOLIDATED METAL PRODUCTS CORPORATION	
For research in metallury	1,000.00
CONSUMERS UNION OF U. S., INC.	
For a fellowship in chemistry	2,000.00
CONVAIR	
For general purposes	500.00
CARLE C. CONWAY '53	
For general purposes	300.00
CORNING GLASS WORKS	
For research in metallurgy	2,000.00

CRANE COMPANY	
For a fellowship in metallury	$ 1,050.00
CURTISS-WRIGHT COMPANY	
For research in aeronautical engineering	20,000.00
DAMON RUNYON CANCER FUND	
For high voltage research in electrical engineering	40,000.00
For research in biochemistry	8,000.00
DEAN'S CHAPEL FUND	
Contributions	25.00
WILLIAM E. P. DOELGER '26	
For research in food technology	100.00
DONNER FOUNDATION	
For research in civil engineering	3,420.00
DORR OLIVER, INC.	
For research in mechanical engineering	2,000.00
DOUGLAS AIRCRAFT COMPANY	
For a fellowship in aeronautical engineering	2,000.00
CAMILLE AND HENRY DREYFUS FOUNDATION, INC.	
For research in chemistry	6,000.00
E. I. DU PONT DE NEMOURS AND COMPANY, INC.	
For an instructor in chemistry	4,040.00
For research in chemistry	15,000.00
For a fellowship in mechanical engineering	4,200.00
For a fellowship in physics	4,200.00
For a fellowship in chemical engineering	4,475.00
EASTMAN KODAK COMPANY	
For Executive Development Program fees	2,900.00
For a scholarship in chemical engineering	1,100.00
For research in electronics	7,500.00
ELECTRO METALLURGICAL COMPANY	
For comminution research in metallurgy	3,300.00
For a fellowship in metallurgy	3,300.00
D. W. EMERSON	
For the Foreign Student Summer Project	50.00
ENGINEERING FOUNDATION	
For research in metallurgy	2,500.00
ESSO RESEARCH AND ENGINEERING COMPANY	
For research in geology	4,000.00
ETHICON SUTURES LABORATORY, INC.	
For research in biology	5,000.00
ETHYL CORPORATION	
For research in chemistry	3,600.00
For research in mechanical engineering	4,800.00
For a fellowship in chemistry	2,900.00
EXECUTIVE DEVELOPMENT PROGRAM	
Fees from industrial concerns	84,134.11
EXOMET, INC.	
For research in metallurgy	7,595.15
FIRMENICH, INC.	
For research in chemistry	9,000.00

FORD FOUNDATION	
For economics (via the University of Chicago):	
Research in the utilization of human resources	$ 16,000.00
Grant for individual research	2,477.46
For the Center for International Studies:	
For international communications studies	380,000.00
For economic and political development studies	325,000.00
Assistance to the Indonesian Institute for economic and social research	10,270.00
FORD MOTOR COMPANY	
For general purposes	1,500.00
FOUNDRY EDUCATIONAL FOUNDATION	
For research in metallurgy	500.00
For a scholarship in metallurgy	3,850.00
THE FUND FOR ADVANCEMENT OF EDUCATION	
For the program in humanities	9,000.00
GENERAL DYNAMICS CORPORATION	
For a fellowship in chemical engineering	4,000.00
For a fellowship in physics	4,000.00
GENERAL ELECTRIC COMPANY	
For turbo machine research in aeronautical engineering	10,000.00
GENERAL ELECTRIC EDUC. AND CHARITABLE FOUNDATION	
For a fellowship in chemistry	3,300.00
For a fellowship in physics	3,700.00
For a fellowship in metallurgy	6,950.00
For a fellowship in mathematics	1,200.00
For a fellowship in mechanical engineering	1,200.00
For a fellowship in chemistry	1,200.00
For a fellowship in chemical engineering	3,600.00
For an educational program in electrical engineering	50,000.00
For general purposes	750.00
GENERAL FOODS CORPORATION	
For research in biology	3,500.00
GENERAL MILLS, INC.	
For research in food technology	10,000.00
GENERAL MOTORS CORPORATION	
Executive Development Program fees	2,900.00
For a fellowship in mechanical engineering	3,000.00
Unrestricted grant allocated to the Admissions Office	1,000.00
THE GIRDLER COMPANY	
For research in food technology	314.16
GIVAUDAN CORPORATION	
For research in biochemistry	4,000.00
For research in chemistry	5,000.00
B. F. GOODRICH CHEMICAL COMPANY	
For a textile fellowship in mechanical engineering	5,000.00
GOODYEAR TIRE AND RUBBER COMPANY	
For a fellowship in aeronautical engineering	2,500.00
GREEN GIANT COMPANY	
For research in food technology	1,000.00

CRAWFORD H. GREENEWALT '22	
For film research in electrical engineering	$ 1,500.00
EARLE A. GRISWOLD '23	
For the Proctor Portrait Fund	100.00
GRUMMAN AIRCRAFT ENGINEERING CORPORATION	
For general purposes	6,500.00
HERBERT GRUNFELD TRUST	
For the Department of Metallurgy	250.00
GULF OIL CORPORATION	
For a fellowship in chemical engineering	3,185.88
For research in geology	4,054.75
HITCHINER MANUFACTURING COMPANY, INC.	
For the Joseph N. Scanlon Memorial Fund	250.00
H. P. HOOD AND SONS COMPANY	
For research in food technology	2,000.00
HOPEDALE FOUNDATION	
For research in metallurgy	1,666.66
AUSTIN Y. HOY '04	
For the Dean's Chapel Fund	791.00
HUMBLE OIL AND REFINING COMPANY	
For a fellowship in chemical engineering	2,700.00
PROFESSOR JEROME C. HUNSAKER '12	
For the Department of Aeronautical Engineering	1,000.00
GODFREY M. HYAMS TRUST	
For research in radiation in electrical engineering	18,000.00
ELMER C. INGRAHAM '26	
For the Research Laboratory of Electronics	2,000.00
INSTITUTE OF FOOD TECHNOLOGISTS	
For a fellowship in food technology	1,600.00
INTERNATIONAL NICKEL COMPANY	
For fellowships in metallurgy	8,470.83
INTERNATIONAL SALT COMPANY, INC.	
For soil stabilization research in civil engineering	3,000.00
JONES AND LAUGHLIN STEEL CORPORATION	
For equipment for metallurgy	2,500.00
KENNECOTT COPPER COMPANY	
For a fellowship in metallurgy	4,000.00
JAMES R. KILLIAN, JR. '26	
For equipment for athletics	2,000.00
KIMBERLY CLARK FOUNDATION	
For a fellowship in chemical engineering	4,010.00
ESTATE OF CHARLES A. KING '96 AND MARJORIE KING	
For research in biology	10,000.00
JACOB KURTZ	
For research in metallurgy	200.00
LASALLE STEEL COMPANY	
For research in mechanical engineering	1,577.75
LEVER BROTHERS COMPANY	
For the Howard D. Williams Fund in industrial management	500.00

DR. AND MRS. WARREN K. LEWIS	
For a practice school scholarship in chemical engineering	$ 1,009.44
LIFE INSURANCE MEDICAL RESEARCH FUND	
For research in biochemistry	500.00
ELI LILLY COMPANY	
For research in biology	8,400.00
LOCKHEED LEADERSHIP FUND	
For a fellowship in aeronautical engineering	2,500.00
LORD MANUFACTURING COMPANY	
For research in civil engineering	13,200.00
LUCIDOL DIVISION OF WALLACE AND TIERNAN COMPANY	
For research in chemistry	3,000.00
THE MACMILLAN COMPANY (New York)	
For the International Relations Section	1,000.00
MAGNOLIA PETROLEUM COMPANY	
For research in geology	4,000.00
MANUFACTURING CHEMISTS ASSOCIATION, INC.	
For research in civil engineering	20,000.00
LOUIS AND GENE MARRON FOUNDATION	
For the Louis Marron Science Fund in biology	2,000.00
NEWMAN M. MARSILIUS '17	
Additional for the Newman M. Marsilius Fund in industrial management	1,000.00
COMMONWEALTH OF MASSACHUSETTS	
For the highway project in civil engineering	30,000.00
MASSACHUSETTS GENERAL HOSPITAL	
For research in textiles in mechanical engineering	100.00
For research in biology	823.70
M.I.T. BOSTON STEIN CLUB	
Contributions by members of the M.I.T. Boston Stein Club for the purchase of religious fittings for the Chapel	3,364.50
MCGRAW HILL PUBLISHING COMPANY	
For a fellowship in aeronautical engineering	2,700.00
MELPAR, INC.	
For a fellowship in electrical engineering	5,000.00
MERRILL FOUNDATION FOR THE ADVANCEMENT OF FINANCIAL KNOWLEDGE	
For research in economics	1,790.00
NICHOLAS A. MILAS	
For research in chemistry	8,950.00
MINNEAPOLIS-HONEYWELL REGULATOR COMPANY	
For a fellowship in electrical engineering	2,900.00
MONSANTO CHEMICAL COMPANY	
For research in civil engineering	6,000.00
MONSANTO CHEMICAL COMPANY CHARITABLE TRUST	
For a fellowship in chemical engineering	3,850.00
For a fellowship in chemistry	3,850.00
STEPHEN R. MONTGOMERY	
For turbo machine research in aeronautical engineering	75.00
HENRY MORGENTHAU, JR.	
For the Morgenthau Fund in humanities	8,250.00

JOHN P. MOUKS		
For the Foreign Student Summer Project	$	250.00
MUCHNIC FOUNDATION		
For a fellowship in metallurgy		3,000.00
MUSCULAR DYSTROPHY ASSOCIATION OF AMERICA, INC.		
For research in biology		6,134.90
NATIONAL GEOGRAPHIC SOCIETY		
For Edgerton film research in electrical engineering		3,000.00
NATIONAL INSTITUTES OF HEALTH		
For research in biology		500.00
For research in chemistry		1,000.00
For research in electrical engineering		500.00
For a fellowship in the Medical Department		4,000.00
NATIONAL LIME ASSOCIATION		
For research in civil engineering		7,000.00
NATIONAL SCIENCE FOUNDATION		
For research in chemistry		3,800.00
NOVA SCOTIA RESEARCH FOUNDATION		
For research in geology		2,500.00
NUTRITION FOUNDATION		
For the K. T. Compton Fellowship — Nutrition Foundation in biology		6,400.00
OHIO OIL COMPANY		
For research in geology		4,800.00
OLIN MATHIESON CHEMICAL CORPORATION		
For soil stabilization research in civil engineering		5,000.00
OWENS ILLINOIS GLASS COMPANY		
For research in chemistry		7,000.00
PANTEX MANUFACTURING COMPANY		
For research in mechanical engineering		745.55
PFAUDLER COMPANY COMMUNITY FUND		
For the Joseph N. Scanlon Memorial Fund		500.00
PHILLIPS PETROLEUM COMPANY		
For research in geology		4,800.00
JOHN B. PIERCE ('48) FOUNDATION		
For corrosion research in civil engineering		1,500.00
PITNEY-BOWES, INC.		
For general purposes		500.00
PROCTER AND GAMBLE COMPANY		
For a fellowship in chemical engineering		5,200.00
For a fellowship in mechanical engineering		2,950.00
WILLIAM L. PUTNAM PRIZE FUND		
For the Putnam Fund in mathematics		100.00
SIDNEY H. RABINOWITZ FAMILY FOUNDATION		
For research in food technology		1,000.00
RADIO CORPORATION OF AMERICA		
For general purposes		1,500.00
RAYTHEON MANUFACTURING COMPANY		
For research in food technology		8,000.00
REFRIGERATION RESEARCH FOUNDATION		
For research in food technology		500.00

J. F. Remington	
For the Henley Regatta Fund	$ 10.00
Research Corporation	
For research in chemistry	10,100.00
For research in metallurgy	3,000.00
The Roche Anniversary Foundation	
For research in food technology	6,720.00
Rockefeller Foundation	
For research in chemistry	11,645.53
For research in city planning	21,703.68
For research in geology	4,000.00
For research in modern languages	2,389.23
Rodney Hunt Machine Company	
For research in food technology	314.16
Rohm and Haas Company	
For research in chemistry	3,000.00
For soil stabilization research in civil engineering	2,000.00
Rufo Construction Company	
For the Charles B. Breed Fund in civil engineering	150.00
Paul A. Samuelson	
For economics seminar room	137.10
Schlumberger Foundation	
For a fellowship in electrical engineering	3,000.00
Seal, Inc.	
For the Theodore H. Kreuger Fund in industrial management	300.00
Harvey I. Seley '55	
For general purposes	1,250.00
For the Program for Senior Executives (School of Industrial Management)	
Electrolux Corporation	2,500.00
General Electric Company	2,500.00
B. F. Goodrich Company	5,000.00
Humble Oil and Refining Company	2,500.00
Pan American World Airways, Inc.	2,500.00
Radio Corporation of America	2,500.00
Standard Oil Company of California	2,500.00
Standard Oil Company (Indiana)	2,500.00
United Aircraft Company	2,500.00
Westinghouse Corporation	2,500.00
Whirlpool-Seeger Corporation	2,500.00
Sharp and Dohme, Inc.	
For research in chemistry	4,800.00
Shell Companies Foundation	
For a fellowship in mechanical engineering	3,400.00
For a fellowship in physics	3,400.00
For research in mechanical engineering	7,500.00
For research in metallurgy	7,500.00
For research in physics	7,500.00
George P. Shultz '49	
For the Joseph N. Scanlon Memorial Fund	100.00

H. Nelson Slater, Jr. '50	
For the School of Industrial Management	$ 100.00
Alfred P. Sloan ('95) Foundation	
For the School of Industrial Management	550,000.00
For executive research	63,100.00
For the Executive Development Program	242,500.00
For research in chemistry	23,750.00
For the Foreign Student Summer Project	107,000.00
Mr. and Mrs. Alfred P. Sloan, Jr. '95	
For special awards	247,014.06
Society of Naval Architects and Marine Engineers	
For research in mechanical engineering	1,620.00
For research in naval architecture	6,500.00
Socony-Mobil Oil Company, Inc.	
For a fellowship in electrical engineering	750.00
For a fellowship in mechanical engineering	750.00
Standard Oil Company of California	
For a fellowship in geology	3,350.00
For a scholarship in mechanical engineering	750.00
Standard Oil Foundation, Inc.	
For a fellowship in chemical engineering	2,300.00
Stanolind Oil and Gas Company	
For research in geology	4,000.00
Steel Founders Society of America	
For research in metallurgy	35,600.00
William L. Stewart, Jr. '23	
For a regional conference	340.00
Stromberg Carlson Company	
For the Joseph N. Scanlon Memorial Fund	1,000.00
Warner Swasey Company	
For research in mechanical engineering	5,000.00
Technology Christian Association Advisory Board	
For the program in humanities	5,000.00
Tasty Baking Company	
For research in food technology	5,000.00
Howard F. Taylor '46	
For research in metallurgy	664.50
Technical Association of the Pulp & Paper Industry	
For research in civil engineering	5,000.00
Titanium Alloy Manufacturing Division	
For research in metallurgy	1,500.00
Tropic Food, Inc.	
For research in food technology	6,000.00
Union Carbide and Carbon Corporation	
For a fellowship in chemistry	2,700.00
For research in electrical engineering	5,000.00
United Aircraft Corporation	
For general purposes	2,500.00
United Engineering and Constructors, Inc.	
For the United Engineering and Constructors, Inc., preceptorship in chemical engineering	1,000.00

UNITED ENGINEERING TRUSTEES, INC.	
For research in civil engineering	$ 3,000.00
For research in metallurgy	5,500.00
UNITED SHOE MACHINERY COMPANY	
For the Library	500.00
For research in industrial management	900.00
UNITED STATES RUBBER COMPANY FOUNDATION	
For a fellowship in chemistry	3,300.00
UNITED STATES STEEL CORPORATION	
For a commons room in metallurgy	2,500.00
UNIVERSITY OF PUERTO RICO	
For research in city planning	4,210.00
VANADIUM ALLOY STEEL COMPANY	
For a fellowship in metallurgy	7,000.00
VOORHEES, WALKER, FOLEY AND SMITH	
For a fellowship in architecture	2,500.00
WALWORTH COMPANY	
For a fellowship in mechanical engineering	3,000.00
WEIRTON STEEL COMPANY	
For a fellowship in metallurgy	5,200.00
WESTINGHOUSE EDUCATIONAL FOUNDATION	
For the Westinghouse Professorship in Mechanical Engineering	15,000.00
WESTINGHOUSE ELECTRIC CORPORATION	
For research in aeronautical engineering	30,000.00
For research in electrical engineering	15,000.00
WEYERHAEUSER TIMBER FOUNDATION	
For general purposes	2,000.00
JOHN G. WOLBACH	
For the President's Fund	500.00
For the Dean's Chapel Fund	500.00
WORTHINGTON CORPORATION	
For research in mechanical engineering	1,500.00
YALE UNIVERSITY	
For the Stimson Fund in industrial management	6,750.00
	$3,325,284.83

OTHER GIFTS

Added to agency funds held for investment purposes

CONTRIBUTIONS OF CLASS MEMBERS DESIGNATED FOR THEIR CLASS FUNDS:	
Class of 1907	$ 20,542.61
Class of 1909	2,034.08
Class of 1910	750.00
Class of 1916	995.38
Class of 1917	3,004.96
Class of 1918	89.54
Class of 1933	571.68
Class of 1937	728.04
Class of 1944	491.95
Class of 1948	21.45
Class of 1949	489.98
Class of 1950	392.44

Class of 1952	$	69.05
Class of 1954		53.98
Class of 1955		70.23
DR. AND MRS. C. BALDWIN		
For the Sailing Pavilion Fund		183.88
MARGARET T. COLEMAN '50		
For the M.I.T. Women's Association		25.00
PRISCILLA M. RAYMOND '51		
For the M.I.T. Women's Association		25.00
	$	**30,539.25**

Added to annuity funds

ANONYMOUS		
Additional for an annuity	$	12,000.00
PHILIP L. COLEMAN '23		
For the Philip L. Coleman Fund		10,000.00
KNIGHT W. WHEELER '06		
Additional for the Knight W. Wheeler Fund		46,000.00
GEORGE S. WITMER '09		
Additional for the George S. Witmer Fund		6,168.75
	$	**74,168.75**

SUMMARY OF GIFTS, GRANTS, AND BEQUESTS RECEIVED

	1956	1955	1954	1953	1952	1951	1950	1949	1948	1947
GIFTS FOR ENDOWMENT:										
Real Estate	.....	$ 275,000	.....	.....	.....	.....	.....	$ 175,000	.....	.....
Funds for general purposes	$ 61,264	111,956	$ 82,558	$ 50,128	$ 7,740	$ 86,586	$1,030,511	193,255	$ 379,560	$ 977
Funds for designated purposes	2,342,351[1]	499,495	677,230	538,077	340,532	523,599	382,069	106,114	105,919	327,397
GIFTS FOR STUDENT LOANS	2,200	4,550	9	905	2,973	227,756	10	115	7,360	3,650
GIFTS FOR BUILDING FUNDS	1,133,990	1,530,684	274,400	15,004	40,308	3,797,212	1,268,266	91,666	316,974	1,110,334
OTHER GIFTS:										
Unexpended balances of endowment fund income	6,450	6,340	7,786	5,800	5,425	5,775	2,525	9,180	13,800	.....
Funds for general purposes — invested	191,826	765,680	391,881	1,403,533	2,850,889	2,206,364	2,066,934	482,730	101,899	125,122
Funds for designated purposes — invested	1,871,291	922,299	293,548	1,108,931	1,537,653	554,665	245,454	316,441	396,770	356,377
Funds for designated purposes — not invested	4,673,207	2,765,567	3,356,835	3,046,288	2,093,875	1,657,399	1,463,763	1,106,065	810,494	437,384
	$10,282,579	**$6,881,571**	**$5,084,247**	**$6,168,666**	**$6,879,395**	**$9,059,356**	**$6,459,532**	**$2,480,566**	**$2,132,776**	**$2,361,241**
MISCELLANEOUS GIFTS:										
Agency funds	$ 30,539	$ 137,598	$ 26,171	$ 38,728	$ 45,711	$ 38,751	$ 18,247	$ 22,436	$ 54,747	$ 7,244
Annuity funds	74,169	55,688	6,625	24,500	28,000	47,000	50,310	33,800	4,300	14,197
	$ 104,708	$ 193,286	$ 32,796	$ 63,228	$ 73,711	$ 85,751	$ 68,557	$ 56,236	$ 59,047	$ 21,441
Total	**$10,387,287**	**$7,074,857[1]**	**$5,117,043[1]**	**$6,231,894[1]**	**$6,953,106**	**$9,145,107**	**$6,528,089**	**$2,536,802**	**$2,191,823**	**$2,382,682**

[1] Adjusted to include grants to the Center for International Studies.

DEAN OF STUDENTS

As I turn over the responsibilities of the Dean of Students to Professor John T. Rule, it seems appropriate to comment on the evolution of the office of the Dean of Students in the last decade. At the end of the war it was the determined conviction of the Institute that special efforts be directed to the development of undergraduate education to meet the new demands of society upon this type of education. Central to the thinking of the Faculty was the need to turn out professionally trained men capable of assuming leadership not only in technical affairs but also in the complex, human environment created by a technological society. This meant that parallel to the work in the classrooms and laboratories must be programs and facilities designed to broaden and develop personal and cultural growth as citizen and leader. It also reflected the increasingly apparent fact that undergraduate education in science and engineering was no longer so much terminal professional education, but, in increasing degree, a new-type general education which in most cases had to be followed by graduate education for true professional competence, as has been true for many years in law and medicine.

When Dean Everett M. Baker took office, the Institute was in process of becoming a residential school and introducing professionally run programs in music and athletics and more adequate guidance programs, including mental health. Plans were being made and implemented as quickly as possible for the physical facilities necessary to these new programs: dormitories, athletic facilities, chapel, auditorium, etc. In retrospect, it seems clear that Dean Baker—at a time when the student body had almost doubled since before World War II and when many of the traditional procedures and bulwarks of undergraduate life had lapsed because of the war—had the task of selling new concepts, facing the daily problems of sailing in new, uncharted waters, and evolving the concepts necessary to meet new programs and new conditions. Dean Baker's tragic death clearly delayed the evolution of the program while new personnel was found and went through the necessary stages of orientation.

During my term of office student government, the Faculty through Faculty committees, and administration and Corporation through meetings and formal studies, have all, separately and together, had the time to understand the problems, evolve a common philosophy, and in large measure to set common goals. As these new developments have taken place, a highly competent staff has been recruited for the office of the Dean of Students; and a philosophy of organization and operation has been developed for this staff, for Faculty committees, and for student government which promises in the years immediately ahead the rapid, smooth accomplishment of many new goals designed to improve the student community as an integral part of the educational program of the Institute. It is my fondest hope for my successor that with the already largely evolved staffing and decentralization of the office, Faculty responsibility exercised by Faculty committees, and the responsibility for administrative development of proposed physical changes and improvements placed in other hands through my own new assignment as Special Adviser to the President, he may serve as a top administrative officer in the area of student life, free from the detailed responsibility of any particular area of the office as well as from developmental responsibilities and free to keep informed about all areas, to develop closer relationships with students, Faculty, and academic departments, and to serve at all times as the protagonist for the best interests of the students, both as individuals and as groups. It is

furthermore strongly recommended that additional personnel be provided for the office if experience proves that Dean Rule cannot enjoy such freedom with existing personnel.

COMMITTEE ON STUDENT HOUSING

Without doubt the most significant development during the last year has been the work of the Committee on Student Housing. The report is available elsewhere and speaks eloquently for itself. It should be added, however, that in addition to developing the very significant recommendations included in the report, the Committee served another and valuable function for the M.I.T. community. Representing as it did all groups in the Institute, the Committee served as a forum for interested representatives from all groups and thus brought together varying viewpoints and evolved a true concensus of Institute opinion on the goals of student community life. On behalf of the whole M.I.T. community as well as for those of us privileged to sit with the Committee, I should like to express appreciation for the work of the Chairman, Edwin D. Ryer, Term Member of the M.I.T. Corporation. Not only was he tireless in his efforts and generous with his time beyond any normal measure of expectation, but he was a superbly patient, effective presiding officer. M.I.T. and the nation owe Mr. Ryer a deep debt of gratitude, and I say the nation advisedly because this report will have influence far beyond the walls of the Institute.

In cooperation with the Committee on Student Housing, an experiment in family-style dining was successfully conducted during the spring term in Baker House. Appreciation is expressed to the student officers of the House, the Dining Service, the Office of General Services, and the special committee under Professor William A. Wilson for their cooperative efforts in making the experiment a success.

RELIGIOUS PROGRAM

With the new M.I.T. Chapel taking its place as the focal point of formal religious activity by all religious groups, each operating independently, the Technology Christian Association and the various Protestant groups have debated the implications of the unfolding religious program at M.I.T. and have determined courses of action to meet new conditions. T.C.A., long primarily a Protestant organization which welcomed participation in its program by stu-

dents of all faiths, is in process of becoming a non-religious student activity whose primary purpose shall be to enable students to render service both within and without the Institute. Central among its service departments remains the Religious Action Division, the primary function of which will be to stimulate and assist independent religious groups and to serve as the all-student agency through which all religious groups may be brought together for joint participation in appropriate interreligious activities. At the same time the United Christian Council, as the only interdenominational Protestant activity on campus, has arranged daily services for Protestants in the Chapel, with the assistance of various Protestant clergy under the leadership of Reverend Robert C. Holtzapple, Jr.

"In another sense the auditorium has also become a community meeting house sheltering a number of interests—but primarily the musical and dramatic arts. In effect, although the music and drama activities have attracted large crowds of spectators, the more substantial educational purpose has been served in the personal growth and development of the student participants who have used rehearsal time and long hours of practice to acquire proficiency and skills.

"Eloquent in their beauty, the chapel and auditorium have now become in fact members of the Institute family and are joined with their predecessors in creating increasingly a living, beloved community of memory and of hope."

CONSULTANT ON VALUES

Through a grant from the Fund for the Advancement of Education, Dr. Robert S. Hartman, Associate Professor of Philosophy at Ohio State University, spent the year as Consultant on Values to the Dean's Office and at the same time taught two subjects in the School of Humanities and Social Studies. So far as is known this was a unique experiment, and only time will indicate its value in adding the voice of the philosopher to that of the Deans, the Faculty advisers, the psychiatrists, and the clergy in debating the principles and methods of the noncurricular part of the educational program. Dr. Hartman served as a consultant to the Committee on Student Housing, participated in numerous student conferences both formal and informal, represented the Institute at many conferences away from M.I.T., spoke on numberless occasions both within and with-

out the Institute, lectured for various members of the Faculty, counseled with members of the Dean's Office staff on almost every phase of its responsibilities, served as adviser to a newly formed student Philosophical Society, and engaged in extensive counseling with individual students. One of Dr. Hartman's major formal concerns was the vital problem of defining nonscholastic factors affecting success in college and developing ways to test or appraise these factors. He wrote a theoretical study entitled, "The Structure of Personality: A Teleological Model of Nonscholastic Success Features," and additional studies were inaugurated with Professor Warren G. Bennis and associates.

In an age when the airplane and the radio have brought all the cultures of the world together, it seems imperative that ways be found to define and apply to human affairs human values common to all men regardless of race, color, or creed. This is a subject much in the mind and heart of the modern undergraduate, not to mention his elders. Dr. Hartman rendered invaluable service in enabling many students, Faculty, and clergy to debate these issues freely and to begin to think about them objectively, unencumbered by personal embarrassment and implied threats to accepted truths of faith and revelation.

INSTITUTE COMMITTEE

Under the able leadership of John S. Saloma, III '56, student government this year has all but completed the reorganization started after the war and made necessary by increased enrollment and changed conditions in the post-war Institute community. Mr. Saloma's annual report has been separately printed and speaks eloquently of student government philosophy, accomplishments, and goals. Special mention is made here of four important major developments. First, the Activities Council has this year developed a clear concept of its responsibilities and gone far towards organizing to meet the challenges of an activities program designed to contribute to the undergraduate educational program. Recognition has also been made of the transference from the Alumni Association to the Faculty of formal responsibility for the development and continuity of a sound activities program.

Secondly, intensive studies have been made of undergraduate finances, and basic policy changes have been effected in cooperation with the administration. The changes give students more

freedom in the management of undergraduate life but at the same time provide more adequate checks and balances to ensure continuity and a quality of performance worthy of M.I.T. standards.

Thirdly, commuting students have been formally organized and will occupy new quarters on the second floor of Walker Memorial in September. Thus all our undergraduates will have a formal voice in the life of the student community.

Fourthly, the new student Committee on Educational Policy, which succeeded the Student-Faculty Committee, has completed its first year of work under the able leadership of Jonathan H. Hathaway '56. At the same time the Liaison Council, a new group bringing together monthly the leaders of undergraduate life with the President, the Provost, and members of the Faculty and administration closely associated with undergraduate life, has proved to be an inavaluable innovation, providing excellent communication and a most efficient vehicle generating new ideas and preventing serious misunderstandings in the community.

Special brief mention should also be made of the following:

The bequest for athletic purposes of $1,006,000 by David F. du Pont '56, tragically killed just before the start of his senior year, will make possible the fulfillment of fond dreams of many M.I.T. students and alumni and has served as a great stimulus to those concerned with M.I.T. athletics.

The tragic accidental death of Thomas L. Clark '59 during a fraternity initiation became a national news item. Renewed sympathy is expressed to his family with the statement that subsequent events both at M.I.T. and at colleges and universities throughout the land clearly indicate that he shall not have died in vain. The Interfraternity Conference under the inspired leadership of its chairman, George W. Luhrmann, Jr. '56, and with the able counsel of Dean Frederick G. Fassett, Jr., took swift and thorough action for the prevention of any such catastrophe in the future. Student government followed the action of the Interfraternity Conference with legislation designed to prevent abuses hitherto infrequently occurring in connection with pre-Field Day rivalry between the freshman and sophomore classes. Tom Clark's memory will live on at M.I.T. through the Thomas L. Clark Scholarship established by the community in his memory under the leadership of his fraternity brothers of Delta Kappa Epsilon. As Dean I want

especially to express my admiration for the conduct of the undergraduate leaders of Delta Kappa Epsilon following this unfortunate happening.

Paralleling the work of the Committee on Student Housing in developing community life at the Institute was the work of the committee appointed by the Dean of Students to make recommendations regarding the handling of undergraduate finances, administrative organization of the Dean's Office in the areas of athletics and student activities, and relationship of the Dean's Office to the Department of Buildings and Power and student government in these areas. Chaired by Richard L. Balch, and composed in addition of Robert J. Holden, John A. Little, and William Mackintosh, it considered extensive recommendations made by student government relative to student financing. As a result of this report, students will have greater freedom but more realistic responsibility in handling undergraduate finances, further decentralization and Faculty responsibility in student affairs is assured, and improved operating relationships between the Dean's Office and the Treasurer's Office has been effected.

The Athletic Administrative Board under the leadership of Professors John A. Hrones and Thomas F. Jones, Jr., has rendered invaluable service through its intensive studies this year of the philosophy and physical needs of athletics at M.I.T.

The Corporation Committee on Student Life held a significant all-day meeting with the Dean's Office staff on March 6, 1956, at which the objectives, problems, and needs of each area were explained and discussed. The Dean's Office is grateful to this Committee for its support of our program.

Increased cooperation with those concerned with counseling and Faculty committees concerned with curriculum and teaching has been marked, and this illustrates the growing concept of undergraduate education as the total development of an individual. Particular mention is made of the cooperative work of the Committee on the First Two Years, the Freshman Advisory Council, and Deans Speer and Bean.

Two innovations in the counseling area were introduced during the last year: an Institute-sponsored dinner for incoming transfer students and a series of meetings between the instructors and advisers of individual freshmen sections.

The Graduate Student Council continues to develop and is now exploring its future organization and function in relation to the emerging concept of a Graduate Center as outlined in the report of the Committee on Student Housing. Financing of student affairs in the Graduate School has been completely separated from undergraduate finances.

IN APPRECIATION

After three years as Faculty Resident in Burton House, Professor Laurens Troost, Jr., is moving this summer into a new house which he has just built in Lexington. Dr. Troost's contribution both as a Faculty Resident in Burton House and in the deliberations of those concerned with student housing has been invaluable, lending as it has the fruits of his maturity, his clear sense of values, his love of students, and abiding faith in student life as an integral part of the educational process. Professor and Mrs. Troost will be sorely missed in Burton House. The entire dormitory community expresses its appreciation and extends an affectionate farewell.

One of the most significant developments in the last three years has been the replacement of administrative officers by members of the Faculty as ex officio chairmen of Faculty committees. I should like to pay special tribute to Professor James W. Daily who has just completed a two-year term as chairman of the Faculty Committee on Student Environment. He has been tireless in his effort, conscientious, imaginative, fearless, and both understanding and firm in his dealings with students. The Institute can be justly proud of the work of the Committee under Professor Daily's leadership.

Two administrative officers of the Freshman Advisory Council are retiring this year: Professor Norman C. Dahl, chairman, and Professor S. Curtis Powell, executive officer. Much credit is due these men for their imaginative leadership and tireless effort in the final formative stages of the Council's development.

Professor William N. Locke has ably served this last year as the first Faculty chairman of the Committee on Discipline. Much appreciation is expressed for his conscientious leadership despite the pressure of his new duties as Director of Libraries.

Appreciation is expressed to Mrs. Paul M. Chalmers, chairman, and the other members of the Women's Advisory Board who have

been so generous with their time in enriching the lives of our women students.

Special mention is made of the cooperation of Father J. Edward Nugent, Rabbi Herman Pollack, and Reverend Robert C. Holtzapple, Jr., in working with Edgar Kaufman in the development of liturgical objects especially designed by outstanding artists and craftsmen for the M.I.T. Chapel.

Finally, as I leave the office of Dean of Students, I should like to express my special appreciation for the work and support of my immediate associates, Deans Fassett, Pitré, Speer, and Bean; Messrs. Balch and Holden; and to student government with whom it has been a privilege to work so closely. Mrs. Bowditch joins me in expressing thanks to all of M.I.T. who have cooperated at every turn to make my term of office a memorable one for us.

E. FRANCIS BOWDITCH

DIRECTOR OF ATHLETICS

In an effort to carry out the general objectives of physical education at M.I.T., the Director of Athletics has endeavored to plan a program that "serves the educational objectives and provides wholesome recreation."

A conscious effort has been made to relate the physical education program to the basic policies stated by the Committee on Student Environment: 1. to increase the relative importance of the individual; 2. to facilitate easy social intercourse; and 3. to provide many centers for growth of a variegated community culture. It is my firm conviction that participation in a purposefully directed recreation program can and will accelerate the implied goals of the Committee on Student Environment.

With the interest taken by members of the M.I.T. Faculty in volunteering their time as team advisers in various sports, it is felt that we can succeed in our avowed purpose to maintain an athletic program which exists within the broad definition of recreation.

ATHLETIC STAFF

New members appointed to the physical education staff have been screened carefully with particular attention to breadth of personal as well as professional background.

Edwin Crocker comes to the Institute from Springfield College. He will serve, in his primary duties, as tennis and squash coach and will be responsible for working cooperatively with the Medical Department in the administration of physical fitness tests.

John Burke has been appointed freshman basketball coach and baseball coach. In addition to general teaching responsibilities, Mr. Burke will teach classes for both students and Faculty in golf. Mr. Burke comes to the Institute after four years of experience at Wesleyan University in Connecticut.

Charles Batterman, a former national intercollegiate diving champion, comes to M.I.T. from Ohio State and Harvard Universities. Mr. Batterman will assume duties in the class physical education program and will serve as freshman swimming and varsity diving coach.

In making the above appointments, it has been necessary to seek men who are able and willing to vary their coaching experience

both in physical education classes and in intercollegiate activities. It would otherwise be impossible to maintain the variety of activity we now have in the Athletic Department. Only in such novel programs as sailing and crew can we afford specialists. We must work in the future toward hiring fewer part-time members of the coaching staff; thus the stated need for versatility.

Through the recommendation of the new president of the Athletic Association, Bruce Blanchard '56, the M.I.T. Athletic Association and Athletic Department will be administered through a single budget. The Association will maintain its identity as a student organization responsible for student management. Bookkeeping, purchasing, and other services rendered all departments of the Institute will be provided through Institute offices.

INTERCOLLEGIATE PARTICIPATION

A successful season was completed in the following sports at M.I.T., with approximately 800 participants. Seventy men competed in track, 37 in sailing, 65 in lacrosse, 54 in baseball, 90 in heavyweight crew, 40 in lightweight crew, 49 in tennis, 34 in pistol, 27 in golf, 25 in fencing, 34 in squash, 41 in wrestling, 43 in basketball, 68 in swimming, 30 in rifle, 20 in cross-country, 39 in hockey, and 60 in soccer.

We sent to the Olympic trials John Morefield '56 who, during his intercollegiate competition in the hammer throw, identified himself as one of the five finest competitors in this event in the United States. John missed being made a member of the Olympic team, but in so doing he carried the name of M.I.T. to the West Coast where all could judge the calibre of the individual as well as his athletic prowess. John's effort in itself helped correct the mistaken impression that M.I.T. does not carry on intercollegiate competition.

Dimitry Vergun '56 established new records in his accomplishments on the basketball floor during the past season. By scoring 409 points during the 1955–56 basketball season, Dimitry qualified as a member of the All-Star New England Intercollegiate Team and set a pattern at M.I.T. of which we can all be proud. Dimitry's contribution both as a student and as a competitor on the basketball floor justifies, in every conceivable way, intercollegiate competition.

INTRAMURAL PARTICIPATION

During the course of the academic year 1955–56 1292 students took part in the intramural program. Of this number 175 were graduate students. Participation in intramural football provided recreational opportunities for 516. In addition there were 126 in intramural swimming, 363 in basketball, 71 in squash, 186 in badminton, 253 in bowling, 32 in golf, 116 in table tennis, 391 in volleyball, 553 in softball, 137 in tennis, 125 in track, 40 in sailing, and 337 in hockey.

Under the leadership of David Palamountain '56 and Thomas O'Connor '58, the intramural program provided as much possibility for participation as land area permitted.

This past season was the first full season for intramural hockey. The new rink provided intramural contests for 24 hockey teams from fraternity and dormitory living groups.

It has been necessary during the past year to limit the number of participating teams in touch football and basketball, as our facilities could not provide the space requested by the many organizations and living units asking that they be allowed to compete. In this regard, it is hoped that the coming year will bring about the addition of space on the West Campus for playing fields and that indoor facilities will provide for the indoor intramural participation.

The Athletic Department has carried out a policy by which the Faculty have been encouraged to use the athletic facilities at M.I.T. at any time that such use does not interfere with the undergraduate or graduate student body. We have reserved 150 lockers at the swimming pool for Faculty and employees and will do likewise at Briggs Field House if and when demand makes this necessary. It is hoped that during the next few years we will have locker facilities extensive enough to serve the entire M.I.T. community.

PHYSICAL EDUCATION PROGRAM

The physical education class instruction program, under the direction of Robert M. Whitelaw, exposes over 80 per cent of the underclassmen to the class program.

Close to 1200 students registered for class activities during each semester of the school year 1955–56. Approximately thirty-one per cent of the Class of 1959 completed their physical education point requirement during their freshman year. Twenty-nine per cent of the sophomore class (1958) lack sufficient points toward their physical

education requirements as they enter the junior year. The Class of 1957 was the first class to complete the third year requirement under the policy established by the Undergraduate Policy Committee in 1953. At the end of the first semester the Athletic Department records indicated that twenty-seven juniors for various reasons had not acquired any points toward their physical education requirements. By vote of the Faculty Committee on Third Year Records students having received no credit were asked to complete at least four points during the Second Term of 1955–56 in order to continue at M.I.T. after June, 1956. Under pressure of this vote and notifications sent by the Athletic Department, at the end of 1955–56 school year fifty students lacked sufficient points to complete their requirements by the end of their junior year. By special vote the Third Year Committee allowed those juniors until the end of their first semester of the senior year to complete the requirement.

In the early part of the first semester a committee was formed to reevaluate the physical education class program. After lengthy study and discussion by all members of the athletic staff, it was voted "that the school year shall be divided into four quarters with two points credit, per quarter, being given to an intercollegiate sport or physical education class activity." The revised system indicated that the athletic staff thought students at M.I.T. would and should go out for intercollegiate sports because of the very nature of the athletic program and not because of the credit received by participation.

The Athletic Department recommended to the Undergraduate Policy Committee that completion of the physical education requirement be limited to the first two years. The suggestion was passed by the Undergraduate Policy Committee and approved by the Faculty. Realizing the need for a physical education program for women students at M.I.T., the Department has been in close touch with Assistant Dean Ruth L. Bean. It is the hope that in future years classes will be afforded women students. Classes in tennis, skating, and sailing are now offered on an informal basis.

The Medical Department has been most cooperative in assisting and guiding the Athletic Department in the mental and physical therapy of students brought to their attention. Both departments have many mutual problems and common objectives.

It is the goal of the Physical Education Department to introduce students to a program, the quality of which will enhance interest in physical activities while in college and later in life.

The Massachusetts Institute of Technology faces a great opportunity among the institutions of higher learning in America. It is my hope that we may lead the way in bringing together the intellectual and recreational experiences of the Institute family. If such an ideal is realized we will have succeeded in setting the pattern for the necessary compromise between the complete neglect of physical education in European universities and the over-emphasis in most American educational institutions.

RICHARD L. BALCH

DIRECTOR OF STUDENT AID

For the second year in succession the total financial aid to our undergraduate students increased by almost 10 per cent, to a total of $1,039,829. This amount of aid was provided by the Institute through scholarships, loans, and part-time jobs; specifically, $354,622 in scholarships, $390,937 in loans, and $294,270 earned by part-time employment in student staffs and other divisions of the Institute. It is noteworthy that 30 per cent of our student body was helped through scholarships and loans and almost one-third did some part-time work to earn during the college year.

SCHOLARSHIP FUNDS

With an increase of $200 in tuition becoming effective with the academic year 1956–57, it is most encouraging to report that substantial additions have been made to the capital amount of the scholarship endowment during the past year; also, gifts for current use as scholarship awards increased by more than 50 per cent over last year, and for 1956–57 these gifts will triple the amounts given in 1954–55.

The initial contribution of the M.I.T. Alumni Fund is of major significance; slightly more than $50,000 was added to the endowments by name, class, and regional funds. The Alumni Fund Board generously added an additional $50,000 for current use during 1956–57 for making scholarship grants. This help is most timely, and we are deeply grateful to the alumni for their loyalty and financial support.

It is a pleasure to record that the endowment funds for undergraduate scholarships have been increased by more than $400,000 during the year. Gifts to the endowment came from Paul W. Litchfield, Redfield Proctor, and John J. Wilson. In addition to these, gifts came from the Cabot Foundation, S. Niarchos, and bequests establishing the Carl Pullen Dennett Memorial Scholarship Fund and the Howard A. Noble Scholarship Fund. The amount granted in 1956–57 from current funds will be about $340,000, an increase of almost 55 per cent over 1955–56. This compares with the tuition increase of about 22 per cent.

FRESHMAN SCHOLARSHIPS

With the great amount of public attention being focused on the current shortage of engineering and scientific personnel, a new interest by foundations and industry has sprung up in helping qualified young people through financial assistance to seek their training in fields of science and technology. The Institute has been a direct beneficiary through these efforts, and this fall fifty young men and women will enter the Institute as freshmen sponsored by the two large programs, General Motors and the National Merit Scholarship. Other companies, such as Procter & Gamble, Inland Steel, Cincinnati Milling Machine, and Lockheed, have smaller but just as effective programs supporting four-year scholarships at the Institute.

The result of all these efforts has been to catalyze requests for scholarship assistance from hopeful prospective freshmen. This year we received 2,300 completed applications for financial aid from freshmen aspirants; this represents a 60 per cent increase over 1953. It is quite likely that we will continue to experience a steady increase in the number of applications for assistance in the years ahead.

Although these large programs have been of material assistance in helping capable and needy students, the basic selection has been outside of the Institute and there has been yet another element of confusion added to the highly competitive situation of top-ranking students. As is to be expected with most new programs, unforeseen problems have developed; when some of the less desirable aspects are eliminated, better results and smoother operation may be obtained.

Almost $55,000 was received by the Institute as a contribution by foundations and industrial companies which sponsored undergraduate scholarships this year, as an aid "to meet the cost of education." It is anticipated that for this next year this amount will be increased substantially.

LOAN FUNDS

The following table illustrates the statistics for the year. Attention is called to the fact that our loan funds, including some of the smaller ones, have been effectively used and the number of students assisted materially increased, though the average loan still remains approximately two-thirds of the tuition charge.

Scholarships and loans	1955-56			1954-55		
	Number	*Awards*	*Total*	*Number*	*Awards*	*Total*
Undergraduate scholarships						
From M.I.T. endowment funds:						
Freshman scholarships	196	$101,870.50		199	$94,892.00	
Other undergraduate scholarships	298	118,121.65	$219,992.15	291	110,598.00	$205,690.00
From outside sources:						
Freshman scholarships	45	55,020.00		30	26,308.00	
Other undergraduate scholarships	115	79,610.00	134,630.00	79	60,830.00	87,138.00
	654		**$354,622.15**	**599**		**$292,828.00**
Undergraduate loans						
Technology Loan Fund	462	262,286.00		352	245,513.00	
Mead Fund	67	41,325.00		35	21,350.00	
Other student loan funds	6	3,850.00	307,461.00	3	934.75	266,897.75
	1054[1]		**$662,083.15**	**989**[1]		**$559,725.75**

[1] Allowing for individuals receiving both scholarships and loans.

During 1955–56 772 applications for loans were received from both graduate and undergraduate students; of this number 693 were presented for consideration to the Technology Loan Fund and 621, or 90 per cent, were acted upon favorably, totaling $342,264.00. For 1954–55 the corresponding figures were 565, 510, 90.2 per cent and $319,386.46. Seventy-three applicants were granted assistance from the George J. Mead Fund in the amount of $44,820.00; six others were helped from other student loan funds to the extent of $3,850.00, making a grand total of 699 loans granted for $390,937.00 for the year.

STUDENT EMPLOYMENT

Student employment continued this year at about the same level both in number of students employed and in total earnings. This source of assistance has in many cases closed the gap between outgo and income and has thus made it possible for individuals to finance their college years without deficit. In 1955–56, 1,169 students earned $294,270.00 while a year ago 1,200 students earned $294,300.00.

TUITION EXCHANGE

The initial experience of the Institute with the Tuition Exchange Plan was reported in last year's statement. For the year 1955–56 less than one half of the fifteen children certified for tuition remission were acted upon favorably—seven were accepted and eight denied help. Twenty-two Faculty children have been certified as eligible under this plan for the fall of 1956. Unfortunately, only three children have been accepted, and nineteen have not been accepted. Since joining the plan our score reads twenty acceptances and thirty-two refusals.

The latest report from the central office of the Tuition Exchange Plan at Williamstown shows that we are now in balance—and in terms of the "currency" of this plan (one semester) we enjoy a credit of two semesters. This has been brought about by the Institute's acceptance of ten "imports" for 1956–57, while for 1955–56 we had only two "imports." Our total imports since the beginning of the plan totals fifteen individuals. We have not denied acceptance to any "imports." During this year we have had eleven Faculty children on full tuition remission and it is expected that we shall have seven continuing during 1956–57.

A summary of the experience of M.I.T. Faculty children with the Tuition Exchange Plan may be stated as follows:

	Applications	*Placed*	*Refused*
Faculty children certified for "export"	52		
Faculty children accepted for "export"		20	
Faculty children refused for "export"			32
Faculty children accepted at M.I.T.	12	12	—
Total	**64**	**32**	**32**

VETERANS ENROLLMENT

The benefits established under the "G. I. Bill"—Public Law 346 for veterans of World War II—ceased as of June 30, 1956. The number receiving benefits during the year had shrunk to one per cent of the all-time high, 3,146 registered in the Spring Term, 1947.

The total of registered graduates and undergraduates receiving assistance under Public Law 550 (The Korean G. I. Bill) increased by 28 per cent during the past year.

	PL 16 or PL 346	*PL 550*	*Total*	*Per Cent of Total Registration*
Fall Term	36	314	350	5.9
Spring Term	31	397	418	7.7
Summer Term	5	135	140	9.0

T. P. PITRE

REPORTS OF OTHER ADMINISTRATIVE OFFICERS

VICE PRESIDENT FOR INDUSTRIAL AND GOVERNMENTAL RELATIONS

During the year the organization to administer sponsored research was the subject of careful study. We had been operating under two divisions—the Division of Industrial Cooperation under Dr. F. Leroy Foster, and the Division of Defense Laboratories under Henry W. Fitzpatrick. Nathaniel McL. Sage had been serving as the Head of the Office of Sponsored Research in a broad supervisory position. His death, after a long illness, on May 14, 1956, made some organizational changes necessary.

During the year, with the increased experience in the administration of the Division of Defense Laboratories, it became clear that we might simplify somewhat the research administration, delegating additional responsibilities to the Lincoln Laboratory, to the Instrumentation Laboratory, and to the Operations Evaluation Group working in the Navy Department in Washington, D.C.

This required the assignment of experienced administrative officers in each case. It also involved the consolidation of the responsibilities in the office of the Vice President for Industrial and Governmental Relations. Plans were therefore completed to establish a new Division of Sponsored Research to take the place of both the Division of Industrial Cooperation and the Division of Defense Laboratories.

Consolidation of the Research Fiscal Office in the office of the Vice President and Treasurer a year ago continues to work effectively. In fact, all of the financial problems associated with the research program are reviewed.

During the year, a plan for budgetary control of the work in the various laboratories was devised and placed in trial operation. In this plan, each laboratory submits at the beginning of the year estimates of its proposed program. As subsequent proposals are submitted, the budget estimate of the laboratory, showing the amount already contracted for and the additional amount committed by proposals together with the estimate for the new proposal, is reported. The administrative officers acting on the proposals are thus fully informed as to the overall commitments of each laboratory.

These plans are working smoothly and will permit increasingly effective administration of the whole program of sponsored research.

E. L. COCHRANE

DIVISION OF INDUSTRIAL COOPERATION

The volume of research administered by the Division of Industrial Cooperation decreased during the past year. This had been anticipated because one large laboratory (the Flight Control Laboratory), associated with a program of long standing, was closed completely; and during the summer of 1955 there were no special survey projects of the type undertaken for several years in the past.

That total operations were not smaller is due to several factors. One laboratory, the Naval Supersonic Laboratory, increased its programs extensively; and although several of the larger laboratories showed reductions in appropriations for research, a number of new contracts were entered into providing for a much wider

diversification of interests in smaller laboratories throughout the Institute. This has resulted in bringing more of the academic staff into the programs and has offered more opportunity for graduate student participation, all of which is in line with the basic philosophy of the contract research administered by the Division.

Because of increased costs, it must be borne in mind that the man-hours devoted to research during the past year have been reduced to a larger extent than is indicated by the dollar figures.

It is to be noted that the decrease in dollar volume has been in the area of research supported directly by the Government; work sponsored by industry and foundations has continued at approximately the same dollar volume as in fiscal 1955.

In tabular form below are shown comparative volume figures for the fiscal years 1955 and 1956, as well as information concerning personnel employed on Division projects.

Dollar Volume of D.I.C. Projects

	Fiscal Years	
	1955–56	*1954–55*
Government	$ 9,889,980	$10,252,170
Industrial and foundations	1,771,060	1,784,450
Total	**$11,661,040**	**$12,036,620**

Personnel Employed on D.I.C. Projects

	As of June 30, 1956	*As of June 30, 1955*
D.I.C. Staff	317	418
Academic Staff devoting some time to research projects	783	723
Supporting personnel (includes part-time student help)	704	652
Total	**1,804**	**1,793**

F. L. Foster

SECRETARY OF THE INSTITUTE

One of the highlights of the year was a dinner given by the Corporation at the Waldorf Astoria Hotel in New York with the theme "Science, the Mighty Multiplier," at which Dr. Robert E. Wilson of the Corporation paid tribute to Dr. Compton. General Robert Cutler, formerly Special Assistant to the President of the United States, was the principal speaker; President Killian presided. More than 1,500 alumni and friends of the Institute attended the dinner to celebrate the successful completion of the fund for the Karl Taylor Compton Laboratories. Much credit for the success of the dinner is deserved by Thomas D'A. Brophy of the Corporation, who was not only chairman of the Committee on Arrangements but who provided the fine judgment and finesse in setting up the program and creating the proper atmosphere; and Ralph T. Jope, who worked out the seating and the host of detailed arrangements for the dinner.

In an institution as large as M.I.T., keeping the several segments of the Institute's family and friends continually informed about campus developments is difficult. The various publications and press releases are of course a vital part of the program to keep our constituents systematically and regularly abreast of important happenings. I think *The Observer*, edited by Walter Milne of the News Service, which was first published two years ago, has now clearly taken its place among the important information media. *The Observer* is prepared particularly for parents, but it has become useful as a means of keeping a widening group of the Institute's friends informed about significant educational and research activities.

Supplementing the several Institute publications as a means of keeping friends informed, two events deserve mention in addition to the previously mentioned New York dinner. First are the now-well-established regional conferences, held annually in two major cities under the auspices of the Alumni Association; this year conferences were held in St. Louis and Los Angeles. In each city, upwards of 300 alumni and friends were brought up-to-date on the part M.I.T. is playing in putting science and technology to work effectively in medical and industrial fields. The other notable event was the Parents Weekend, held this year for the first time. This

was organized and carried out almost entirely by student government. Since there was no way of forecasting the number that would accept the invitation and in order to make sure that every parent who attended would be appropriately cared for, invitations were limited to parents of sophomores and juniors. More than 600 parents attended the two-day meeting, which included visits to individual departments as well as group meetings in the Kresge Auditorium. The enthusiastic response of the parents makes it clear that the Parents Weekend should become an annual event.

CORPORATION ACTIVITY

In addition to attending the four regularly scheduled meetings, many members of the Corporation participated actively in the affairs of the Institute through the several standing and visiting committees. For example, sixteen of the twenty-four visiting committees met in Cambridge for sessions lasting up to two days. The importance of these committees to the vitality of both the educational and research programs cannot be overstated. Each committee, comprising representatives from the Corporation, the alumni, and other distinguished men in the professional field, brings a refreshing point of view to bear on the department's activities. Among other results, the visiting committee meetings keep the departments alert to the needs of industry in a way that would be difficult to achieve by any other mechanism.

In connection with the regularly scheduled meetings, the Corporation met informally and heard a report of the President's Committee on Student Housing and a report on plans for the nuclear reactor. At the time of the October meeting, Corporation members attended an all-Technology convocation at which the Right Honorable Clarence D. Howe was the principal speaker; and at the time of the December meeting members visited the Lincoln Laboratory in Bedford where they saw the SAGE movie and were taken on a tour of the facilities.

THE EDUCATIONAL COUNCIL

The Institute's welfare in a very large measure depends upon the continuing interest and support of its alumni, who contribute so much in so many different ways.

The Educational Council members make a very notable contribution because they are concerned with the most important segment of

our community—the students. Distributed over the United States and in many foreign countries, Council members constitute a vital link between the Institute and the public.

The Council has continued to increase in size as shown by the accompanying statistics, but the most important effect does not show in the numbers. This is the effect on our relations with school personnel and parents at the local community level

There is clear evidence that the Council members are doing a better and better job in counseling students and are showing more interest in the progress of an applicant both before and after admission. More and more members are actively building friendships with the school teachers and taking an interest in their problems.

Two Council members have been instrumental in having their companies adopt programs of encouragement and assistance for students and teachers. Others have worked with the school teachers to build a program of supervised plant visits into the science curriculum.

Some of this increased activity is directly attributable to the Alumni Officers Conference, and, judging by other signs of its benefits, we would be remiss in our efforts to reward and help these alumni if we do not hold such conferences at regular intervals.

During the year a steady flow of pertinent information went to all members of the Educational Council. In addition to the Council *Bulletin*, *The Observer*, and the revised Council Handbook, a convenient wallet card, giving an abbreviated sketch of M.I.T., was prepared specifically for the Council. This informative material was supplemented by visits to fifteen areas to assist them in starting a Council unit or to help one along.

In an effort to inform our staff and graduating seniors concerning the aims and activities of the Council, a small brochure was prepared and sent to those groups.

For the future, we must work diligently to bring all major centers up to the operational stage, and we must be sure that we use every means to keep the members well informed since they will become increasingly active as our representatives in explaining M.I.T. and our admissions policies to the schools. As these competitive times approach, the Council members will have to do this kind of personal representation more frequently.

As one measure of Council activity, there has been an increase of fifty-one in the membership of the Council, bringing the total to 668. These members maintain liaison with a total of 982 secondary schools in 121 geographical areas. In addition, some 38 other areas are in the process of organization.

DEVELOPMENT

Gifts for the year totaled more than $10,375,000. In a brief report, it is impossible to give an adequate acknowledgement to the literally thousands of individuals as well as many companies and foundations whose contributions helped to make up this impressive total. Every gift, whether large or small, represents recognition of what the Institute has accomplished in the past; but perhaps more importantly, support acknowledges a belief in the future potentialities of the institution.

With many thousand worthwhile educational, religious, and charitable institutions making regular pleas for support, every institution is on its mettle to demonstrate not only that its objectives are clearly in the public interest but that it is prudently managed and that a contribution to the enterprise will yield maximum return. M.I.T. has been fortunate in getting financial support, but even greater needs are evident in terms of both its responsibilities and opportunities. The present highly competitive race for technical manpower makes it imperative to maintain an adequate scale of Faculty salaries in order to obtain and retain top-flight Faculty. The inherently high cost of maintaining first-quality scientific equipment, lest we submit to the hazards of obsolescence and thus mediocrity, adds to the need for continuing support on an even higher scale than in the past.

Two steps have been taken in the last year to strengthen the fund-raising organization. John W. Sheetz has joined the staff as Executive Secretary for Development, to supplement the work of Mr. Jope as Director of Development and Professor Walter H. Gale, who continues to devote his energies effectively to the Institute's relations with existing and prospective Industrial Liaison companies. In addition to the administrative management of the Development Office, Mr. Sheetz has special responsibility for seeking annual support from parents and from companies not large enough to be interested in the Liaison Program.

A large number of the Institute's friends can be kept informed of the Institute's activities by mail; there remains, however, a substantial number who should be seen personally. With a small staff devoting full attention to fund raising it is impossible to cover adequately the latter group. To meet this situation, the second step taken this year has been to decentralize the fund-raising effort by setting up a collaborative arrangement between the schools and those directly concerned with development. Plans have been formulated in the Schools of Architecture and Industrial Management. In addition, E. Francis Bowditch, Former Dean of Students, will carry the principal responsibility for seeking the funds to implement the recommendations of the Committee on Student Housing.

For the second year in succession, annual gifts to the Alumni Fund exceeded $500,000. This impressive total was achieved largely by mail solicitation. The appointment of Joseph E. Conrad to assist Henry B. Kane in extending the special gift and regional solicitation among alumni represents an important step in giving a larger number of alumni an opportunity to support the Institute regularly through annual gifts.

No report of the Institute's development activities would be complete without an expression of great appreciation to the two members of the Corporation who have guided the Institute's overall fund-raising efforts for the last eight years. Alfred P. Sloan, Jr., and Marshall B. Dalton have provided the inspiring leadership that has resulted in a doubling of the annual gifts over the last ten years. Their efforts have been supplemented by many other members of the Corporation who have willingly and enthusiastically contributed time and effort to bringing the Institute's needs to the attention of prospective friends. It is this kind of devotion and help that reaches every segment of the Institute family and assures the future of the institution.

ROBERT M. KIMBALL

DEAN OF THE GRADUATE SCHOOL

In a manpower economy where scientists and engineers are in notably short supply, graduate schools across the country feel mounting pressures in these fields. Industries compete in offering lucrative opportunities to the new Bachelor of Science. Our sister graduate schools compete for him, especially if he shows outstanding academic aptitude. Industry, in order to enhance the attractiveness of its opportunities, is actively advocating and often making possible graduate study of various types in association with full- or part-time employment. Industry is hungry for those who hold advanced degrees and encourages graduate study by fellowships, research grants, and even unrestricted institutional support. In this situation, maintenance of a Graduate School policy that expresses the highest standards of graduate education on the one hand and yet is responsive to real and valid national and industrial needs on the other involves nice judgments indeed. The M.I.T. Graduate School has not been immune to these pressures. It is striving to react constructively to them.

Despite competition for the current year's graduates from both industry and other graduate schools, applications for admission for 1956 exceed those for 1955 by about 15 per cent and those for 1954 by 25 per cent. Acutal admissions as of July 1 were 10 per cent above those of last year and 30 per cent above 1954. The natural accompaniment of this increasing pressure for admission is a discernible rise in student quality.

Some form of subsidy for living as well as tuition expense has been almost universal in recent years for our graduate student population. This year's successful though modest experiment in shifting the use of our general funds from tuition scholarships toward fellowships has been expanded to a substantially larger and somewhat more generous program for new graduate students entering in 1956. Twenty-four Whitney Fellowships, each offering $1,400 plus tuition, were accepted for 1956–57 out of offers to twenty-nine new applicants of outstanding promise. This acceptance ratio is considered near optimum in today's highly competitive market.

GRADUATE EDUCATION POLICY

Because of widespread industrial interest in programs combining opportunity for graduate study with industrial employment,

President Killian appointed a committee under the chairmanship of Professor C. Stark Draper to study the subject intensively. This committee stressed the importance of maintaining the essential ideals for graduate study but recommended flexibility regarding details of operation. It concluded that present policies and procedures were sound and that the principal need appeared to be more active communication with industry concerning existing opportunities. Its recommendation for a Special Adviser to Industry on Graduate Study has been implemented by the appointment of Professor William M. Murray to this post.

Meanwhile, a variety of arrangements with outside organizations has been set up which provide opportunities for their employees to do graduate study at the Institute under conditions that amply meet the spirit as well as the formal requirements of a residential degree.

In cooperation with the Draper Committee, a subcommittee of the Committee on Graduate School Policy under the chairmanship of Professor William P. Allis reexamined and restated the principles underlying the residence requirement. This requirement is a widely accepted tenet of strong graduate schools. The Institute's graduate degrees have such standing that they are widely sought. Practical considerations often urge a prospective student or employer to press for maximum recognition of work done elsewhere and a minimum of full-time living, working, and participation in the Institute community and atmosphere. Thus the validity of residence as an essential component of graduate study experience, while widely recognized in principle, is subject to erosive pressures in practice against which good mutual understanding is the best defense.

Classified theses, widely regarded as a necessary evil, received further attention from a subcommittee under Professor John W. Irvine, Jr. As a result, a program was initiated for the review of all classified theses, directed toward their earliest possible declassification. Active prosecution of this program will be in the hands of a declassification officer in each department concerned.

The Graduate Committee approved the graduate portion of a five-year honors program in Geology and Geophysics. This program is designed to stimulate exceptionally able students to develop, under substantial freedom and Faculty advice, programs in the earth sciences incorporating relatively advanced mathematics, physics, and chemistry.

The Foreign Student Summer Project continues to develop strong enthusiasm among its participants from other nations who spend the summer at M.I.T. Our own graduate students who spend a summer in salaried professional work in Europe as Overseas Summer Fellows, sponsored by the Food Machinery and Chemical Corporation, are likewise enthusiastic about the total educational values they experience. Our graduate student exchange with the Swiss Federal Institute of Technology at Zurich continues to provide excellent opportunity for international exchange. Its practical foreign language requirement does emphasize the relative illiteracy of the American graduate student in modern foreign languages as compared with his European counterpart.

GRADUATE STUDENT ACTIVITIES

The Graduate Student Council enjoyed a year of substantial accomplishment and growth under the able leadership of Christopher Newton. It started the year with an Endicott House conference, including Faculty and administration as well as graduate students, in which the opportunities, possible functions, and responsibilities of the Council were thoughtfully explored. In addition, the Council continued to sponsor a notably successful Welcoming Committee activity for foreign students, the development of student-Faculty groups within departments, an athletic program with wide participation, and a social program. In several of these activities it cooperated fully with the Graduate House Executive Committee. A really successful pattern of operation for the Graduate Student News, whose value is generally recognized, is still to be realized. The development of the full potentialities of the Graduate Student Organization through the active leadership of the Council will continue to challenge students of broad vision for years to come.

Planning for graduate student housing and activities facilities over the long term has been greatly influenced by studies of the Committee on Student Housing under the chairmanship of Edwin D. Ryer. Its recommendations include the eventual shift of all graduate student housing to the East Campus. In view of the fact that the East Campus is regarded as presently inferior in certain respects to the Graduate House, and in recognition of the incomplete understanding of what constitutes optimum living and activity facilities for the graduate student, the Ryer Committee indicated that immediate further study is needed "to develop and formulate

the attributes of ideal housing of an advanced intellectual community at the Institute;" the Committee recommended that "as an integral part of such a study there be determined to what extent and how the existing East Campus housing facilities may best be incorporated into a graduate center which shall be a reasonable approximation of that ideal."

One of our graduate students, Thomas W. Mix, was one of the Compton Prize recipients for 1956. His citation mentions, among many items, "he served as an able and courageous representative of graduate students on the Ryer Committee."

FELLOWSHIPS AND SCHOLARSHIPS

For the coming year the Institute continues to be second only to Harvard University in the total number of National Science Foundation Fellows expecting to attend. In the engineering field, the number choosing the Institute far exceeds that selecting any other school.

Industry continues to recognize tangibly the value of graduate work through support by fellowships. During the past year the following companies have established new fellowships:

Lockheed Leadership Fund, in aerodynamics
Carbide and Carbon Chemicals Company, in chemical engineering
Economic Development, in the Department of Economics
Procter and Gamble, in food technology
Standard Oil Company of California, in earth science
LaSalle Steel Foundation, in metal cutting
Crane Company, in foundry research
National Steel Corporation, in the plastic behavior of steel
International Nickel Company, in corrosion
Boeing Airplane Company, in a field relating to the aircraft industry
United States Steel Foundation, in the general area of industrial organization and management

A tuition scholarship was established by the Eastman Kodak Company in the Chemical Engineering Practice School. To these and also to those who have sponsored and continue to sponsor industrial fellowships in support of graduate work we express appreciation for their generosity and for the high quality of such enlightened self-interest.

An unfortunate yet unavoidable result of the increasing number of applications for admission from both American and foreign nationals has been the necessity of refusing admission to large

numbers who are well qualified. Experience establishes limits on departmental capacity for properly handling graduate students and maintaining high standards. Such non-admissions are even more difficult to explain to the foreign applicants than to those from the United States.

The Graduate School, achieving common purpose and action by volunteer cooperation among largely autonomous departments through the medium of vigorous discussion and even dissent, exemplifies to an extraordinary degree the quality of loyalty and productive team play so characteristic of the Institute. The deeper the unity, the greater the independence of opinion and action that can be enjoyed by its component departments. The Graduate School notably exemplifies this concept and is greatly strengthened thereby.

Graduate School Registration, 1955–56

School	*Summer 1955*	*Fall 1955*	*Spring 1956*
Engineering	596	1210	1185
Science	189	568	547
Architecture & City Planning	22	50	49
Economics & Social Sciences	6	61	61
Industrial Management	35	91	96
	848	**1980**	**1938**
U.S. or Canadian Citizens	718	1655	1619
Others	130	325	319
	848	**1980**	**1938**
Regular	765	1708	1661
Special	83	272	277
	848	**1980**	**1938**
Civilian		1808	1785
Military		172	153
		1980	**1938**

Advanced Degrees Conferred, 1955–56

	S.M.[1]	*Engineer*	*Sc.D.*	*Ph.D.*	*Total*
September 1955	125	7	21	14	167
February 1956	58	10	18	22	108
June 1956	305	45	38	44	432
	488	**62**	**77**	**80**	**707**

[1]Includes Master in Architecture and Master in City Planning.

1955–56 Awards of M.I.T. Fellowships and Scholarships and Staff Appointments

	Number of Awardees	*Amount*
Fellowships	198	$320,655.00
Scholarships	102	61,553.00
Staff Awards	395	150,533.00
	695	**$532,741.00**

HAROLD L. HAZEN

DIRECTOR OF PUBLIC RELATIONS

Activities in public relations for the Institute have been extended during the past year to include collaboration in such enterprises as the recording of music and the production of films. Responsibility has now been assumed for M.I.T. participation in educational television programs of the Lowell Institute Cooperative Broadcasting Council.

NEWS SERVICE

At the end of the fiscal year, John J. Rowlands, Director of the News Service, began a leave of absence for reasons of health. He has served the Institute with distinction since 1925 and will continue to be relied upon for his wise counsel. Walter L. Milne, administrative assistant, now becomes Assistant to the Director of Public Relations.

The News Service extended circulation of the *Calendar of Events* and *The Observer* to include all members of the Faculty and has dealt with a great variety of problems in its relations with the press.

OFFICE OF PUBLICATIONS

The excellent work done under the supervision of John I. Mattill, Director of Publications and Assistant to the Director of Public Relations, has won deserved recognition. The M.I.T. Undergraduate Catalogue was voted the best of 125 catalogues on exhibit at the 1956 convention of the American College Public Relations Association, and the 1955 President's Report won second place in its category. The outstanding quality of the Institute's publications was given a special salute by *Direct Advertising*, a national quarterly.

Increasing use has been made of Photon typesetting equipment, and this process requires careful editorial and design management.

Since demand for publications services has become greater, the Office of Publications has not been able to respond to all requests for assistance. An increase in personnel may prove to be necessary.

The student-staffed mailing room has been responsible for mailing more than 370,000 pieces of M.I.T. printing during the year.

FRANCIS E. WYLIE

DIRECTOR OF THE SUMMER SESSION

The 1956 Summer Session continued and extended the tri-partite pattern which has proved so successful in recent years; i.e., (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

The 39 Special Summer Programs given in 1956 were carried out in four different schools as follows:

Engineering (23):	Civil and Sanitary Engineering	2
	Mechanical Engineering	10
	Metallurgical Engineering	3
	Electrical Engineering	4
	Naval Architecture	1
	Aeronautical Engineering	3
Science (10):	Chemistry	5
	Biology	1
	Physics	1
	Mathematics	1
	Meteorology	1
	Food Technology	1
Architecture and	Architecture	2
City Planning (3):	City Planning	1
Industrial Management (3):		3

These thirty-nine Special Summer Programs of 1956 attracted a total of 2,762 registrants, representing an increase of 971 over the last year's figure. In addition, 373 other persons also admitted subsequently found that changed personal plans prevented their participation, and 66 of these admitted failed to enroll without giving us

advance notice. This represents 3201 persons actually admitted. In addition, there were 31 withdrawn and 305 declined for various reasons, making a total of 336 refusals. The total number of applications in 1956 was 3,537 compared to 2,080 in 1955, 1,865 in 1954, and 1,640 in 1953. Thus the number of applications was this year 170 per cent of the highest previous total.

The 2,762 registrants who actually attended included 2,694 (97.5 per cent) men and sixty-eight (3.5 per cent) women. They came primarily from industrial companies (1,692=61.2 per cent), the remainder being drawn from government (843=30.5 per cent), or other research and educational institutions (227=8.3 per cent). They came from forty-six out of the forty-nine recognized geographical divisions of the continental United States but also included 100 representatives of seventeen other areas as follows: Canada 73, Canal Zone 1, Cuba 1, England 5, Hawaii 2, Holland 1, India 2, Indonesia 1, Ireland 1, Israel 1, Italy 1, Korea 2, Mexico 2, Puerto Rico 3, Saudi Arabia 1, Sweden 1, and West Indies 2. Of the 2662 registrants from the continental United States, 512 (19.2 per cent) came from New England, 1,716 (64.5 per cent) from elsewhere east of the Mississippi River, 241 (9.1 per cent) from the central and mountain areas, and 193 (7.2 per cent) from the Pacific Coast.

The average age of the 2,762 was 35.1 years. The oldest individual was seventy-two; the youngest twenty (three cases). Registrants below the age of twenty-five totalled eighty-six, while those of fifty or above numbered 155. The youngest average age for any one Program was 32.8 for Switching Circuits; the oldest was 38.7 for Molecular Engineering.

While the professional training of the 2,762 registrants cannot readily be measured, the extent of their previous academic training is suggested by their degrees. Of the total group 252 (9.19 per cent) held no college degree although many of these had some college training; 1,527 (55.2 per cent) held at least one Bachelor's degree; 682 (24.6 per cent) others also held Master's degrees; and 301 (11.09 per cent) also held Doctor's degrees.

CONFERENCES

Three professional conferences were held during the 1956 schedule, as follows: a four-day seminar on Speech Communication,

Monday, June 11 through Thursday, June 14; a two-day conference on Speech Communication, Friday, June 15 and Saturday, June 16; and the Second International Congress on Acoustics held from Sunday, June 17 to Saturday, June 23, 1956.

REGULAR INSTITUTE SUBJECTS

Concurrent with the series of Special Summer Programs and Conferences, a program of regular M.I.T. subjects was offered to both graduate and undergraduate students again in 1956. The following table shows the number of persons so registered at the end of the first week of the Summer Session:

	1950	*1951*	*1952*	*1953*	*1954*	*1955*	*1956*
Graduate	846	938	872	919	857	857	904
Undergraduate	1006	923	817	660	689	685	649
	1852	**1861**	**1689**	**1579**	**1546**	**1542**	**1553**
Number of subjects offered	235	235	235	179	115	111	80

Since during the course of the summer the initial registration always increases slightly, a subsequent count taken during the next to the last week of the 1956 Summer Session showed of 1,553 persons registered (according to their Spring 1956 status) as follows: graduate 904; undergraduate 649 (comprising first year ninety-seven, second year 240, third year 232, and fourth year eighty.)

These subjects include those offered by the Nova Scotia Center for Geological Sciences but do not include the Foreign Student Summer Project, sponsored and administered independently by an undergraduate student committee.

In addition to the statistical material reported above, several more general items deserve notation. The year 1956 represented the first in which a joint series of special feature programs was carried out with Harvard University. Each school carried the responsibility for three events. M.I.T. also made available to persons holding the rank of instructor or higher on the teaching staffs of other educational institutions a limited number of Special Summer Program Scholarships, each representing remittance of half the published tuition fee; and sixty such were awarded.

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, 1956, 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[1]	*September, 1955*	*September, 1956*
Total applications	5,168	5,735
Admissions granted	1,822	1,924
Actual registration	945	941
Registration as percent of admissions	51.8%	49.0%
Number of secondary schools represented	640	646

College transfers	*September, 1955*	*September, 1956*
Total applications	815	760
Preliminary applications not followed up	154	198
Admissions granted	225	182
Actual registration	156	133
Combined Plan of Study (included in above)	32	26
Registration as percent of admissions	69.4%	73.0%

[1] Includes 9 former students returning and 18 college transfers entering the first year.

The year's operations were marked by a sharp increase in the number of well-qualified applicants, resulting in a markedly higher degree of selectivity. As a result, the total number of candidates actually refused admission rose from 1,127 in 1955 to 1,693 in 1956. Of these, 941 could be regarded as qualified for admission, since they had predicted first term ratings of 2.50 or higher, compared with 585 last year.

This increased selectivity results not only in a rising standard of academic performance as evidenced by a higher average of entrance test scores but also in a larger proportion of freshmen who have been given exceptionally high appraisals on personal grounds. As before, we find difficulty in making clear to schools, alumni, and parents the fact that refusal of an application does not imply any defect in the record or qualifications of the candidate but means simply that there were others who seemed even better qualified for the places available in the class.

The shrinkage in the admitted list ran somewhat above last year. Cancellations through the summer were normal, but a considerable number who did not take the trouble to cancel their applications simply failed to appear in September. Fortunately, a sufficient number had been accepted from the waiting list in June to offset this shrinkage, yielding a final count somewhat above our target figure of 900 freshmen. Announcement has been made of an application fee of $10 to take effect in 1957. It is expected that this will to some extent reduce the number of casual applications and eventually facilitate more precise control of the size of the class, although the extent of its effect in the first year is not predictable. The fee will be non-returnable, and it will have the effect of imposing part of the heavy cost of the admissions operation on the large number of applicants who do not enter.

The visiting of secondary schools on a large scale by members of the Faculty and administrative staff has now been in effect for five years. During this time 2,639 school visits have been made; and direct contact has been made with some 27,000 students individually or in small groups. Participating in this effort were six members of the Admissions staff, twelve other administrative officers, and a total of forty-two members of the Faculty, who took part over a period ranging from one to five years, in individual cases. Including the fifteen Faculty members who have agreed to take part during the coming year, this makes a total of seventy-five staff participants. This enlarged school visiting program, plus the active efforts of the 700 alumni members of the Educational Council, contributes to our policy of broadening the admissions function. By engaging the co-operation of Faculty and alumni, we have been able to give information and guidance on a large scale, and with a maximum degree of personal contact. We continue to meet a warm reception in the secondary schools. Our approach in terms of guidance as a needed aid to students, rather than recruiting for our own benefit, insures cooperation from the schools, who welcome this supplement to their own educational efforts.

Members of the Institute staff who participated in school visiting during the year were: Professors Martin A. Abkowitz, Elmer E. Allmendinger, Isadore Amdur, Holt Ashley, Edward H. Bowman, John A. Clark, W. Van Alan Clark, Jr., Robert C. Dean, Jr., Robert B. Fetter, Richard Filipowski, Carl W. Garland, Robert L.

Halfman, Thomas F. Jones, Jr., Delbar P. Keily, John G. King, Walter McKay, S. Curtis Powell, Lockhart B. Rogers, Albert B. Van Rennes, Kenneth R. Wadleigh, David Waugh, J. Stanley Waugh, William A. Wilson, Theodore Wood, Jr., Morton G. Wurtele, and Jerrold R. Zacharias; from the administrative staff, in addition to Admissions Office personnel, Dean Thomas P. Pitré and Robert M. Briber, Joseph Jefferson, Walter Milne, John W. Sheetz III, and Warren D. Wells. During this year just ended, a total of 681 schools was visited, and 6,983 students were seen individually or in small groups.

In addition to these school visits M.I.T. was invited to send representatives to 169 high school "college conferences" during the year, of which 129 in twenty-one states were attended by alumni as members of the Educational Council. They conferred with a total of 1,613 students.

The Admissions Office during the year referred 4,115 students to alumni members of the Educational Council; of these 2,971 had a serious enough interest to look up a member of the Council for a personal conference, a report of which was duly sent to this office. Fuller details of Educational Council activity are included in the report of the Secretary of the Institute.

Freshmen who entered after taking courses of freshman college grade in secondary schools, followed by the Advanced Placement Tests of the College Entrance Examination Board, number twenty-seven of whom nine received freshman credit in one or more subjects here.

During the year M. Bryce Leggett was appointed Assistant Director of Admissions and J. Peter Anderson Assistant to the Director of Admissions.

B. Alden Thresher

REPORT OF THE REGISTRAR

All statistics on registration and staff are as of the fifth week of the Fall Term, except: 1943–1944 as of August 2, 1943; 1944–1945 as of November 27, 1944; 1945–1946 as of July 30, 1945.

TABLE 1. Registration of Students Since the Foundation 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		
1893–94	1,157	1925–26	2,813		
1894–95	1,183	1926–27	2,671		
1895–96	1,187	1927–28	2,712		
1896–97	1,198	1928–29	2,868		

* From 1943–46 Army and Navy Students omitted. See Table 3-B in reports for 1943–46.

TABLE 1-A. REGISTRATION OF STUDENTS IN SUMMER SESSION SINCE 1920

Year	†Regular	Special (not included in Regular)
1920	1233	—
1921	1487	—
1922	1419	—
1923	1419	—
1924	1405	58
1925	1454	154
1926	1336	134
1927	1316	132
1928	1305	109
1929	1413	158
1930	1551	137
1931	1459	226
1932	1305	48
1933	1057	—
1934	926	—
1935	1013	—
1936	1196	—
1937	1291	—
1938	1393	—
1939	1555	—
1940	1607	—
1941	1532	—
1942	*	*
1943	*	*
1944	*	*
1945	*	*
1946	*	*
1947	*	*
1948	2146	—
1949	1875	171
1950	1852	259
1951	1861	813
1952	1689	832
1953	1672	1289
1954	1675	1398
1955	1619	1653

† Students attending regular subjects from M. I. T. Curricula.
* Regular Academic Term during summer.

TABLE 2. The Corps of Instructors

	'43	'44	'45	'46	'47	'48	'49	'50	'51	'52	'53	'54	'55
Faculty Members of the Staff	319	317	330	379	398	413	435	436	457	480	503	515	534
Professors	97	107	113	110	118	124	131	132	136	144	152	158	169
Associate Professors	108	105	103	128	131	131	141	137	144	149	157	155	167
Assistant Professors	99	92	101	125	137	133	138	144	154	166	170	178	175
Ex-Officio	9	10	10	11	11	10	10	8	11	10	12	14	15
Professors Emeriti (Lecturers)	—	—	—	—	—	14	13	13	10	9	10	9	7
Instructors	3	—	—	—	—	—	—	—	—	—	—	—	—
Technical Instructors	1	1	1	1	—	—	—	—	—	—	—	—	—
Research Associates	2	2	2	2	—	—	2	2	2	2	2	1	1
Library Fellows	—	—	—	2	1	1	—	—	—	—	—	—	—
Other Members of the Staff	306	222	252	694	846	824	861	940	999	1051	1092	1047	1105
Instructors	97	70	82	119	154	142	151	145	139	141	144	129	146
Technical Instructors	8	6	8	14	17	15	15	13	12	13	12	13	11
Administrative Assistants	—	—	—	1	—	—	—	2	2	2	2	2	4
Teaching Assistants	1	—	—	—	—	—	—	—	186	208	222	214	249
Teaching Fellows	52	8	18	74	77	72	91	98	—	—	—	—	—
Fellows in Applied Math.	—	—	—	4	3	—	—	—	—	—	—	—	—
Assistants	49	44	47	127	137	116	124	122	—	—	—	—	—
Consultant	—	—	—	—	—	—	1	—	—	—	—	—	—
Lecturers	16	7	7	11	10	13	11	22	32	25	25	28	33
Research Consultant	1	—	—	—	—	—	—	—	—	—	—	—	—
Research Associates	23	33	39	151	176	155	120	105	86	100	97	93	86
Research Assistants	59	54	51	193	272	311	348	433	474	517	542	529	536
Technical Assistants	—	—	—	—	—	—	—	—	46	45	48	39	40
Carnegie Fellows	—	—	—	—	—	—	—	—	2	—	—	—	—
Fellows	—	—	—	—	—	—	—	—	20	—	—	—	—
Total	625	539	582	1073	1244	1237	1296	1376	1456	1531	1595	1562	1639
Other Members of the Faculty	39	44	52	60	67	50	50	54	55	53	58	55	58
Faculty and Administrative Officers:													
Emeriti (not Lecturers)*	38	43	51	59	66	49	49	53	54	52	57	55	58
Non-Resident Professor	1	1	1	1	1	1	1	1	1	1	1	—	—

*Beginning 1948-49.

TABLE 3. Classification of Students by Courses and Years

COURSE NAME AND NUMBER	1953–54 YEAR						1954–55 YEAR						1955–56 YEAR					
	1	2	3	4	G	Total	1	2	3	4	G	Total	1	2	3	4	G	Total
Aeronautical Engineering XVI	61	55	29	20	140	305	66	40	36	34	115	291	60	53	31	30	111	285
Aeronautical Engineering (Coöperative) XVI-B	—	—	8	5	—	13	—	—	14	7	—	21	—	—	16	14	—	30
Architecture IV-A	18	40	26	33	29	146	18	25	40	30	31	144	17	26	28	39	28	138
Architecture (IV-A) Fifth Year	—	—	—	26	—	26	—	—	—	34	—	34	—	—	—	28	—	28
Biology																		
Quantitative VII	7	26	11	8	41	93	16	14	19	10	39	98	9	13	12	17	39	90
†Physical VII-A	—	—	—	—	1	1	—	—	—	—	—	—	—	—	—	—	—	—
†Chemical VII-B	—	—	—	2	1	3	—	—	—	—	—	—	—	—	—	—	—	—
Building Engineering and Construction XVII	10	15	12	13	19	69	7	6	20	11	24	68	—	—	11	20	20	51
Business and Engineering Administration XV	43	81	81	101	—	306	40	88	93	92	—	313	41	63	87	90	—	281
Industrial Management	—	—	—	—	98	98	—	—	—	—	84	84	—	—	—	—	91	91
Chemical Engineering X	125	126	78	64	123	516	166	91	115	66	131	569	141	123	81	107	154	606
Chemical Engineering Practice X-A, X-B	—	—	—	12	25	37	—	—	—	9	20	29	—	—	—	5	30	35
Chemistry V	23	23	15	21	155	237	41	18	20	13	158	250	43	30	17	25	184	299
City Planning IV-B	—	—	—	2	22	24	—	—	—	—	18	18	—	—	—	—	22	22
Civil Engineering I	59	51	46	47	67	270	44	44	53	48	63	252	40	49	44	53	76	262
Army Engineer (in Civil Eng. Department)	—	—	—	—	7	7	—	—	—	—	10	10	—	—	—	—	15	15
Economics and Engineering XIV-A, XIV-B	4	10	6	13	44	77	1	6	14	7	49	77	1	10	17	14	63	105
Electrical Engineering VI	183	169	105	79	347	883	237	199	106	106	322	970	239	250	134	100	315	1,038
Electrical Engineering (Coöperative) VI-A	—	—	41	53	34	128	—	—	62	45	47	154	—	—	57	66	38	161
Food Technology																		
Food Technology XX, XX-A	3	7	2	4	30	46	6	9	4	2	37	58	—	14	8	4	41	67
Biochemical Engineering XX-B	—	—	2	—	—	2	—	—	4	2	1	7	—	—	2	4	3	9
General Engineering IX-B	3	8	13	29	—	53	13	4	15	20	—	52	12	3	13	13	—	41
General Science IX-A	3	2	3	4	—	12	3	—	6	7	—	16	6	1	7	8	—	22
Geology XII-A	4	7	10	8	25	54	6	6	8	11	26	57	5	10	4	6	25	50
Geophysics XII-B	—	15	6	3	24	48	3	13	12	4	18	50	1	15	11	11	23	61
Humanities and Engineering XXI-A	—	—	—	—	—	—	—	—	—	—	—	—	5	9	—	—	—	14
Humanities and Science XXI-B	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	—	1
Mathematics XVIII	22	22	12	15	77	148	21	16	24	17	71	149	15	24	13	27	75	154
Mechanical Engineering II	119	144	80	82	150	575	152	117	111	84	133	597	113	114	98	113	163	601
Mechanical Engineering (Coöperative) II-B	—	—	10	17	—	27	—	—	20	11	—	31	—	—	33	21	—	54
Metallurgy III	17	24	29	32	112	214	14	22	29	25	124	214	13	25	29	27	129	223
Ceramics (in Metallurgy Department)	—	—	—	—	14	14	—	—	—	—	12	12	—	—	—	—	12	12
Meteorology XIX	1	1	1	8	60	71	3	1	1	1	43	49	1	1	2	2	39	45
Naval Architecture and Marine Eng. XIII	10	20	16	17	13	76	11	6	21	12	12	62	6	8	11	18	12	55
Naval Construction and Engineering XIII-A	—	—	—	—	89	89	—	—	—	—	83	83	—	—	—	—	76	76
Physics VIII	117	70	61	53	184	485	126	93	55	48	173	495	178	109	74	44	183	588
Sanitary Engineering XI	—	—	—	—	23	23	—	—	—	—	23	23	—	—	—	—	23	23
Science Teaching IX-C	1	3	1	—	2	7	1	1	6	1	—	9	2	3	2	4	1	12
Shipping and Shipbuilding Management XIII-B	—	—	—	—	—	—	—	—	—	2	—	2	—	—	—	2	1	3
Total	833	919	704	771*	1,956	5,183	995	819	908	759*	1,867	5,348	948	954	842	912	1,992	5,648

* These totals include fifth year in Architecture IV-A.
† 1954–55 Discontinued.

TABLE 4-A. Classification of Students by Courses, Options and Years

COURSE No.	Name	Option	Option	Year I Opt.	Year I Tot.	Year 2 Opt.	Year 2 Tot.	Year 3 Opt.	Year 3 Tot.	Year 4 Opt.	Year 4 Tot.	Year G Opt.	Year G Tot.	Total	Course Number
I	Civil Engineering	1. Theory and Design	1	—		—		20		26					
		2. Planning and Administration	2	—		—		5		4		76			
		3. Construction and Management	3	—	40	—	49	19	44	23	53		91	277	I
	Army Engineer			—		—		—		—		15			
II	Mechanical Engineering			—		—		—		—		152			
	Textile Technology			—	113	—	114	—	98	—	113	11	163	601	II
II-B	Mechanical Engineering (Coöperative)	a. At Plant	a	—		—		12		—		—			
		b. At M. I. T.	b	—	—	—	—	21	33	21	21	—	—	54	II-B
III	Metallurgy	1. Metallurgy	1	—		—		28		—		122			
		2. Mineral Engineering	2	—	13	—	25	1	29	—	27	7	141	235	III
	Ceramics			—		—		—		—		12			
IV-A	Architecture			—		—		—		39		—			
	Fifth Year			—	17	—	26	—	28	28	7	—	28	166	IV-A
IV-B	City Planning			—	—	—	—	—	—	—	-	—	22	22	IV-B
V	Chemistry			—	43	—	30	—	17	—	2	—	184	299	V
VI	Electrical Engineering			—	239	—	250	—	134	—	100	—	315	1038	VI
VI-A	Electrical Engineering (Coöperative)			—	—	—	—	—	57	—	66		38	161	VI-A
VII	Quantitative Biology			—	9	—	13	—	12	—	17	—	39	90	VII
VIII	Physics			—	178	—	109	—	74	—	44	—	183	588	VIII
IX-A	General Science			—	6	—	1	—	7	—	8	—	—	22	IX-A
IX-B	General Engineering			—	12	—	3	—	13	—	13	—	—	41	IX-B
IX-C	Science Teaching			—	2	—	3	—	2	—	4	—	1	12	IX-C
X	Chemical Engineering			—	141	—	123	—	81	—	107	—	154	606	X
X-A	Chemical Engineering Practice — Graduate			—	—	—	—	—	—	—	—	—	30	30	X-A
X-B	Chemical Engineering Practice — Undergraduate			—	—	—	—	—	—	—	5	—	—	5	X-B
XI	Sanitary Engineering			—	—	—	—	—	—	—	—	—	23	23	XI
XII-A	Geology			5		10		4		6		25			
XII-B	Geophysics			1	6	15	25	11	15	11	17	23	48	111	XII
XIII	Naval Architecture and Marine Engineering			—	6	—	8	—	11	—	18	—	12	55	XIII
*XIII-A	Naval Construction and Engineering			—	—	—	—	—	—	—	—	—	76	76	*XIII-A
XIII-B	Shipping and Shipbuilding Management			—	—	—	—	—	—	—	2	—	1	3	XIII-B
XIV-A	Economics and Engineering			1		7		12		12		—			
XIV-B	Economics and Science			—	1	3	10	5	17	2	14	—	63	105	XIV
XV	Business and Engineering (Administration)	A. Physical Sciences	A	34		50		70		75		—			
		B. Chemical Sciences	B	7	41	13	63	17	87	15	90	—	91	372	XV
XVI	Aeronautical Engineering			—	60	—	53	—	31	—	30	—	111	285	XVI
XVI-B	Aeronautical Engineering (Coöperative)			—	—	—	—	—	16	—	14	—	—	30	XVI-B
XVII	Building Engineering and Construction			—	—	—	—	—	11	—	20	—	20	51	XVII
XVIII	Mathematics			—	15	—	24	—	13	—	27	—	75	154	XVIII
XIX	Meteorology			—	1	—	1	—	2	—	2	—	39	45	XIX
XX	Food Technology			—	—	—	14	—	8	—	4	—	38	64	XX
XX-A	Food Technology			—	—	—	—	—	—	—	—	—	3	3	XX-A
XX-B	Biochemical Engineering			—	—	—	—	—	2	—	4	—	3	9	XX-B
XXI-A	Humanities and Engineering			—	5	—	9	—	—	—	—	—	—	14	XXI-A
XXI-B	Humanities and Science			—		—	1	—	—	—	—	—	—	1	XXI-B
	Total				948		954		842		**912		1992	5648	

* First Graduate Year, 23. Second Graduate Year, 23. Third Graduate Year, 30.

** This total includes fifth year in Architecture.

TABLE 4-B

CLASSIFICATION OF SPECIAL STUDENTS BY COURSES AND YEARS
(Included in Table 4-A)

COURSE	YEAR					TOTAL	COURSE
	1	2	3	4	G		
I Civil Engineering	—	—	1	—	6	7	I
II Mechanical Engineering	1	—	—	2	13	16	II
II-T Textile Technology	—	—	—	—	1	1	II-T
III Metallurgy	1	—	2	1	22	26	III
IV-A Architecture	—	—	2	—	4	6	IV-A
Fifth Year	—	—	—	1	—	1	
IV-B City Planning	—	—	—	—	2	2	IV-B
V Chemistry	—	—	—	1	7	8	V
VI Electrical Engineering	—	—	—	1	80	81	VI
VII Quantitative Biology	—	1	—	—	7	8	VII
VIII Physics	—	1	—	—	20	21	VIII
IX-A General Science	—	—	1	—	—	1	IX-A
X Chemical Engineering	—	—	—	—	8	8	X
XIII Naval Architecture and Marine Engineering	—	—	—	—	2	2	XIII
XIV Economics and Engineering	—	—	2	—	13	15	XIV
XV Business and Engineering Administration	—	1	1	—	7	9	XV
XVI Aeronautical Engineering	—	—	1	—	38	39	XVI
XVII Building Engineering and Construction	—	—	—	—	2	2	XVII
XVIII Mathematics	—	1	1	—	17	19	XVIII
XIX Meteorology	—	1	—	—	20	21	XIX
XX Food Technology	—	—	—	—	8	8	X
Total	2	5	11	6	277	301	Total

TABLE 4-C

CLASSIFICATION OF FORMER STUDENTS WHO RETURNED THIS YEAR*
(Included in Table 4-A)

COURSE	YEAR					TOTAL	COURSE
	1	2	3	4	G		
I Civil Engineering	1	4	3	1	4	13	I
II Mechanical Engineering	3	1	10	5	8	27	II
III Metallurgy	—	1	—	2	2	5	III
IV-A Architecture	—	3	1	—	1	5	IV-A
Fifth Year	—	—	—	1	—	1	
V Chemistry	—	—	1	2	3	6	V
VI Electrical Engineering	4	5	6	5	7	27	VI
VII Quantitative Biology	—	1	—	—	—	1	VII
VIII Physics	1	4	2	—	5	12	VIII
IX-A General Science	—	1	4	—	—	5	IX-A
IX-B General Engineering	—	1	2	—	—	3	IX-B
IX-C Science Teaching	—	2	1	—	—	3	IX-C
X Chemical Engineering	2	1	7	—	13	23	X
XI Sanitary Engineering	—	—	—	—	2	2	XI
XII-A Geology	—	—	—	—	2	2	XII-A
XII-B Geophysics	1	—	1	—	1	3	XII-B
XIII Naval Architecture and Marine Engineering	—	—	—	1	1	2	XIII
XIV Economics and Engineering	—	—	—	1	2	3	XIV
XV Business and Engineering Administration	—	5	4	7	4	20	XV
XVI Aeronautical Engineering	—	3	2	1	3	9	XVI
XVII Building Engineering and Construction	—	—	1	2	1	4	XVII
XVIII Mathematics	—	2	—	1	4	7	XVIII
XIX Meteorology	—	—	—	1	4	5	XIX
XX Food Technology	—	1	—	—	—	1	XX
Total	12	35	45	30	67	189	Total

* Excludes 55 special students.

TABLE 5. Classification of Students by Courses since 1948

	1948-49	1949-50	1950-51	1951-52	1952-53	1953-54	1954-55	1955-56
School of Engineering . . . . . *Total*	4,094	4,055	3,287	3,094	3,269	3,370	3,489	3,616
Aeronautical Engineering XVI, XVI-B	304	274	276	246	290	318	312	315
Building Engineering and Construction XVII	111	124	116	94	76	69	68	51
¶Business and Engineering Administration XV	449	415	—	—	—	—	—	—
Chemical Engineering X, X-A, X-B	611	596	541	482	522	553	598	641
Civil Engineering I	258	277	277	273	279	277	262	277
¶Economics and Engineering XIV-A, XIV-B	87	81	—	—	—	—	—	—
Electrical Engineering VI, VI-A	1,051	996	900	908	977	1,011	1,124	1,199
General Engineering IX-B	57	62	44	40	49	53	52	41
Mechanical Engineering II, II-B	691	711	617	526	593	602	628	655
Metallurgy III	203	243	231	218	220	228	226	235
Meteorology XIX	66	65	71	115	93	71	49	45
***Naval Arch. and Marine Eng. XIII, XIII-B, XIII-C	92	92	101	85	70	76	64	58
Naval Construction and Engineering XIII-A	98	98	91	86	80	89	83	76
Sanitary Engineering XI	16	21	22	21	20	23	23	23
School of Science . . . . . *Total*	1,090	1,151	1,176	1,159	1,164	1,136	1,189	1,352
*Biology VII, VII-A, VII-B	77	85	89	92	89	97	98	90
Chemistry V	280	281	272	258	266	237	250	299
Food Technology, XX, XX-A, XX-B	59	46	49	43	46	48	65	76
General Science IX-A	7	10	15	20	21	12	16	22
**Geology and Geophysics XII-A, XII-B	61	86	99	82	82	102	107	111
Mathematics XVIII	137	165	140	147	148	148	149	154
Physics VIII	469	478	512	514	505	485	495	588
Science Teaching IX-C	—	—	—	3	7	7	9	12
School of Architecture and Planning . . . . . *Total*	204	202	224	205	219	196	196	188
Architecture IV-A	169	169	194	179	193	172	178	166
City Planning IV-B	35	33	30	26	26	24	18	22
¶*School of Humanities and Social Studies* . . . . *Total*	—	—	484	92	83	77	77	120
Business and Engineering Administration XV	—	—	371	—	—	—	—	—
Economics and Engineering XIV	—	—	113	92	83	77	77	105
Humanities and Engineering (or Science) XXI-A, XXI-B	—	—	—	—	—	—	—	15
¶*School of Industrial Management* . . . . . *Total*	—	—	—	324	339	404	397	372
Business and Engineering Administration XV	—	—	—	324	339	404	397	372
†Economics and Eng. or Natural Science, Industrial Economics, and Group Psychology . . . . . *Total*	45	50	—	—	—	—	—	—
Grand Total	5,433	5,458	5,171	4,874	5,074	5,183	5,348	5,648

* VII-A and VII-B discontinued June 1954.
† After June 1950 included in Economics and Engineering XIV.
¶ June 1950, School of Humanities and Social Studies started. Business and Engineering Administration and Economics and Engineering changed from School of Engineering to New School. 1951-52 Business and Engineering Administration changed to School of Industrial Management.
** June 1952, Geology changed to Geology Course XII-A and Geophysics Course XII-B
*** XIII-C discontinued June 1953. XIII-B started September 1954.

TABLE 6

Geographical Classification of Students since 1951

United States	1951	1952	1953	1954	1955
North Atlantic . . . . . Total	3,139	3,276	3,274	3,313	3,298
Connecticut	151	150	161	162	172
Maine	40	44	41	43	54
Massachusetts	1,542	1,547	1,466	1,447	1,241
New Hampshire	47	42	39	46	42
New Jersey	270	282	291	331	346
New York	824	939	990	987	1,088
Pennsylvania	205	199	209	238	287
Rhode Island	38	49	51	43	51
Vermont	22	24	26	16	17
South Atlantic . . . . . Total	262	269	288	318	355
Delaware	11	12	17	16	15
District of Columbia	38	40	45	39	44
Florida	52	62	60	72	90
Georgia	17	17	20	26	31
Maryland	45	43	47	53	54
North Carolina	16	14	23	20	17
South Carolina	8	9	5	12	16
Virginia	55	56	61	66	73
West Virginia	20	16	10	14	15
South Central . . . . . Total	161	148	166	178	210
Alabama	23	15	18	13	15
Arkansas	10	8	5	7	11
Kentucky	23	24	21	22	26
Louisiana	16	14	25	17	19
Mississippi	12	11	7	12	11
Tennessee	25	17	24	28	31
Texas	52	59	66	79	97
North Central . . . . . Total	597	626	665	674	762
Illinois	139	169	175	196	202
Indiana	36	28	30	29	46
Iowa	14	15	18	20	21
Kansas	14	19	23	22	24
Michigan	96	92	95	103	107
Minnesota	35	38	39	42	52
Missouri	47	45	51	53	54
Nebraska	16	18	23	15	18
North Dakota	5	4	4	8	10
Ohio	145	148	154	140	170
South Dakota	5	3	5	6	6
Wisconsin	45	47	48	40	52
Western . . . . . Total	259	272	266	287	348
Arizona	12	14	13	9	10
California	96	109	105	121	145
Colorado	20	18	23	22	30
Idaho	7	6	5	8	11
Montana	9	10	10	11	16
Nevada	2	2	2	3	3
New Mexico	5	9	14	13	9
Oklahoma	28	20	20	23	32
Oregon	20	21	19	15	21
Utah	9	8	9	10	9
Washington	44	49	40	47	56
Wyoming	7	6	6	5	6
Territories and Dependencies . . . . Total	26	19	25	27	30
Alaska	6	2	3	1	2
Canal Zone	4	2	2	2	2
Hawaii	14	12	14	16	15
Puerto Rico	2	3	6	8	11
Total for United States	4,444	4,610	4,684	4,797	5,003

Continued

TABLE 6 — (*Continued*)

GEOGRAPHICAL CLASSIFICATION OF STUDENTS SINCE 1951

FOREIGN COUNTRIES	1951	1952	1953	1954	1955
Total	430	464	499	551	645
Afghanistan	—	—	1	—	—
Arabia	—	—	—	1	2
Argentina	10	12	15	17	20
Australia	8	8	6	2	5
Austria	3	1	1	—	2
Azores	1	—	—	—	—
Bahamas	—	—	—	1	—
Belgian Congo	—	—	—	1	—
Belgium	1	4	7	3	12
Bolivia	2	1	1	1	—
Brazil	15	10	18	19	35
British North Borneo	—	—	1	1	1
British West Indies	3	2	5	5	5
Burma	1	3	5	15	11
Canada	73	74	74	78	93
Chile	1	2	1	3	3
China	17	16	15	6	17
Colombia	12	13	16	17	24
Costa Rica	1	1	1	—	1
Cuba	17	17	12	17	18
Cyprus	—	—	1	1	2
Denmark	1	1	—	1	1
Dominican Republic	—	1	2	2	1
Ecuador	2	2	2	2	3
Egypt	5	5	3	5	7
England	14	16	21	19	6
Ethiopia	1	1	1	1	—
Finland	2	3	3	5	5
Formosa	—	—	1	2	6
France	12	13	18	19	25
French Indochina	1	—	—	—	—
Germany	1	2	6	6	7
Greece	12	17	22	21	24
Guatemala	4	2	1	5	8
Haiti	—	1	1	1	1
Honduras	—	—	—	2	2
Hong Kong	14	10	1	6	4
Hungary	—	—	—	—	1
Iceland	1	2	2	—	2
India	30	37	43	44	36
Indonesia	—	—	—	2	3
Iran	2	2	2	4	5
Iraq	4	2	2	4	2
Ireland	—	1	—	1	1
Israel	19	23	21	12	16
Italy	3	1	5	7	8
Jamaica	1	—	—	—	—
Japan	6	9	10	16	15
Kenya	1	1	—	—	—
Korea	1	—	1	6	17
Lebanon	1	3	2	—	1
Liberia	—	—	—	1	—
Luxembourg	—	—	1	2	2
Malaya	1	1	1	2	2
Mauritius	—	1	1	1	1
Mexico	12	18	21	26	29
Morocco	1	—	—	1	1
Mozambique	1	1	1	1	1
Netherlands	3	2	1	4	4
Netherlands West Indies	2	3	1	1	1

Continued

TABLE 6 — (*Continued*)

GEOGRAPHICAL CLASSIFICATION OF STUDENTS SINCE 1951

FOREIGN COUNTRIES	1951	1952	1953	1954	1955
New Zealand	2	3	2	—	3
Nicaragua	2	3	1	1	2
Nigeria	1	1	3	2	2
Norway	22	13	16	16	16
Pakistan	2	4	4	2	2
Panama	1	2	2	2	2
Peru	7	8	8	4	4
Philippines	14	16	13	16	15
Poland	—	1	—	—	—
Portugal	3	2	—	—	—
Salvador	2	1	3	3	2
Scotland	4	5	2	2	3
Singapore	2	1	1	—	—
Spain	1	3	3	2	4
Sweden	10	9	5	9	6
Switzerland	3	1	3	5	6
Syria	1	2	2	4	4
Tanganyika	1	—	—	—	1
Thailand	3	5	5	5	10
Timor	—	—	—	1	—
Transjordan	—	1	—	2	2
Turkey	2	5	4	4	6
Union of South Africa	5	2	5	7	11
Uruguay	8	5	4	4	6
Venezuela	11	25	35	35	36
Vietnam	—	—	1	1	2
Wales	—	—	—	4	1
Yugoslavia	—	1	—	—	—
Grand Total, United States and Foreign	4,874	5,074	5,183	5,348	5,648

TABLE 7

NEW STUDENTS ENTERING FROM OTHER COLLEGES AS CANDIDATES FOR DEGREES

Class Joined at the Institute	Years Spent at College				Total
	One	Two	Three	Four or more	
First Year	10	9	1	1	21
Second Year	23	16	4	15	58
Third Year	1	11	28	36	76
Fourth Year	—	—	1	3	4
Graduate Year	—	—	34	531	565
Total	34	36	68	586	724

TABLE 8. Women Students Classified by Courses and Years

Course	YEAR					Total
	1	2	3	4	G	
I Civil Engineering	—	—	—	1	—	1
II Mechanical Engineering	—	2	—	—	—	2
III Metallurgy	—	—	—	—	3	3
IV-A Architecture	1	1	3	3	1	9
Fifth Year	—	—	—	2	—	2
V Chemistry	1	1	3	2	7	14
VI Electrical Engineering	1	—	1	2	2	6
VII Quantitative Biology	—	—	—	3	5	8
VIII Physics	6	5	1	1	4	17
IX-A General Science	1	—	—	1	—	2
IX-B General Engineering	—	—	1	1	—	2
IX-C Science Teaching	—	1	—	—	—	1
X Chemical Engineering	—	3	—	—	3	6
XIV Economics and Engineering	—	—	2	—	3	5
XVI Aeronautical Engineering	1	1	1	—	1	4
XVIII Mathematics	1	7	1	2	5	16
XIX Meteorology	—	—	—	—	1	1
XX Food Technology	—	1	1	1	4	7
Total	12	22	14	19	39	106

TABLE 9. Old and New Students

Year	1950–51	1951–52	1952–53	1953–54	1954–55	1955–56
Students registered at end of last academic year (including specials)	3,461	3,251	3,130	3,361	3,395	3,621
Students who have previously attended the Institute but were not registered at end of last academic year (including specials)	186	204	214	212	218	244
New students who entered by examination	510	443	605	803	955	913
New students who entered without examination	206	238	304	—	—	—
New students who entered from other colleges as candidates for degrees	732	575	631	677	639	724
New students (specials, not candidates for degrees)	76	163	190	130	141	146
Total	5,171	4,874	5,074	5,183	5,348	5,648

TABLE 10. List of American Colleges and Universities with Number of Graduates Attending the Institute

College		*College*		*College*	
Akron University	4	DePauw University	1	Massachusetts Institute of Technology	565
Alabama Polytechnic Inst.	2	Detroit, University of	3	Massachusetts Maritime Academy	2
Alabama, University of	3	Drew University	2	Massachusetts School of Art	2
Alfred University	6	Drexel Institute of Tech.	4	Massachusetts, University of	17
Allegheny College	1	Duke University	7	Mercer University	1
American International Coll.	1	Eastern Nazarene College	1	Merrimack College	2
Amherst College	15	Emmanuel College	1	Miami University (Ohio)	4
Antioch College	4	Emory University	1	Miami, University of	2
Arkansas, University of	1	Evansville College	1	Michigan College of Mines and Technology	3
Baldwin-Wallace College	1	Fenn College	1	Michigan State College	5
Ball State Teachers College	1	Florida, University of	2	Michigan, University of	23
Barnard College	1	Fordham University	2	Middlebury College	12
Bethany College	1	Franklin and Marshall Coll.	2	Milwaukee School of Engineering	1
Boston College	18	Furman University	1	Minnesota, University of	17
Boston University	13	General Motors Institute	5	Mississippi, University of	1
Bowdoin College	6	Georgetown University	1	Missouri School of Mines and Metallurgy	2
Bradford Durfee Technical Institute	1	George Washington Univ.	2	Missouri, University of	2
Bradley University	1	Georgia Institute of Tech.	18	Monmouth College	1
Brandeis University	5	Gettysburg College	3	Montana School of Mines	2
Bridgeport Engineering Inst.	1	Grinnell College	1	Montana State College	1
Brigham Young University	2	Hamilton College	1	Montana State University	1
Brooklyn College	6	Hamline University	1	Mount Holyoke College	1
Brown University	16	Harvard University	52	National Agricultural Coll.	1
Bucknell University	6	Haverford College	1	Nebraska, University of	1
Buffalo, University of	2	Hiram College	2	Nevada, University of	1
Butler University	1	Holy Cross, College of	3	Newark Coll. of Engineering	3
California Inst. of Tech.	5	Hope College	2	New Hampshire, Univ. of	5
California State Polytechnic College	1	Houghton College	1	New Mexico Institute of Mining and Technology	1
California, University of	24	Hunter College of the City of New York	1	New Mexico, University of	1
Capital University	1	Idaho, University of	1	New York University	11
Carleton College	1	Illinois Inst. of Technology	6	Niagara University	1
Carnegie Inst. of Technology	10	Illinois, University of	33	North Carolina State Coll.	3
Case Inst. of Technology	4	Indiana University	4	North Carolina, Univ. of	1
Catholic University of America	1	Iowa State College	9	North Dakota, University of	1
Central Michigan College of Education	1	Iowa Wesleyan College	1	North Dakota Agric. Coll.	3
Centre College of Kentucky	1	Johns Hopkins University	4	Northeastern University	33
Chicago, University of	13	Juniata College	2	Northwestern University	9
Cincinnati, University of	12	Kansas State College of Agric. and Applied Science	1	Norwich University	3
Citadel, The	3	Kansas, University of	5	Notre Dame, University of	7
City College, The (N.Y.)	27	Kentucky, University of	2	Oberlin College	4
Clarkson College of Tech.	4	Kenyon College	1	Ohio State University	4
Clark University	1	Lafayette College	1	Ohio University	1
Clemson College	3	Lamar College	1	Ohio Wesleyan University	1
Colby College	3	Lawrence Institute of Tech.	1	Oklahoma Agric. and Mech. College	3
Colgate University	2	Lebanon Valley College	1	Oklahoma, University of	6
College of Puget Sound	2	Lehigh University	16	Oregon State College	3
College of Wooster	5	Lincoln University	1	Pacific Union College	1
Colorado Agriculture and Mechanical College	1	Louisiana State University and Agric. and Mech. Coll.	6	Pembroke College	1
Colorado College	1	Louisville, University of	1	Pennsylvania Military Coll.	1
Colorado School of Mines	3	Lowell Technological Inst.	5	Pennsylvania State College	11
Colorado, University of	5	Lowell Textile Institute	2	Pennsylvania, University of	8
Columbia College	1	Loyola University (Ill.)	2	Philadelphia Textile Inst.	1
Columbia University (N.Y.)	23	Lycoming College	1	Phillips University	1
Concord College	1	Macalester College	1	Pittsburgh, University of	1
Concordia College	1	McMurry College	1	Polytechnic Institute of Brooklyn	14
Connecticut, University of	7	Maine, University of	13	Pomona College	4
Cooper Union, The	4	Manhattan College	3	Pratt Institute	1
Cornell University	28	Marquette University	3		
Dartmouth College	9	Marietta College	1		
Davidson College	1	Maryland, University of	2		
Delaware, University of	4				
Denver, University of	1				

Continued

TABLE 10. List of American Colleges and Universities with Number of Graduates Attending the Institute (*Continued*)

College	
Princeton University	28
Principia College	2
Purdue University	30
Queen's College (N.Y.)	1
Radcliffe College	3
Reed College	3
Rensaelaer Polytechnic Inst.	42
Rhode Island School of Design	3
Rhode Island, University of	4
Rice Institute	7
Ripon College	2
Roanoke College	1
Rochester, University of	15
Rockhurst College	1
Roosevelt College of Chicago	1
Rose Polytechnic Institute	1
Rutgers University	10
St. Anselm's College	1
St. John's College (N.Y.)	3
St. Lawrence University	3
St. Louis University	3
St. Mary's University	2
St. Olaf College	1
San Diego State College	1
Seattle University	1
Smith College	1
South Carolina, Univ. of	2
South Dakota School of Mines and Technology	3
Southern California, Univ. of	1
Southern Methodist Univ.	3
Southwestern Louisiana Inst.	1
Stanford University	9
Stevens Inst. of Technology	5
Superior State College	1
Swarthmore College	10
Syracuse University	5
Temple University	2
Tennessee Polytechnic Inst.	1
Tennessee, University of	4
Texas Agric. and Mech. Coll.	4
Texas Christian University	1
Texas Lutheran College	1
Texas Technological College	12
Texas, University of	16
Texas Western College	1
Tri-State College	1
Tufts College	24
Tulane University of Louisiana	5
Union College (N.Y.)	6
U.S. Air Force Inst. of Tech.	3
U.S. Coast Guard Academy	33
U.S. Merchant Marine Academy	3
U.S. Military Academy	30
U.S. Naval Academy	84
U.S. Naval Postgraduate School	14
Utah, University of	6
Vanderbilt University	3
Vassar College	2
Vermont, University of	4
Villanova College	4
Virginia Military Institute	3
Virginia Polytechnic Inst.	8
Virginia, University of	6
Washington and Jefferson College	6
Washington, State College of	5
Washington, University of	11
Washington and Lee Univ.	1
Washington University	7
Wayne University	3
Waynesburg College	1
Webb Inst. of Naval Arch.	3
Wellesley College	1
Wesleyan University	7
Western Kentucky State College	1
West Virginia, University of	2
Wheaton College	1
Wilkes College	1
Willamette University	1
Williams College	25
Wisconsin, University of	16
Worcester Polytechnic Inst.	6
Wyoming, University of	1
Yale University	28
Yeshiva College	3
Youngstown College	2
Total	2028
Number of American Colleges Represented	264
Number of Foreign Colleges Represented (not Listed)	174
Total	438

TABLE 11

Regular Students from Colleges Classified by Courses

COURSE	No Previous Degree			Graduates of Other Colleges					Graduates of M. I. T. Taking Graduate Work		
	Entered			Entered							
				Sept. 1955		Previous Years					
	Sept. 1955	Previous Years	Total	Undergrad.	Grad.	Undergrad.	Grad.	Total	S.B. Degree 1955	Other Graduates	Total
Aeronautical Engineering XVI	8	16	24	3	27	2	20	52	15	11	26
Architecture IV-A	4	21	25	9	18	12	3	42	2	1	3
Biology VII	1	2	3	—	8	—	17	25	1	6	7
Building Engineering and Construction XVII	1	5	6	—	4	3	11	18	1	2	3
Business and Engineering Administration XV	5	13	18	6	54	2	22	84	5	3	8
Chemical Engineering X, X-A, X-B	8	22	30	1	69	—	62	132	22	23	45
Chemistry V	1	4	5	1	48	—	121	170	—	8	8
City Planning IV-B	—	—	—	—	11	—	8	19	—	1	1
Civil Engineering I	6	17	23	3	43	5	23	74	9	10	19
Economics and Engineering XIV	1	2	3	1	15	—	33	49	—	2	2
Electrical Engineering VI, VI-A	33	65	98	13	70	11	113	207	54	36	90
Food Technology XX, XX-A, XX-B	—	—	—	—	6	—	21	27	3	6	9
General Engineering IX-B	2	4	6	—	—	2	—	2	—	—	—
General Science IX-A	—	5	5	—	—	—	—	—	—	—	—
Geology XII-A	—	—	—	1	6	—	12	19	3	4	7
Geophysics XII-B	—	5	5	—	4	—	8	12	2	9	11
Mathematics XVIII	5	5	10	—	15	—	30	45	4	9	13
Mechanical Engineering II	18	39	57	6	61	11	36	114	25	27	52
Metallurgy III	2	4	6	—	30	1	56	87	5	28	33
Meteorology XIX	1	—	1	—	3	—	11	14	—	5	5
Naval Architecture and Marine Eng. XIII	4	3	7	4	4	5	3	16	1	2	3
Naval Construction and Engineering XIII-A	—	—	—	—	22	—	54	76	—	—	—
Physics VIII	11	13	24	—	37	2	77	116	9	40	49
Sanitary Engineering XI	—	—	—	—	10	—	10	20	3	—	3
Science Teaching IX-C	—	—	—	—	—	—	—	—	—	—	—
Shipping and Shipbuilding Management XIII-B	—	2	2	—	—	—	—	—	1	—	1
Total	111	247	358	48	565	56	751	1,420	165	233	398

TABLE 12. Number of Degrees Awarded in September 1955, January 1956, and June 1956

ne of Course	S.B.			B.Arch.and B.C.P.			S.M.			M.Arch. and M.C.P.			Adv.Eng.			Ph.D.			Sc.D.			Total		
	Sept.	Jan.	June	Sept.	Jan.	June	Sept.	Jan.	June	Sept.	Jan.	June	Sept.	Jan.	June	Sept.	Jan.	June	Sept.	Jan.	June	Sept.	Jan.	June
al Engineering	6	1	37	—	—	—	4	2	23	—	—	—	—	2	4	—	—	—	—	—	4	10	5	68
re	—	—	—	2	—	14	—	—	—	15	1	1	—	—	—	—	—	—	—	—	—	17	1	15
al Engineering	—	—	2	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	1	—	—	4
try	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	3	—	—	—	1	1	3
ng. and Constr.	—	—	15	—	—	—	1	1	6	—	—	—	1	—	—	—	—	—	—	—	—	—	—	1
nd Eng. Admin.	11	11	59	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	1	21
	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	1	11	11	59
Biology	1	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
Engineering	2	1	96	—	—	—	11	5	14	—	—	—	—	—	—	—	—	—	5	2	7	18	8	117
Engineering Practice	—	—	6	—	—	—	2	5	24	—	—	—	—	—	—	—	—	—	—	—	—	2	5	30
	—	2	18	—	—	—	—	—	1	—	—	—	—	—	—	8	5	14	—	—	1	8	7	34
ning	—	—	—	—	—	—	—	—	—	3	1	4	—	—	—	—	—	—	—	—	—	3	1	4
neering	—	5	47	—	—	—	4	2	31	—	—	—	—	1	1	—	—	—	1	2	1	5	10	80
s and Engineering	—	1	11	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	1	12
Engineering	14	13	103	—	—	—	26	18	60	—	—	—	3	2	—	—	—	—	5	2	12	48	35	175
nology	—	—	5	—	—	—	2	—	4	—	—	—	—	—	—	—	2	—	—	—	—	2	2	9
ngineering	5	2	6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	5	2	6
cience	2	1	10	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	1	10
	—	—	5	—	—	—	—	—	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—	8
nd Geophysics	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	3	2	—	—	—	1	3	2
s	—	1	8	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	1	9
Economics	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	6*	—	—	—	—	1	6
Management	—	—	—	—	—	—	5	2	40	—	—	—	—	—	—	—	—	—	—	—	—	5	2	40
tics	2	1	18	—	—	—	—	1	4	—	—	—	—	—	—	1	2	5	—	—	—	3	4	27
al Engineering	5	9	101	—	—	—	13	6	22	—	—	—	2	3	8	—	—	—	1	2	7	21	20	138
y	—	3	22	—	—	—	10	3	11	—	—	—	—	1	—	—	—	—	8	9	4	18	16	37
gy	—	—	2	—	—	—	4	1	—	—	—	—	—	—	—	—	—	1	—	—	—	4	1	3
h. and Marine Eng.	—	2	11	—	—	—	2	—	4	—	—	—	1	—	30	—	—	—	—	—	—	3	2	45
ngineering	—	—	—	—	—	—	7	—	3	—	—	—	—	—	—	—	—	—	—	—	—	7	—	3
	6	—	39	—	—	—	5	1	6	—	—	—	—	—	—	3	8	13	—	—	—	14	9	58
ive Biology	—	—	14	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	14
Engineering	—	—	—	—	—	—	3	1	7	—	—	—	—	—	2	—	—	—	1	1	—	4	2	9
echnology	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Course Classification	—	—	—	—	—	—	7	8	29	—	—	—	—	—	—	—	—	—	—	—	—	7	8	29
l	54	53	635	2	—	14	107	56	300	18	2	5	7	9	45	14	22	44	21	18	38	223	160	1,081

des 2 in Psychology.

TABLE 13

Degrees of Bachelor of Science According to Class in Which They Were Awarded

(Calendar Year)	Aeronautical Eng.	Architectural Eng.‡	Architecture	Biology or Natural Hist.(Inc. VII-A)	Bldg. Eng. & Constr.	Business and Eng. Admin.	Chemical Eng.	Chemical Eng. Practice X-B	Chemistry	Civil Engineering	Economics and Engineering	Electrical Eng. (Inc. VI-A)	Electrochemical Engineering*	Food Technology & Biochemical Eng.	General Eng.	General Science or General Course	Geol. & Geophysics	Mathematics	Mechanical Eng. (Inc. II-A)	Metallurgy**	Meteorology	Military Eng.	Mining Eng. and Metallurgy	Naval Arch. and Marine Eng.	Physics	Sanitary Eng.	Total	Total by Decades
58	—	—	—	—	—	—	—	—	1	6	—	—	—	—	—	1	—	—	1	—	—	—	6	—	—	—	14	
59	—	—	—	—	—	—	—	—	1	2	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	5	
70	—	—	—	—	—	—	—	—	1	4	—	—	—	—	—	1	—	—	2	—	—	—	2	—	—	—	10	29
71	—	—	—	—	—	—	—	—	2	8	—	—	—	—	—	—	—	—	2	—	—	—	5	—	—	—	17	
72	—	—	—	—	—	—	—	—	3	3	—	—	—	—	—	—	—	—	1	—	—	—	5	—	—	—	12	
73	—	—	1	—	—	—	—	—	7	12	—	—	—	—	—	1	—	—	2	—	—	—	3	—	—	—	26	
74	—	—	1	—	—	—	—	—	—	10	—	—	—	—	—	2	—	—	4	—	—	—	1	—	—	—	18	
75	—	—	1	—	—	—	—	—	1	10	—	—	—	—	—	2	—	—	7	—	—	—	6	—	1	—	28	
76	—	—	1	2	—	—	—	—	5	12	—	—	—	—	—	4	—	—	8	—	—	—	8	—	3	—	43	
77	—	—	4	—	—	—	—	—	2	12	—	—	—	—	—	—	—	—	6	—	—	—	8	—	—	—	32	
78	—	—	3	—	—	—	—	—	3	8	—	—	—	—	—	1	—	—	2	—	—	—	2	—	—	—	19	
79	—	—	1	1	—	—	—	—	3	6	—	—	—	—	—	—	—	—	8	—	—	—	3	—	1	—	23	
80	—	—	—	—	—	—	—	—	1	3	—	—	—	—	—	1	—	—	—	—	—	—	3	—	—	—	8	226
81	—	—	3	1	—	—	—	—	8	3	—	—	—	—	—	2	—	—	5	—	—	—	6	—	—	—	28	
82	—	—	3	1	—	—	—	—	6	2	—	—	—	—	—	1	—	—	5	—	—	—	5	—	1	—	24	
83	—	—	1	—	—	—	—	—	3	3	—	—	—	—	—	—	—	—	7	—	—	—	5	—	—	—	19	
84	—	—	—	—	—	—	—	—	12	5	—	—	—	—	—	—	—	—	6	—	—	—	13	—	—	—	36	
85	—	—	2	—	—	—	—	—	4	4	—	2	—	—	—	1	—	—	7	—	—	—	8	—	—	—	28	
86	—	—	1	1	—	—	—	—	7	9	—	10	—	—	—	1	—	—	23	—	—	—	7	—	—	—	59	
87	—	—	1	1	—	—	—	—	9	10	—	8	—	—	—	3	—	—	17	—	—	—	8	—	1	—	58	
88	—	—	5	3	—	—	—	—	10	11	—	17	—	—	—	1	—	—	25	—	—	—	4	—	1	—	77	
89	—	—	3	1	—	—	—	—	8	14	—	17	—	—	—	2	—	—	24	—	—	—	5	—	1	—	75	
90	—	—	5	3	—	—	—	—	13	25	—	18	—	—	—	6	—	—	28	—	—	—	3	—	2	—	103	507
91	—	—	6	3	—	—	7	—	11	18	—	23	—	—	—	1	1	—	26	—	—	—	4	—	3	—	103	
92	—	—	13	6	—	—	4	—	7	22	—	36	—	—	—	7	1	—	26	—	—	—	4	—	1	6	133	
93	—	—	2	2	—	—	8	—	8	25	—	41	—	—	—	6	2	—	30	—	—	—	5	—	—	—	129	
94	—	—	14	1	—	—	12	—	11	21	—	33	—	—	—	5	—	—	31	—	—	—	4	—	3	3	138	
95	—	—	15	—	—	—	11	—	14	25	—	33	—	—	—	4	—	—	30	—	—	—	3	5	2	4	146	
96	—	—	24	3	—	—	7	—	17	26	—	48	—	—	—	7	3	—	34	—	—	—	10	5	3	4	191	
97	—	—	16	2	—	—	12	—	20	25	—	33	—	—	—	7	1	—	40	—	—	—	7	9	3	4	179	
98	—	—	29	3	—	—	9	—	25	32	—	33	—	—	—	6	—	—	41	—	—	—	7	7	4	3	199	
99	—	—	22	2	—	—	10	—	22	30	—	32	—	—	—	1	—	—	37	—	—	—	9	8	2	1	176	
00	—	—	21	3	—	—	11	—	19	32	—	23	—	—	—	5	—	—	34	—	—	—	21	9	3	4	185	1,579

* Prior to 1909 this Course was designated as Option 3 (Electrochemistry) of Course VIII.
‡ Prior to 1923 degrees were awarded in Architecture.
** Prior to 1938 included in Mining Engineering and Metallurgy.

Continued

TABLE 13 — (*Continued*)

Degrees of Bachelor of Science According to Class in Which They Were Awarded

	Aeronautical Eng.	Architectural Eng.‡	Architecture	Biology or Natural Hist. (Inc. VII-A)	Bldg. Eng. & Constr.	Business and Eng. Admin.	Chemical Eng.	Chemical Eng. Practice X-B	Chemistry	Civil Engineering	Economics and Engineering	Electrical Eng. (Inc. VI-A)	Electrochemical Engineering*	Food Technology & Biochemical Eng.	General Eng.	General Science or General Course	Geol. & Geophysics	Mathematics	Mechanical Eng. (Inc. II-A)	Metallurgy**	Meteorology	Military Eng.	Mining Eng. and Metallurgy	Naval Arch. and Marine Eng.	Physics	Sanitary Eng.	Tota	Total by Decades
1	—	—	21	1	—	—	14	—	17	37	—	25	—	—	—	6	1	—	39	—	—	—	18	16	1	4	200	
2	—	—	18	5	—	—	9	—	14	24	—	35	—	—	—	3	—	—	46	—	—	—	14	14	3	7	192	
3	—	—	15	1	—	—	10	—	13	26	—	39	1	—	—	1	1	—	37	—	—	—	27	12	3	4	190	
4	—	—	24	3	—	—	7	—	15	34	—	34	8	—	—	5	1	—	45	—	—	—	32	17	5	2	232	
5	—	—	12	3	—	—	13	—	23	46	—	31	3	—	—	3	1	—	54	—	—	—	26	24	—	5	244	
6	—	—	22	2	—	—	10	—	21	47	—	37	3	—	—	—	—	—	69	—	—	—	38	19	4	6	278	
7	—	—	21	—	—	—	14	—	10	37	—	32	5	—	—	—	2	—	52	—	—	—	22	10	—	3	208	
8	—	—	19	4	—	—	15	—	16	48	—	38	2	—	—	—	—	—	62	—	—	—	19	5	—	2	230	
9	—	—	18	5	—	—	13	—	12	51	—	42	3	—	—	—	—	—	41	—	—	—	30	5	3	9	232	
0	—	—	18	3	—	—	18	—	10	57	—	36	3	—	—	2	—	—	57	—	—	—	24	11	—	12	251	2,257
1	—	—	10	1	—	—	19	—	12	46	—	49	5	—	—	2	—	—	49	—	—	—	17	6	1	15	232	
2	—	—	21	4	—	—	31	—	7	55	—	52	3	—	—	1	—	—	47	—	—	—	21	3	2	14	261	
3	—	—	26	2	—	—	30	—	12	58	—	43	8	—	—	—	—	—	50	—	—	—	20	4	1	15	269	
4	—	—	19	6	—	—	37	—	9	60	—	51	8	—	—	4	—	—	65	—	—	—	17	8	1	19	304	
5	—	—	30	3	—	—	33	—	23	49	—	42	10	—	—	3	—	—	69	—	—	—	5	7	3	12	289	
6	—	—	37	5	—	—	32	—	11	45	—	56	14	—	—	2	—	—	84	—	—	—	5	9†	3	18	321	
7	—	—	27	10	—	37	43	—	13	49	—	45	10	—	—	5	2	—	63	—	—	—	14	9†	1	17	345	
8	—	—	28	7	—	29	40	—	10	45	—	50	11	—	2	4	1	—	75	—	—	—	10	4	3	5	324	
9	—	—	16	9	—	28	44	—	8	45	—	50	6	—	3	1	—	—	66	—	—	—	7	7	4	6	300	
0	—	—	19	2	—	48	63	—	6	52	—	30	9	—	1	4	—	—	55	—	—	—	13	12	2	2	318	2,963
1	—	—	11	3	—	70	92	—	9	98	—	75	15	—	15	—	3	—	128	—	—	—	24	18	1	3	565	
2	—	—	32	8	—	126	98	15	11	65	—	109	25	—	25	1	8	—	56	—	—	—	27	16	8	7	637	
3	—	13	18	6	—	115	73	19	16	64	—	78	16	—	23	2	8	3	106	—	—	—	23	13	9	3	608	
4	—	6	15	6	—	82	57	8	13	69	—	125	17	—	36	4	2	1	82	—	—	—	19	11	3	1	557	
5	—	6	18	2	—	94	53	8	18	57	—	110	9	—	37	2	3	2	98	—	—	—	23	10	5	—	555	
6	—	9	24	5	—	95	45	13	19	76	—	108	14	—	33	2	4	1	76	—	—	—	20	14	1	2	561	
7	2	15	19	6	—	89	39	6	13	73	—	121	8	—	22	2	3	3	72	—	—	1	9	4	4	3	514	
8	8	19	16	5	—	73	38	7	13	59	—	114	11	—	12	2	1	3	67	—	—	—	12	3	3	5	471	
9	29	25	26	7	9	69	37	11	18	46	—	84	10	—	14	1	2	5	64	—	—	—	11	5	4	6	483	
0	29	15	44	9	23	59	39	12	11	46	—	76	8	—	9	1	2	1	48	—	—	—	6	6	11	4	459	5,410

* Prior to 1909 this Course was designated as Option 3 (Electrochemistry) of Course VIII.
† Two received the degree in Naval Architecture, Course XIII-B, in 1916 and three in 1917.
‡ Prior to 1923 degrees were awarded in Architecture.
** Prior to 1938 included in Mining Engineering and Metallurgy.

Continued

TABLE 13 — (*Continued*)

DEGREES OF BACHELOR OF SCIENCE ACCORDING TO CLASS IN WHICH THEY WERE AWARDED

(Calendar Year)	Aeronautical Eng.	Architectural Eng.	Architecture	Biology or Natural Hist.(Inc. VII-A)	Bldg. Eng. & Constr.	Business and Eng. Admin.	Chemical Eng.	Chemical Eng. Practice X-B	Chemistry	Civil Engineering	Economics and Engineering	Electrical Eng. (Inc. VI-A)	Electrochemical Engineering	Food Technology & Biochemical Eng.	General Eng.	General Science or General Course	Geol. & Geophysics	Mathematics	Mechanical Eng. (Inc. II-A)	Metallurgy**	Meteorology	Military Eng.	Mining Eng. and Metallurgy	Naval Arch. and Marine Eng.	Physics	Sanitary Eng.	Total	Total by Decades
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	—	—	—	24	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	
1946	84	—	—	—	5	33	59	—	9	13	—	91	—	1	12	2	1	4	93	7	24	—	—	29	12	—	479	
1947	84	—	—	4	9	154	114	—	23	45	—	189	—	6	28	3	—	7	170	20	12	—	—	30	35	—	933	
1948	64	—	—	13	29	225	163	—	35	31	10	262	—	3	37	8	1	12	186	16	6	—	—	12	60	—	1,173	
1949	51	—	—	3	23	157	72	12	28	49	16	176	—	12	33	7	3	5	114	17	5	—	—	16	40	—	839	
1950	51	—	—	16	29	121	92	33	37	55	35	180	—	13	39	6	11	21	185	36	9	—	—	17	61	—	1,047	6,626
1951	50	—	—	14	32	119	92	27	26	55	23	150	—	10	26	7	18	13	139	40	7	—	—	23	53	—	924	
1952	34	—	—	9	30	98	65	11	26	52	14	130	—	8	14	7	18	21	117	38	9	—	—	26	67	—	794	
1953	40	—	—	12	18	77	59	12	23	55	12	126	—	5	21	10	18	17	81	27	5	—	—	10	58	—	686	
1954	19	—	—	12	12	91	58	13	18	43	12	106	—	4	24	4	11	12	93	31	7	—	—	15	51	—	636	
1955	36	—	—	9	7	87	62	8	12	41	9	147	—	3	21	6	13	13	88	22	1	—	—	11	47	—	643	
1956	38	—	—	14	15	70	97	6	20	52	12	116	—	7	8	11	14	19	110	25	2	—	—	13	39	—	688	
Total	1,098	172	865	445	359	3,106	2,764	361	1,189	2,856	143	4,936	301	72	798	318	199	234	4,837	429	87	5	880	850	915	264	28,488	

** Prior to 1938 included in Mining Engineering and Metallurgy.
§ Includes only January and June degrees.

TABLE 14

Degrees of Master of Science Awarded

Class (Calendar Year)	Aeronautical Engineering	Architecture	Biol. & P. H. (Inc. VII-A)	Bldg. & Eng. Constr.	Bus. & Eng. Admin. & Ind. Man.	Ceramics	Chem. Eng. & Nuclear Eng.	Chem. Eng. Practice X-A	Chemistry	Civil Engineering	Economics and Engineering or Natural Science	Electrical Eng. (Inc. VI-A)	Food Technology & Biochem. Eng.	Geology & Geophysics	Mathematics	Mech. Eng.	Metallurgy	Meteorology	Naval Architecture & Mar. Eng.	Naval Construction & Eng.	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
1909	—	6	—	—	—	—	1	—	1	2	—	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	—	—	—	—	—	—	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	—	—	—	1	—	3	35	3	5	—	35	—	—	—	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	—	—	—	2	—	3	21	4	6	—	79	—	4	2	16	—	—	—	6	—	2	1	45	196
1930	3	—	—	—	1	—	7	22	5	9	—	51	—	1	2	5	3	—	1	5	—	1	1	53	170

Continued

TABLE 14 — (*Continued*)

Degrees of Master of Science Awarded

Class (Calendar Year)	Aeronautical Engineering	Architecture	Biol. & P. H. (Inc. VII-A,B)	Bldg. & Eng. Constr.	Bus. & Eng. Admin. & Ind. Man.	Ceramics	Chem. Eng. & Nuclear Eng.	Chem. Eng. Practice X-A	Chemistry	Civil Engineering	Economics and Engineering or Natural Science	Electrical Eng. (Inc. VI-A)	Food Technology & Biochem. Eng.	Geology & Geophysics	Mathematics	Mech. Eng. (Inc. II-A)	Metallurgy	Meteorology	Naval Architecture & Mar. Eng.	Naval Construction & Eng.†	Petroleum Engineering	Physics	Sanitary Engineering	Without Course Classification	Total
1931	4	—	2	—	5	—	15	34	5	12	—	57	—	2	5	10	4	4	—	8	—	2	—	20	189
1932	5	—	5	—	9	—	25	33	8	17	—	56	—	2	3	16	1	4	—	7	—	6	—	40	237
1933	10	—	1	—	5	—	14	26	7	12	—	46	—	—	1	18	2	—	1	13	—	4	2	20	182
1934	7	—	5	—	5	—	16	19	11	9	—	46	—	3	3	20	5	1	—	11	—	3	1	21	186
1935	3	—	1	—	2	—	16	14	4	13	—	55	—	—	3	16	6	—	—	10	—	7	2	21	173
1936	5	—	—	—	4	2	7	30	3	19	—	22	—	2	2	14	—	4	1	7	1	5	—	23	151
1937	12	—	1	—	5	1	12	29	8	17	7	35	—	—	1	15	4	4	—	8	1	2	1	23	186
1938	13	—	—	—	8	—	11	28	1	29	2	58	—	—	1	24	1	4	—	7	1	3	—	30	221
1939	8	—	3	—	8	—	20	34	1	31	3	45	—	2	1	21	6	6	—	8	—	5	2	28	232
1940	9	—	1	—	9	—	16	37	3	20	—	54	—	4	5	22	7	8	18	10	2	3	2	37	267
1941	16	—	1	—	12	—	15	42	3	10	3	35	—	3	2	25	7	18	15	22	—	4	1	25	259
1942	9	—	2	—	16	1	12	23	2	5	1	24	—	2	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	1	3	7	2	9	—	13	—	—	—	12	5	11	1	55	—	—	3	5	150
1945	9	—	3	—	1	—	12	—	3	5	—	25	—	—	2	11	7	6	—	23	—	2	3	9	121
1946	47	—	1	—	4	—	29	2	5	24	—	45	—	2	5	47	4	5	3	46	—	2	4	9	284
1947	67	—	5	—	18	—	65	32	12	47	1	63	5	5	9	64	13	8	7	—	—	10	13	12	456
1948	40	—	4	9	19	1	31	39	13	30	5	92	—	—	5	63	11	12	4	33	—	5	9	13	438
1949	44	—	6	5	29	—	36	41	7	26	3	109	5	1	10	58	15	8	5	—	—	11	9	19	447
1950	32	—	2	7	22	—	57	19	3	29	3	110	2	2	11	58	17	6	3	—	—	14	9	20	426
1951	40	—	4	3	25	1	56	30	8	20	2	106	1	5	14	53	20	8	8	—	—	12	10	18	444
1952	29	—	7	4	26	—	36	19	4	24	3	111	2	2	6	32	29	19	4	—	—	15	7	26	405
1953	36	—	7	12	26	—	34	12	11	34	—	102	3	2	8	49	17	22	4	—	—	16	8	36	439
1954	33	—	4	3	64	—	35	25	3	37	1	101	6	7	9	64	26	14	8	—	—	11	8	53	512
1955	31	—	1	7	49	1	47	17	1	33	2	106	6	2	3	45	25	10	8	—	—	13	13	41	461
*1956	25	—	3	7	42	1	22	29	1	33	1	78	5	4	5	29	14	1	4	—	—	7	8	37	356
Total	653	84	83	57	418	9	749	902	199	639	37	2,136	35	81	126	967	267	208	124	478	5	187	130	910	9,484

Total of degrees in discontinued courses, Architectural Engineering, Electrochemical Engineering, Fuel and Gas Engineering, General Science, Mining Engineering, Naval Construction (Foreign Students), and Railroad Operation (see 1940–41 Report)	126
Grand Total	9,610

* Includes only January and June degrees.
† Beginning 1949 see Naval Engineer, Table 17.

TABLE 15

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	14	—	2	5
Total	432	31	314	156

* Includes only January and June degrees.
†From 1935 to 1944 Bachelor of Architecture in City Planning.

TABLE 16

Degrees of Master in Public Health Awarded
(Discontinued after 1944)

Class (Calendar Year)	Number of Degrees Awarded		
	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

*72 former recipients of the Certificate of Public Health were awarded the degree of Master in Public Health in June 1948 as of the class in which they received their Certificate of Public Health.

†Includes 1 degree awarded in June 1954.

TABLE 17

Degrees of Advanced Engineering Awarded

Class (alendar 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
)49 . .	—	—	—	—	2	—	—	—	1	—	37	—	40
)50 . .	2	—	—	—	10	—	8	2	—	—	27	—	49
)51 . .	3	—	1	—	9	—	10	2	—	1	33	—	59
)52 . .	2	—	—	1	6	—	13	1	1	—	38	3	65
)53 . .	3	—	—	3	4	—	8	1	—	—	19	—	38
)54 . .	4	2	2	1	7	—	8	3	—	1	29	2	59
)55 . .	3	2	—	2	8	1	5	—	—	1	25	—	47
)56 . .	6	—	—	2	2	1	11	1	—	—	29	2	54
Total	23	4	3	9	48	2	63	10	2	3	237	7	411

* Includes only January and June degrees.

TABLE 18

Degrees of Doctor of Philosophy Awarded

Class (Calendar Year)	Biology	Chemistry	Electrical Engineering	Food Technology	Geology	Industrial Economics	Mathematics	Meteorology	Physics	Group Psychology	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

Continued

TABLE 18 — *(Continued)*

DEGREES OF DOCTOR OF PHILOSOPHY AWARDED

Class (Calendar Year)	Biology	Chemistry	Electrical Engineering	Food Technology	Geology	Industrial Economics	Mathematics	Meteorology	Physics	Group Psychology	Total
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	19	—	2	5	7†	7	1	21	—	66
Total	72	579	2	14	102	62	109	1	392	9	1342

* Includes only January and June degrees.
† Includes one in 1954 and two in 1956 in Psychology.

TABLE 19. Degrees of Doctor of Science Awarded

Class (Calendar Year)	Aero. Eng.	Ceramics	Chem. Eng.	Chemistry	Civil Eng.	Elec. Eng.	Electrochem. Eng.	Food Tech. & Bio. Eng.	Geology	Mathematics	Mech. Eng.	Metallurgy	Meteorology	Min. Eng.	Naval Arch.	Petroleum Eng.	Physics	San. Eng.	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

Continued

TABLE 19. Degrees of Doctor of Science Awarded — (*Continued*)

Class (Calendar Year)	Aero. Eng.	Ceramics	Chem. Eng.	Chemistry	Civil Eng.	Elec. Eng.	Electrochem. Eng.	Food Tech. & Bio. Eng.	Geology	Mathematics	Mech. Eng.	Metallurgy	Meteorology	Min. Eng.	Naval Arch.	Petroleum Eng.	Physics	San. Eng	Total
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	3	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	4	1	9	1	3	14	—	1	—	—	9	13	—	—	—	—	—	1	56
Total	52	41	281	13	60	160	2	9	14	6	120	209	45	5	2	1	41	18	1,079

* Includes only January and June degrees.

TABLE 20

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 21

DEGREES OF DOCTOR OF ENGINEERING AWARDED
(Discontinued after 1918)

Class (Calendar Year)	Electrical Engineering	Elecrtochemical Engineering	Total
1910	1	—	1
1914	1	—	1
1916	1	—	1
1917	—	1	1
Total	3	1	4

TABLE 22

SUMMARY OF DEGREES AWARDED (1868–1956)

Bachelor of Science	28,483
Bachelor in Architecture	432
Bachelor in City Planning	31
Master of Science	9,610
Master in Architecture	314
Master in City Planning	156
Master in Public Health (Discontinued after 1944)	104
Advanced Engineering	411
Doctor of Philosophy	1,342
Doctor of Science	1,079
Doctor of Public Health (Discontinued after 1944)	9
Doctor of Engineering (Discontinued after 1918)	4
Grand Total	41,975

ROBERT E. HEWES

DIRECTOR OF THE REGISTRY OF GUESTS

The Registry of Guests, acting on behalf of the Faculty and administration, arranges for the extension of academic hospitality to our guests, other than those who have made person-to-person arrangements. In so far as possible a visitor's interests and objectives are ascertained in advance and appointments with appropriate Institute personnel, scheduled by a specific day and hour, are supplied both to the visitor and to each of those who are to receive him. This operation appears to save time for all concerned and to minimize delays and conflicts in engagements.

The Federal agencies which sponsor a majority of our guests from other lands have cooperated effectively in this endeavor and the expressions of appreciation, both personal and official, for our planned hospitality now constitute a "thank you" file of imposing dimensions.

Visiting scholars of more than transient duration receive Corporation appointments as Guests or Visiting Fellows, ordinarily without compensation, and are tendered the privileges without any of the obligations of Faculty members for the pursuit of advanced study and research. The names of visiting scholars thus enrolled together with the professional background and objectives of each are now supplied in routine to the Director of the School for Advanced Studies and constitute a cadre for the appointment of Fellows of that School.

This office is in continuing cooperative contact with its opposite number, that of the University Marshal at Harvard University, in behalf of those visitors with headquarters at either institution who desire also to visit the other.

The Registry endeavors to maintain up-to-date information on the whereabouts and the occupations of Guests and Visiting Fellows as well as a record of transient visitors referred to it. During the stay of a visitor this office is at his service for information concerning the Institute and the community of which it is a part.

Foreign guests who have problems of government regulations in respect to immigration visas, exit permits, income tax liabilities, eligibility for temporary employment, and like matters which are common to our foreign students are now referred for counsel by mutual agreement to the Adviser to Foreign Students.

During the past year we have received visits from citizens of the following countries: Argentina, Australia, Belgium, Bolivia, Brazil, Burma, Cambodia, Ceylon, Chile, Colombia, Cuba, Egypt, England, Finland, France, Germany, Guatemala, Honduras, Iceland, India, Indonesia, Iran, Iraq, Israel, Italy, Jamaica, Japan, Korea, Malaya, Mexico, New Zealand, Northern. Rhodesia, Pakistan, Panama, Peru, Philippine Islands, Puerto Rico, Russia, South Africa, Spain, Sweden, Switzerland, Taiwan, The Netherlands, United States, and Viet Nam.

During the year ending June 30, 1956, this office has been privileged to assist the following temporary members of the Institute community:

Guests of the Institute	17
Visiting Fellows	76
Visitors	510
Visiting Professors, Lecturers, etc.	97
Total	**700**

JOHN W. M. BUNKER

ADVISER TO FOREIGN STUDENTS

For the term beginning in September, 1956, requests for admission were received from 2,267 foreign students from nearly every country in the world. In any good admissions procedure, the element of self-selection is perhaps the most important. In order that this may operate, the prospective applicant must be well informed and so able to make an intelligent choice. For example, it is only necessary to inform the inquirer that M.I.T. does not offer a course in forestry—and to suggest to him several colleges that do—to discourage him from filing a final application with us. Or to take an unfortunately much more common example, it is sometimes possible to dissuade from filing the eager applicant whose total resources come to $20 per month. Therefore, our first concern is to send these 2,267 inquirers as complete information as possible. As a result of this process of self-selection, 730 completed applications were filed on which we took action. Two-hundred fifty of these will be newly registered foreign students on September 17, 1956.

The total number of foreign students registered at M.I.T. in 1955–56 was 654. This placed M.I.T. sixth in the country in numbers of foreign students. The leaders were the University of Calfornia, 1392; Columbia University, 1224; the University of Michigan, 1070; New York University, 776; and Harvard University, 729.

M.I.T.'s foreign students were 12.4 per cent of its total enrollment. This placed it first in the country in percentage of foreign students. Next in line are Cornell University, 7.7 per cent; and Harvard University, 7.0 per cent.

A significant new service was rendered our foreign students this last year by our Technology Matrons. They have long had an active Foreign Students Committee which has served to introduce all of our foreign students into Faculty homes for a much appreciated acquaintance with the American way of living. This year this Committee offered to help in an area of great difficulty for our newly arrived foreign students, that of housing. Apartment-hunting is particularly difficult for the married student who arrives usually on a hot September afternoon with one or more babies and no knowledge of the local geography. The Matrons' Committee, under the able and devoted leadership of Mrs. Norman J. Padelford, chairman, and Mrs. Howard F. Taylor, co-chairman, helped find accomodations for forty-one foreign couples. This involved writing them abroad, helping them find temporary accommodations on arrival, and driving them about while house-hunting. This was a humane kind of greeting to a new country and a new city which was warmly appreciated by our new students and their wives. This service will be expanded and improved in the years to come as the Committee becomes even more expert in a rather difficult field of operation.

As in previous years, there was a considerable movement from the M.I.T. campus to various other countries on the part of both students and staff. Ten M.I.T. graduates holding Fulbright awards will study overseas in 1956–57. These were chosen by a selection committee of M.I.T staff headed by Professor David A. Dudley, Fulbright Adviser.

The Overseas Fellowship Program continued its rather unusual and very interesting work. A Faculty committee under the chairmanship of Professor John T. Norton arranged for summer jobs abroad in industry and in research centers. The pay was about

enough to meet maintenance expenses abroad; the Fellowship awards were made to help students with their overseas transportation expenses. These awards were made possible by a generous grant from the Food Machinery and Chemical Corporation.

In the summer of 1956, nineteen graduate students were placed in jobs by the Overseas Fellowship Program. They were one metallurgist; three naval architects; and engineers—mechanical, electrical, chemical, and aeronautical. They were placed in sixteen different companies in Austria, Belgium, Denmark, England, France, Germany, the Netherlands, and Sweden.

PAUL M. CHALMERS

MEDICAL DIRECTOR

This is the first report of the present Medical Director, who hereby expresses his acknowledgement to his two immediate predecessors. Dr. Dana L. Farnsworth made an enduring contribution to M.I.T. in building the Medical Department into a broadly conceived agency for the promotion of the physical and emotional health of the entire Institute community. Following his resignation Dr. James H. Means served as Acting Director with wisdom and consummate tact. Both of these men have been most patient and generous in initiating the new Director to his duties.

No radical change was made in the program of the Department during the year. The three-year Commonwealth Fund grant for Fellowships in College Psychiatry terminated at the end of the year. During this period eleven men and one woman were given training in college psychiatry as practiced at M.I.T., and all of this group continue in college psychiatry on a full- or part-time basis. Two National Institutes of Health Fellows in psychiatry—Drs. J. H. Wingate and E. H. Schell—will work in the Department during the coming year. Dr. Thomas G. Webster has been engaged in making a critical evaluation of the group psychodynamic program. Dr. Herbert I. Harris, Psychiatrist, has given lectures in the course in Creative Engineering and in Professor Warren G. Bennis' subject in Social Psychology. Dr. Edwin M. Cole organized a special elective program for freshman students with serious language difficulty.

Members of the psychiatric staff assisted the upper class students in organizing a freshman counselling program for the next fall's entering class.

FACULTY HEALTH SURVEY

The members of the Faculty enrolled to date in the Health Survey have increased to 450, of whom 300 were examined during the year. This has become a major activity of the Medical Department, requiring considerable time of senior personnel as well as secretarial and laboratory assistants. There seems to be no serious question as to the value of this service, but we do not have reliable data on its cost to the Institute. Such a study will be undertaken next year as part of a reappraisal of this phase of our work.

For the last four years, in cooperation with Dr. Fredrich J. Stare of the Harvard School of Public Health, estimates of blood cholesterol and blood lipoproteins have been made annually on participants in the Faculty Health Survey as part of a long-range study to evaluate the significance of these constituents in the development of atherosclerosis. Last fall a group of Faculty volunteers with high blood cholesterols participated in a study of the effect of ingestion of a special preparation of homogenized fat on the cholesterol levels. The results, while statistically significant, were not dramatic.

SPORTS INJURIES

Of 163 injuries incurred in sports, thirty-nine were in basketball, twenty-nine in football, eighteen in skiing, and fourteen in hockey (100 of the 163). Thirteen other sports contributed the remainder. The most serious sports injury was a ruptured liver from a blow sustained in touch football.

The factors which contribute to sports injuries are well recognized but difficult to eliminate at M.I.T. The most important of these are participation in violent sports with insufficient preliminary training, without proper protective clothing, and without adequate supervision. It is the informal unprogrammed game which is most dangerous.

A symposium under the joint auspices of the Medical Department and the M.I.T. Coaches Association was held on January 10, 1956, in the Kresge Auditorium. The subject was "Physiological Effects of Exercise vs. Inactivity," and speakers were drawn from New York University, the University of Vermont, and the Harvard School of

Public Health. The meeting, which coincided with a blizzard, was not well attended but served at least to draw attention to the common interest of the two segments of the Institute in the promotion of health.

HOMBERG INFIRMARY

The following table summarizes the visits to the various services in the ambulatory clinic during the year:

Surgery	9,975
Medicine	8,426
Psychiatry and neurology	2,599
Otolaryngology	1,164
Ophthalmology	1,254
Dermatology	1,561
Dental	4,691
Emergency clinic (nights and holidays)	2,176
	31,846
Lincoln Laboratory clinic	10,479
Total	**42,325**

Except for an increase of 1,649 visits to the Lincoln clinic, the figures remain substantially the same as the previous year.

In addition, physical examinations were carried out on 3,997 individuals, and 10,012 X-rays were taken.

The requirement of annual chest X-rays of every student has been abandoned chiefly because in the last five years the routine repeat X-rays have not turned up a single new case of tuberculosis. More fruitful has been the active follow-up of cases in which any shadow of suspicion appeared on the routine initial X-ray. In eighty-six such cases followed by Dr. Albert C. England, Jr., three cases of active pulmonary tuberculosis were disclosed—one in a student and two in employees. The requirement of a chest film on admission will be rigidly enforced and all cases with suspicious shadows will continue to have the same meticulous follow-up they have now. All students will be urged but not required to have a second chest film at the end of two years.

The Infirmary showed a moderate increase in bed occupancy over the previous year with a total of 2,895 patient days as compared to 2,689. Of the 781 patients admitted, 670 or 86 per cent were students. The three most common diagnoses were upper respiratory infection 177, gastroenteritis 164, and appendicitis thirty-nine. In spite of an

epidemic of poliomyelitis in the surrounding community, only three students to our knowledge contracted the disease and only one, a graduate student, had residual paralysis.

The Infirmary fees have been raised from $8 and $10 a day to $10 and $12. This is partly to bring the charges a little closer to actual costs and to make it legitimate to charge this amount to the insurance companies. Since approximately 95 per cent of our infirmary patients are insured, the increase should not cause significant hardship.

What appears to be a somewhat more advantageous contract for student health insurance has been negotiated with another agency to take effect September 1, 1956. With the premium remaining the same certain increased benefits will be furnished including compensation for illness which may have pre-existed and for nursing service up to $15 a day.

OCCUPATIONAL MEDICINE

The Occupational Medical Service during the past year has been studying possible harmful biological effects of high-frequency radiation as it may be used in radar communication. Experimental work done elsewhere suggests that cataracts of the eye may be produced at certain energy levels. At the request of Dr. Marshall G. Holloway, Director of the Lincoln Laboratory, the Occupational Medical Service is extending these observations to define safe limits of exposure. This work is under the immediate guidance of Dr. Martin Lubin, with the collaboration of Dr. George Curtis of the Department of Pathology at the Harvard Medical School and Dr. David Cogan of the Howe Laboratory of the Massachusetts Eye and Ear Infirmary. Technical help and equipment are being provided by the staff of the Lincoln Laboratory. To supervise the safety program involved in the construction and operation of the new nuclear reactor, Dr. Constantine Maletskos has joined the Medical Department with the title of Radiation Biophysicist; Reactor Protection Officer. This title is intended to convey the idea that Dr. Maletskos will play a dual role as a safety officer concerned with the prevention of radiation injury and as an investigator dealing with the difficult problem of biological monitoring of fast neutrons.

The Occupational Medical Service has adopted the practice of preparing memoranda to convey to the M.I.T. community necessary

information on potential work hazards. One of these describes dangers associated with the inhalation of methanol used in duplicating fluids. Another calls attention to hazards in the grinding and heating of Teflon, an insulating material widely used in industry and in M.I.T. laboratories. Two more are in preparation, one on the dangers associated with certain beryllium compounds and another discussing the hazards of exposure to carbon dioxide in the form of dry ice.

SANITATION SERVICE

During the academic year 1955–56 the work of the M.I.T. Sanitation Service included the sanitary supervision of seven dining services, the Alumni Pool, and the kitchen facilities and swimming pool at Endicott House in Dedham. In addition, two special investigations were made of epidemics of gastroenteritis that affected two M.I.T. fraternities located on Bay State Road and on Beacon Street, Boston. Various other environmental conditions surrounding the M.I.T. plant were investigated from time to time and followed up until the sanitary defects were corrected. Laboratory examinations of swab rinse samples from the utensils in use in the M.I.T. Dining Services were made at weekly intervals. Samples of milk and cream in use in the M.I.T. Dining Services were also collected simultaneously and examined bacteriologically. A detailed sanitary survey was made of each dining service at frequent intervals and a report submitted to each superintendent with a record of defects observed and recommendations for improvement. Numerous special inspections were also made of each dining service and reports submitted in each case.

PERSONNEL

Four valued members of the clinical staff have resigned during the year: Dr. Thomas J. Cavanaugh, Ophthalmologist; Drs. Sumner D. Liebman and Francis J. West, Assistant Ophthalmologists; and Dr. Willard Dalrymple, Assistant Physician. Dr. Harris has, upon his request, gone from a full-time to a half-time basis.

In Occupational Medicine, in addition to the appointment of Dr. Maletskos, Thomas K. Wilkinson has been made Health and Safety Officer assigned full-time to the Lincoln Laboratory.

Four part-time clinical appointments have been made. The eye work will be concentrated in the hands of Dr. Robert J. Herm,

who has been made Ophthalmologist. Dr. Owen W. Kite has been appointed Assistant Dentist; Dr. C. Vincent Treat, Assistant Physician; and Dr. George T. Bottomley, Assistant Surgeon. In addition, three important appointments have been made to full-time positions in the Department. Dr. LeMoyne White, Associate Psychiatrist at the Massachusetts General Hospital, has been put in charge of psychiatry. Dr. Samuel Drury Clark, a former general practitioner of Bristol, R.I., has been appointed Physician, and Dr. Albert O. Seeler, an internist with a broad background of experience and research in bacteriology and industrial medicine, has also been named Physician. Dr. Seeler will divide his time between clinical and occupational medicine. The Department has been fortunate in securing the services of men of this calibre. A strong nucleus of full-time doctors will foster more personal and less discontinuous doctor-patient relationships together with greater efficiency of operation.

JAMES M. FAULKNER, M.D.

DIRECTOR OF LIBRARIES

The year 1955–56 saw a new administration in the libraries and heavier demands than ever before on most services. Almost without exception, each divisional librarian and department head reports more readers, more requests for information, and increased demands from inside and outside the Institute. The physical plant remained the same and there were no major shifts of collections for the first time in many years.

ADMINISTRATION

Dr. Vernon D. Tate resigned as Director of Libraries on January 1 and, following completion of a study in Italy for the Department of State, has accepted appointment as Professor and Librarian at the United States Naval Academy in Annapolis. Under his guidance the libraries went through a period of expansion unparalleled in the history of the Institute, with the construction of the fine Hayden building, consolidation of the science collections,

and organization of a new Library of Economics and Industrial Management for the School of Industrial Management. Dr. Tate's notable contribution to our library system will be remembered with lasting appreciation by the Institute.

Also on January 1 it was announced that Professor William N. Locke, Head of the Department of Modern Languages since 1945, had been appointed to succeed Dr. Tate. This appointment followed a decision by the administration and by the Faculty Executive Committee on the Library that a Faculty member should be asked to undertake the job of bringing the libraries and the Faculty into closer relationship.

As a further step in this direction, the same committee voted to experiment next fall with a modification of the previous Faculty Advisory Committee made up of a representative from each department. These representatives have assisted the divisional librarians in the selection of books, and there has been no criticism of that aspect of the work; but their number is too large to function effectively as a committee. The decision was to ask the Advisers to meet in sub-committees according to the library serving their department. Except for a few cases, such as economics whose material is divided between two libraries, the new groupings would follow school boundaries. Naturally the departments of the different schools have library interests in common. Chemists, mathematicians, and physicists use the literature in their fields far more intensively than do the engineering departments; so different reserve-book policies, rules as to the circulation of journals, and even different hours are appropriate. The librarian of each divisional library needs the support of the Faculty of the departments he serves to advise him in the selection of new books and journals and to help him decide which old books may be discarded. He also needs the support of the Dean of his school when budgets are being decided upon; for, with the addition of new titles and increasing demands upon services, the libraries must each year have increased financial provision. Closer cooperation between the librarians and the Faculty will enable each better to understand the needs and problems of the others, with improved service to the M.I.T. community as a result.

IMPROVED FACILITIES

It is essential, if the libraries are to do their jobs well, that all materials should have maximum accessibility for authorized users. To this end, two major changes are under way. One is the opening of the stacks in the Hayden building. The stacks contain material for which there is no space on reading-room shelves, together with all the older science and humanities books and periodicals. The necessary modifications in exit signs, lighting, the locking of external doors and the opening of internal ones are under way as the year closes. All traffic entering and leaving the main wing of the building will use the ground-floor entrance. We shall thus have better control and perhaps diminish the number of missing books, a subject which will be treated at greater length below. For improved accessibility we also plan new, fast elevators for the Engineering Library, where in addition a men's room is being installed and the ladies' room modernized. For comfort and better appearance 90 attractive new chairs have been placed in the Engineering Library. The old tables should be refinished and the remaining old chairs replaced in the near future. The reading room on the ground floor of the north wing of the Hayden building, which has served as a passageway to East Campus and Walker Memorial, is being transformed by the addition of a partition to provide a corridor along the south wall and to restore the remaining space to a suitable library reading room. Funds for some of these changes have been provided; others have been promised.

SALARIES

A considerable improvement has been made in salaries for library staff. The heads of departments have received long overdue increases, bringing them into line with the salaries in other university libraries in the northeast. This was essential but is far from generous, for the salaries of private institutions in this area are below those of public libraries of comparable size and also below those in the rest of the country. The salaries of the rest of the professional library staff—that is those with a library-school degree or its equivalent—have also been raised, but the situation is less satisfactory than for department heads. As in other fields, the demand for new people has pushed salaries of this year's graduates up to

the $4,000 level, which is about what we are paying people with five or more years' experience.

The salary situation for the clerical staff is similar but, with the cooperation of the Personnel Office, the minimums have been raised and increases given for experience. As the year ends, the salary picture for the clerical staff looks relatively better than that for the professional staff.

ACCESSIONS AND COSTS

To the libraries there have been added during the year a total of 31,864 books, pamphlets, periodicals, and theses; 149 volumes were discarded, giving a net increase of 31,715, according to the report of Miss Eleanor Canty, Accessions Librarian. This brings the total library holdings of the Institute to 588,835 as of June 30, an increase of 6 per cent.

The rising cost of all this material, like the rising cost of salaries, puts the library in the position of having to ask for increases in its budget every year, merely to maintain present services. Just how much of the annual increase goes for this purpose is hard to estimate—it might be as high as 10 per cent. For next year we have received an increased appropriation, which allows the addition of three new full-time people and one new part-time person where understaffing was serious—new full-time assistants in the Engineering Library, the Rotch Library, and the Reference Department, and a new part-time catalog typist. Salary increases and these additions to the staff used up practically all the increased budget. Departmental appropriations for books and periodicals will have to be increased another year.

Miss Canty also points out that funds for the purchase of new books were exhausted by April 1 by the Departments of Chemistry, Economics, Industrial Management, Modern Languages, and Music; and likewise the budget for periodical renewals and for binding were then exhausted. One could argue that we should buy fewer books and choose them more wisely, and that is what has been happening. It is harder to apply the same philosophy to journals, and it is there that the pinch is most felt. In science and engineering, journals and technical reports can be said to have pushed books into third place as sources of up-to-date information. Subscription rates to periodicals are going up, but a more serious drain on finances is the creation of new periodicals, particularly abroad.

In Russia, for example, new journals publishing first-quality papers are appearing nearly every month. If the libraries are to maintain adequate coverage of Russian scientific output, they must buy heavily of these new journals. A check made by Miss Gertrude Perry, Librarian in charge of periodicals and binding, shows that in April we subscribed to periodicals as follows (countries from which we buy over 30 titles are listed separately):

Periodical Subscriptions by Countries

United States	1612	Canada	48
England	379	Switzerland	40
Germany	151	Netherlands	34
France	87	India	33
Japan	57	Russia	22
Italy	49	Others	205

The low figure for Russia indicates how far we have to go to catch up. It is a widely accepted opinion that the quality and quantity of scientific and technical literature in Russian has now surpassed that in French and is catching up on German. In view of this, the Faculty Executive Committee on the Library adopted the following statement of policy with respect to Russian literature:

> "In view of the rapid increase in the quality and quantity of Russian engineering and scientific periodicals since the war, it seems safe to predict that within ten or fifteen years American students of science and engineering will have to be reading Russian. In order to have available for them files of material covering the period in which they will be interested, we must start immediately building up a coverage of Russian output substantially equivalent to that which we have of German."

It is easier to formulate a policy than to find the funds to carry it out, but find the funds we must. For the present, the best we can do is take a few of the most vital new journals and attempt to fill in the gaps of the years after the war when most Russian journals ceased coming. These gaps are being filled principally by purchasing the missing issues on microfilm and microcard. Libraries in this country are handicapped by a shortage of trained people able to read Russian and direct a program of purchasing. We are fortunate to have such a person in our Life Sciences Librarian, Mr. George Halpern.

CATALOGING

The Catalog Department has been brought by its Head, Miss Hildegarde Ziegler, to a high point of efficiency and staff morale, with results best expressed in her own words: "This year, for the first time in its recorded history, the catalogers eliminated practically all arrears." Her figures on the languages in which the works were cataloged may be of interest. The number of Russian titles is creeping up on the French and far ahead of Japanese.

Titles Cataloged by Languages, 1955–1956

English[1]	8,365	Italian	88
German	1,007	Spanish	87
French	295	Dutch	68
Russian	217	Others	114
Japanese	89		**10,330**
		Scores	235
		Records	141
		Total	**10,706**

[1]Including 964 M.I.T. theses.

MISSING BOOKS

One of the drawbacks of size seems to be a decrease in the feeling of responsibility of the individual toward other members of the group, when they are so numerous as to be quite anonymous. The explanation may not be the increased size of M.I.T.; it may simply be the nostalgic tendency to look back upon the good old times. Whatever it is, the librarians are becoming more and more disturbed about the number of books which disappear from the shelves without leaving a trace. Such books are termed *missing*. In library parlance, books which cannot be found by the library are *missing;* books lost by borrowers are *lost*. Ralph R. McNay, Engineering Librarian, says in his report, "One of our most serious problems is the continual increase of books missing both from the electrical engineering reserve section and from the stack area. Well over 100 reserve books are reported lost or missing within an eight months' period." Burton A. Robie, Humanities Librarian, notes sixty-five humanities books and musical scores requested and unable to be located after search during the period from February to June; in the same period, twenty-two reserve books disappeared. Miss Marguerite Chamberlain, Science Librarian, notes, "Thirty missing vol-

umes have been replaced at a cost of about $200. Several are again missing." Miss Ann-Marie Hartmere, Earth Sciences Librarian, writes, "The matter of losses is becoming quite serious. Fifteen books have been taken from the reserve collection in my office in the last year. The number of books taken from the open shelves is high and the replacement of the missing volumes of journals and other serial publications is particularly difficult and causes great inconvenience to borrowers."

This loss of books is not principally a question of money. The number of books stolen and their dollar value is relatively small. The problem is acute because it is the important books, recent journals, and irreplaceable bound volumes which disappear. To alleviate the inconvenience caused by missing books, a new policy was inaugurated this spring of sending monthly lists of books known to have disappeared to the department concerned, asking for advice as to whether they must be replaced immediately, in six months, or not at all.

At present, the placing of new and important books on reserve, where they are a little less accessible, does not completely protect them. During the evening hours and week ends, when the libraries have only a skeleton staff, it is easy for the determined person to take almost anything he wishes. The Faculty Executive Committee on the Library and the Library Council, made up of heads of divisional libraries and departments, have agreed that steps must be taken to cut down on the loss of books. The first move has been to lock some of the uncontrolled exits from the reading rooms in the Hayden building. This will be followed gradually by moving check-out desks nearer to the exit doors of the various libraries. It is hoped that people will no longer accidentally take books without charging them out. This may help, although the feeling of the Faculty of the science departments, where loss is particularly critical because of the intensity with which they use the library, is that stronger measures are needed, such as establishing a control at the exit door. M.I.T. is one of the few urban universities which does not have some such inspection system.

LIBRARY CARDS

The Faculty Executive Committee this year watched carefully the effect of the introduction of library cards at the Institute. In last

year's report it was explained that the heavy use of our facilities by people in no way connected with M.I.T.—spot checks in the Science Library reading room revealed as high as 40 per cent of outside users at times—had made it essential that measures be taken to protect members of our own community. We simply do not have enough copies of important books, nor enough chairs in our reading rooms, to take care of the demand. There are an estimated 50,000 undergraduate students in the Boston region plus thousands of graduate students and more thousands of research workers. Most of them do not have library facilities comparable to ours and, until last year, more and more were using our libraries. The Committee voted that, beginning in September, library cards be required to borrow books. Our undergraduates may use their registration cards. The Faculty and staff, professional librarians from the region, and temporary borrowers with a particular reason for using M.I.T.'s facilities received complimentary cards. Outsiders in general were required to purchase a $10 card entitling them to borrow fifty items or to enjoy borrowing privileges for one year.

The introduction of these cards has considerably reduced circulation, with a drop this year of 5.7 per cent. This is a reversal of the circulation trend of recent years and of this year's trend of increased demands on other services. This year's figures would be even smaller if it were not that borrowers below the rank of research associate and those of the staffs of the Division of Industrial Cooperation and of the Division of Defense Laboratories, under the new rules, must renew material at the end of each two-week period. Miss Barbara Darling reports a 37 per cent increase in circulation at the Aeronautics Library which has a proportionately large number of borrowers in these categories.

The total number of paid borrowers' cards from September 16, 1955, the date of their introduction, to June 30, 1956, was 326. Most of these cards went to employees of industrial firms in the neighborhood, some of whom borrowed so heavily as to use up several cards. Multiplying the number of cards by fifty would give an upper bound for the number of books that could have been borrowed by this class of borrowers but would give a very incomplete picture of our services to outsiders. This is true because 1. professional librarians receive courtesy borrowing privileges on request; some use them heavily, but no figures have been kept for borrowers in this category;

2. libraries borrow from us through interlibrary loan (a total of 1,298 items this year against 1,251 last year); 3. orders for photostats or microfilms filled for outsiders numbered 1,861, and some orders ran to hundreds of pages; and 4. the Reference Department answered 3,741 requests for information from outside M.I.T.

The introduction of library cards has had the desired effect of reducing outside borrowing, figures for which include only material actually signed for by a borrower and not reference works, journals, and other materials consulted in reading rooms. The volume of the latter activity has been shown in a published study on the Science Library by George C. Bush, Herbert P. Galliher, and Professor Philip M. Morse to amount to approximately nine times the circulation figures. The library cards have also enabled us to prevent overcrowding of the reading rooms. Especially in the last two or three weeks before examinations when our students use the libraries heavily, students from other universities have the same impulse. Particularly in the evening the Science Library became overcrowded, so that we stationed a guard at the door to ask for M.I.T. identification. We hope that it will never again be necessary to consult *Chemical Abstracts* standing up.

INFORMATION AND REFERENCE SERVICE

Questions received at the reference desk run all the way from, "Would you look and see if this book I need is in the library?" to "I want to find out the names and dates of birth of the members of the Burmese cabinet," or "Can you find out for me the title of an article in *Steel Processing?* It's the first article in January or February or March this year and was written by a Dutchman, Van-something-or-other." The Reference Department answered a total of 11,415 requests for information this year, an increase of 46 per cent over last year's 7,807. Of these, 3,444 were individual queries over the desk this year compared with 2,178 last year. By telephone 6,540 requests were handled (4,575 last year), and there were 1,431 mail requests (1,054 last year). The 3,741 requests from organizations outside the M.I.T. community was an increase of 27 per cent over last year's services to outsiders. It should be emphasized that these figures refer only to the Reference Department. Figures are not kept for requests for information received direct by divisional libraries and other library departments, but the impression of all is identical: the libraries have been busier this year than ever before.

PHOTOGRAPHY AND PRINTING

As mentioned above, one of the major services to outside institutions is that of providing them with reproductions of material in our libraries. Microfilm copies of theses are requested from all over the world. Wherever possible, these are made and sent out by the Microreproduction Service under the direction of Peter Scott. He is one of the country's experts in the quality of microfilm and he has been called upon to supervise the microfilming of the Adams papers as well as to consult on other projects. His laboratory also makes fine quality permanent paper prints from microfilm at a price less than half that of photostats. Statistics for the year show a large jump in quantity.

Microreproduction Statistics

	1954–55	*1955–56*	*Production Increase*
Photoprints (paper prints from microfilm)	26,671	47,911	79%
Negative Exposures	73,178	101,467	38%
Positive Microfilm	18,449 ft.	23,254 ft.	26%

The laboratory is now in a healthy condition.

To quote his report, "For a number of years, the Microreproduction Service has been a financially unsound operation, incurring yearly deficits of from $4,000 to $11,000. This year our operation shows a profit of $5,000. We will have a higher salary budget in the coming year, and we expect to show a smaller profit, but we also anticipate a further production increase. If the coming year should again show a considerable profit, then consideration should be given to a reduction in charges for film and prints."

Even cheaper and quicker, though less permanent, processes for the reproduction of single pages are making their appearance on the market, and we, like other libraries, have introduced machines, the Contoura and the Verifax, into the reading rooms. Users who wish a copy of a page can make one in less than a minute at a charge of about fifteen cents. Ideally, the cost should be reduced to around five cents. If this could be done—and there seems to be a distinct possibility that it will be in the coming years—it would save libraries much of the expense of duplicate subscriptions to journals in heavy demand. Most borrowers prefer to take away a paper copy of the

journal article they want, adding it to their private libraries, instead of borrowing a whole journal or a bound volume which they must return. Some feel that the tendency of copies made by these new processes to fade away after a year or so may be a positive advantage.

The Microreproduction Service provides printing as well as photographic facilities for the libraries. This year an effort has been made to improve the quality and appearance of our book lists and other materials. Annotated lists of periodical articles and new books of interest to staff and students in certain fields are produced at regular intervals by several of the librarians. This service might well be extended. Such lists seem to be considerably more useful than mere lists of acquisitions.

Miss Caroline Shillaber, Rotch Librarian, has prepared a new guide to her library; several other librarians are now preparing hand books designed to help new staff and students become acquainted with their services. A general handbook for all the libraries, the first in several years, is also planned for next year.

OTHER SERVICES

A number of librarians have been asked to give lectures to graduate students in different departments, introducing them to the technique of using a library and providing them with lists of specific reference tools for their fields. Most of this type of advice is still given on an individual basis. Such instruction is, of course, one of the primary duties of all librarians, but it is more economical to give it to groups; it is hoped that other departments will plan for their librarian to help seniors and graduate students in groups.

During the year an attempt has been made to provide increased service to departments by assembling displays of material to illustrate lectures and to furnish bibliographies for courses and seminars. Mr. Burton A. Robie, Humanities Librarian, works regularly with members of the Humanities Department in preparing exhibits. Sometimes projects of this sort can be carried out under a librarian's own initiative, as is the case with several done by Mr. McNay and Miss Pearl Lewis of the Engineering Library. On other occasions the initiative comes from the department. The librarians are all happy to cooperate in this way.

THE FUTURE

In addition to the financial needs mentioned above, other problems await us in the immediate future. One is to determine the best use to which the reading room in the north wing of the Hayden building can be put. Another is to implement the policy of moving circulation desks close to exit doors to provide better control of outgoing materials. Then there is the question of space. Several of the libraries are seriously cramped, especially Dewey, Rotch, and Music. With the School of Industrial Management growing rapidly, competition for space in the Sloan Building is going to be keen. Yet in the words of Miss Barbara Klingenhagen, Dewey Librarian, "No amount of storing in other buildings, microfilming, or weeding will cancel the inevitable need for more space here." The situation is less critical at Rotch and Music. The Hayden Library still has enough space for ten years or so at the present rate of growth, if gifts are carefully screened and unneeded duplicates and worthless material are regularly weeded out. Several thousand duplicates have been given this year to the World Student Services, the Merchant Marine Association, and the Library of Mindanao College in the Philippines. Miss Eleanor Bartlett, Special Collections Librarian, has added the supervision of gifts to her domain. She reports gifts from a large number of sources ranging from historic globes added to the collection in the Boston Stein Club Map Room to books, journals, slides, and pictures. The libraries appreciate the generosity of the donors of these gifts, and the Director is happy to take this occasion to thank them collectively. He hopes that the collections will continue to be enriched in this way and would like to mention discreetly that, like other gifts to the Institute, these are deductible.

The major collections need an inventory which they have not had for forty years. This task cannot be seriously embarked upon without extra help. Also rearrangements of the working space in the Hayden building, with the provision of a more convenient ladies' lounge and a new men's room on the second floor, would result in the turning back of the space of the present ladies' lounge on the third floor to general Institute uses. The Director's office should be made more accessible to the public by an entrance directly from the stair landing.

STAFF CHANGES

In addition to the change of directors, numerous other changes in the staff of the libraries should be mentioned. Robert E. Booth, Associate Librarian, resigned early in the summer to accept an appointment as Research Associate, Center for Documentation and Communication Research, Western Reserve University. His talent for organization and knowledge of library techniques contributed greatly to planning the Hayden building and to executing the move of the collections to their new locations. With Miss Bartlett he carried out studies of the use of the libraries, which will be of great assistance in planning for the future. Mr. Booth's place will be taken temporarily by Miss Natalie Nicholson who, though she leaves her position as Reference Librarian regretfully, has consented to become Executive Assistant to the Director. Mrs. Irma Johnson, who spent this year on exchange at the University of Edinburgh Library, will become Acting Reference Librarian, and Miss Margaret Little, who came from Edinburgh, will remain as Assistant Reference Librarian. Miss Sibyl Warren, Lindgren Librarian (Earth Sciences) resigned last summer to go to Wellesley College. Her loss is a severe blow to the libraries. Her place has been taken by Miss Hartmere, who has done remarkably well in this difficult job. In the Engineering Library, Miss Lewis came from Boston Public Library, where she was reference assistant, to take the place of Mrs. Ruth McGlashan Lane, now Vail Librarian Emeritus who, like Miss Mirian Smith, Reference Librarian Emeritus, comes regularly to her desk at the Institute.

Numerous other changes in personnel have taken place. Particularly at the circulation desks the turnover is high. Students' wives leave to have babies; unmarried girls leave to become students' wives. Miss Louise Trainor, Circulation Librarian, was particularly affected in her department this year: "We have had a continuous turnover of personnel, five people have held the position of circulation assistant each for periods of six weeks to three months."

In spite of the turnover, we are fortunate, on balance, to have students' wives as a source of personnel. Many experienced and talented girls are willing to work in the library for a few years at salaries clearly below their worth. To them, and to the permanent

staff at all levels who have continued to work conscientiously and cheerfully during the change of administration, the Director wishes to express his sincere appreciation.

WILLIAM N. LOCKE

DEPARTMENTS OF MILITARY AND AIR SCIENCE

President Killian proclaimed May 8, 1956, as Military Day at M.I.T. A joint Army-Air Force R.O.T.C. military review and awards ceremony was held on this date with approximately 1600 M.I.T. R.O.T.C. cadets participating. Distinguished military guests included Major General Raymond Maude, Commanding General, Air Force Cambridge Research Center, and Major General Bryan L. Milburn, Commanding General, Fort Devens. During the ceremony Lt. Colonel Sidney F. Wogan, Associate Professor of Air Science at M.I.T., was awarded the Chung Mu Distinguished Military Service Medal with Gold Star, Republic of Korea, and sixteen Army R.O.T.C. cadets and seventeen Air Force R.O.T.C. cadets received awards for outstanding leadership and military proficiency in the R.O.T.C. program.

On June 7, 1956, eighty-eight advanced course students in the Army and thirty-two in the Air Force who had completed their R.O.T.C. training were commissioned as Second Lieutenants in their respective services. In addition, twenty-two air science and thirty-nine military science students will be commissioned upon later completion of degree requirements and/or summer training. Formal presentation of commissions was made in an impressive commissioning ceremony held in the Kresge Auditorium at which Vice Admiral Edward L. Cochrane, Vice President of M.I.T.; Major General Walter C. Sweeney, Commanding General, Eighth Air Force, Strategic Air Command, Westover Air Force Base; and Brigadier General Robert J. Fleming, Jr., Division Engineer, New England Division, Corps of Engineers, Boston, were principal speakers.

DEPARTMENT OF MILITARY SCIENCE AND TACTICS

Major emphasis in the Department during the past year has been placed in certain areas where past experience has indicated weakness. Among these increasing the interest of the basic course student, refinement of selection procedures for advanced course applicants, and expanding the leadership training of the advanced course student were deemed of major importance.

Among measures taken to increase freshman and sophomore interest in the program were the inauguration of a weekly "newsreel" period in which the showing of combat bulletins and other films of military interest was followed by informal student-instructor discussions; the formation of a drill team for inter-school competition; and the establishment of an intra-company drill competition with appropriate rewards for the winning units.

During the year the selection procedures used to screen out the best qualified applicants for the advanced course were further refined and formalized. As a final step in the system, a committee consisting of Department personnel and a representative of the Dean of Students was established to review the academic, military, and extracurricular achievements of each applicant and to evaluate, by personal interview, his leadership potential. Preliminary appraisal of the new system indicates that it promises to increase the quality of the advanced course student and, at the same time, guarantee each applicant a fair, competitive chance of acceptance.

As a means of providing additional leadership training for the advanced course student, increased stress was placed on expanding the responsibilities and authority of the seniors. A complete cadet regimental staff was organized and made responsible for appropriate phases of cadet activities. Senior students were given authority to correct deficiencies and recommend demerits and the Cadet Regimental Commander was appointed to the Evaluation Board. A program of senior dinners, followed by addresses by outstanding guest speakers, was planned and carried out by R.O.T.C. cadet officers.

Through these measures, considerable progress was made during the year in strengthening and improving the R.O.T.C. program of the Institute and in developing the R.O.T.C. graduate's leadership potential.

DEPARTMENT OF AIR SCIENCE

During the past scholastic year our emphasis on leadership and discipline has been continued with gratifying results. The high quality of leadership demonstrated by this year's seniors in the command of the Corps of Cadets thoroughly justified the specially concentrated leadership program administered to them as juniors last year. Consequently, the special leadership training for juniors, separated from the rest of the Corps of Cadets, has been instituted as a permanent part of the Air Force program.

The insertion of more seminar-type academic sessions into the classroom phase of the program for the advanced course was accomplished with favorable reactions from both Faculty and students. The Department will continue this progress in the advanced course and is now looking to the solution of the many administrative problems associated with reducing the size of the basic course classes so that an increase in seminar-type activities may also be effected in that phase of the program.

This past year the Department gave voluntary orientation flights to over 100 cadets. When possible, cadets were allowed to sit at dual controls and handle the aircraft in simple maneuvers. In addition, two visits to Air Force bases were made during school holidays, one to Eglin Air Force Base, Florida, and the other to West Palm Beach Air Force Base, Florida.

The Air Science Department ended the year with an enrollment of 361 freshmen, 177 sophomores, fifty-five juniors, and fifty-four seniors. Of the thirty-two seniors who were commissioned, fourteen chose flying training and eighteen chose non-flying assignments in fields commensurate with their educational backgrounds.

The staff of the Department is competent and enthusiastic in their endeavor continually to improve the program. General facilities were adequate with the exception of classrooms and office space.

Captain Edward H. Littlejohn has completed his tour of duty with the Department of Air Science and is being replaced by Captain Alan D. Wheeler.

HARMON LAMPLEY, JR.

DIRECTOR OF THE INDUSTRIAL LIAISON PROGRAM

The Industrial Liaison Program has continued to work effectively in attracting to the Institute from industry substantial financial support of an unrestricted nature. The Program provides wider contact for the Faculty with industrial interests and research and works to the advantage of both the participating industrial companies and the Institute. The Industrial Liaison Office is responsible for implementing the contractural arrangements with participating companies and for managing the technical and scientific services extended to these companies, working with the full help and cooperation of the Faculty.

In return for the substantial support for education and research stemming from this Program, the Institute undertakes to keep the participating companies informed of our research activities and to make possible visits to M.I.T. by company personnel to discuss subjects of mutual interest. The Liaison Office sponsors informal research conferences conducted by the Faculty for participating companies, supplies the companies with laboratory technical reports and preprints of Faculty articles, arranges visits by company representatives, and in general acts as a communication link between the Liaison Program companies and the M.I.T. staff. The activities of the Industrial Liaison Office are focused upon the individual interests of member companies and touch on all fields of education and research represented at the Institute.

Faculty members take part in the Program from time to time, keeping in touch with the interests and needs of the companies and obtaining technical information from them directly or through the Liaison Office. Such relations provide:

1. Convenient ways for Faculty members to enlarge their services to industry through consultation, contact with "live" industrial problems, and mutual exchange of information.
2. Additional ideas for important thesis topics. Also, companies will often, upon request, furnish material and background information which place within economic range thesis topics otherwise excluded.
3. Improved opportunities for effective placement of graduates through better mutual knowledge of situations and personnel involved.

4. A favorable climate for increased industrial interest in, and support of, specific projects.
5. An opportunity for the Faculty to visit member companies.

A Faculty committee on Industrial Liaison advises the Administration in all the aspects of this Program and keeps the Administration informed as to the Faculty point of view on the policies and accomplishments of the Program. The Liaison Office, on the other hand, attempts to guide the Program so that it does not become burdensome or exert unreasonable demands upon the Faculty.

WILLIAM R. WEEMS

EXECUTIVE VICE PRESIDENT OF THE ALUMNI ASSOCIATION

As noted in last year's report, the 1955 Alumni Fund totalled $546,745 from 11,176 contributors, and this amount was matched by an anonymous donor subsequently identified as Alfred P. Sloan, Jr. '95. From its accumulated funds the Alumni Fund Board also appropriated an additional $121,510; this makes the grand total for which alumni were responsible through Fund-giving toward the Karl Taylor Compton Laboratories $1,215,000. This sum made possible the start of construction during the summer of 1955.

At the close of the fiscal year on June 30, 1956, the 1956 Alumni Fund totalled $574,221 from 10,787 contributors, thus exceeding the 1955 Fund's record in amount by $27,476, or 5 per cent, although there were 389, or 3.5 per cent, fewer contributors.

On September 9 and 10, 1955, we held our first Alumni Officers' Conference which brought back to the campus nearly 350 of the club and class officers, honorary secretaries and other members of the Educational Council, and class agents of the Alumni Fund. Such a foregathering of the "working personnel" of our alumni body for an exchange of views had no previous parallel, but the meeting established a firm precedent. We look forward, therefore, to a second Alumni Officers' Conference in the autumn of 1957 and others biennially from then on.

Last winter a new M.I.T. club was established at New London, Connecticut, bringing our roster of these geographical units to

ninety-three. Sixty-nine M.I.T. clubs are located in the continental United States, twelve are elsewhere in the Americas, and twelve are overseas in the other hemisphere. At this point it is appropriate not to overlook the admirable accomplishment during 1955–1956 of the M.I.T. Club of New York, which last autumn opened new quarters in the Hotel Chatham and at present is enjoying a dues-paying membership of over 1,200, considerably higher than ever before in its history spanning six decades since 1895.

During the twelve months ended last April, sixty-four members of the Institute staff attended eighty meetings of fifty-one different M.I.T. clubs; and thus in the past five years an average of nearly sixty clubs have had at least one annual visitation from Cambridge.

Outstanding among all visitations of 1955–1956 were, of course, the two Regional Conferences: our seventh at St. Louis on February 4 and our eighth at Los Angeles on March 17—the latter, incidentally, taking place on the eighty-first anniversary of the organization of the Alumni Association at Boston on March 17, 1875.

On each of these occasions the constructive and effective efforts put forth by committees of the local M.I.T. clubs were rewarded by an attendance of approximately 400 alumni and guests. For 1956–1957, arrangements are already underway at Tulsa and Chicago.

It would be difficult to exaggerate the values such Regional Conferences have in furthering the Institute's good relations with important non-alumni in the areas where they take place as well as in the stimulation afforded the local alumni who make such affairs possible.

MEMBERSHIP

A census of our membership rolls taken March 31, 1956, showed a total of 59,655 names: 47,329, or 79.4 per cent, being carried in living status and 12,326, or 20.6 per cent, as deceased. Four per cent of the 47,329 living alumni—that is, 1,770—were fifty or more years out of the Institute, 22 per cent were thirty-one to fifty years out, 40 per cent were eleven to thirty years out, and the remaining 34 per cent were ten years or less out. Of the 1,770 living alumni fifty or more years out, fifty-two were already nonagenarians or due to become so before the end of 1956; and, similarly, 641 were octogenarians.

Besides age-distribution studies, we have undertaken a further examination of the noticeable trends in the geographical distribution

of alumni resident in the continental United States. It will be recalled that tabulations published in the closing pages of the 1955 Alumni Register indicated a striking southward and westward movement over the 40-year span from 1915 to 1955.

To illustrate, alumni residing in the North Atlantic regional area accounted for 71 per cent of the U. S. total in 1915, whereas in 1955 they accounted for but 61 per cent. During the same interval the corresponding percentages of the U.S. total rose from 6 to 11 per cent in the South Atlantic region and from 8 to 10 per cent in the Western region. Massachusetts continued to rank as the state most populous alumni-wise, but in 1955 it had 26 per cent of the U. S. total contrasted with 42 per cent in 1915; and meanwhile, California, our fifth state in 1915 (with less than 4 per cent of the U. S. total) by 1955 had become our third state with 7 per cent.

In an endeavor to measure the effect of these and other shifts on a national scale, we have computed the theoretical *population center* of alumni resident in the continental United States at intervals of approximately five years since the turn of the century. Data for this purpose, back to 1909, has been obtained from geographical listings in successive editions of the Alumni Register, and for the years 1905 and 1900 from listings in the Register of Graduates. Tabulated results of these computations, together with a chart showing twelve locations of the center for the period from 1900 to 1955, appeared in the *Technology Review* for July, 1956.

At the beginning of the 1900's, our center was at a point about four miles north of the village of Antrim in Tioga County, Pennsylvania (at latitude 41°41′ N. and longitude 77°17′ W.); in early 1955 it was at a point about three miles northwest of the village of Salineville in Columbiana County, Ohio latitude 40°39′ N. and longitude 80°54′ W.). The 1955 point was 72 miles south and 189 miles west of the 1900 point.

Thus our center's average rate of movement since 1900 has been appreciably faster than that of the *population center for the entire country* as reported by the federal census. Ours has moved southward at a yearly average of 1.3 miles compared with 0.44 miles by the U. S. center; and annually westward 3.5 miles compared with 2.53 miles.

DIRECTOR OF THE TECHNOLOGY PRESS

The analogy occasionally cited as existing between publishing and farming was well borne out in the operations of the Technology Press during the academic year 1955–56. It was a year primarily of cultivation of manuscripts; the harvest of titles will appear in the Press's listings for 1956–57. Four titles were issued during the report year:

Spheroidal Wave Functions, by J. A. Stratton, P. M. Morse, L. J. Chu, J. D. C. Little, and F. J. Corbató, January, 1956.

Language, Thought, and Reality, Selected Writings of Benjamin Lee Whorf, edited and with an Introduction by John B. Carroll; Foreword by Stuart Chase; February, 1956.

The Terms of Trade, A European Case Study, by Charles P. Kindleberger, February, 1956.

The Theory and Technique of Ship Design, by George C. Manning, March, 1956.

The volume *Spheroidal Wave Functions*, consisting as it does principally of tables of numbers supplied by the Whirlwind computer, presented interesting problems in manufacturing technique. A new method of transparent overlays to supply column rulings in the tables was successfully developed.

The volume of papers by the late Benjamin Lee Whorf was initiated by the Press. It has had world-wide response already and promises to be of lasting influence in linguistics.

During the year appeared Japanese translations of *Applied Electronics*, second edition, by Truman S. Gray; *The Dollar Shortage* by Charles P. Kindleberger, and *Methods of Operations Research* by Philip M. Morse and George E. Kimball; a Spanish translation of *Applied Electronics*, second edition; and Urdu and Arabic translations of *Nine Soviet Portraits* by Raymond A. Bauer.

F. G. Fassett, Jr.

PLACEMENT OFFICERS

In the interests of uniformity of policy and simplification of records and operation, the Placement Offices were joined as of July, 1956, with Professor James G. Kelso as Placement Officer and Mrs. Evelyn B. Yates as Associate Placement Officer.

STUDENT PLACEMENT

The abnormally high demand of industry for technically and scientifically trained personnel has resulted in full utilization of the facilities at the Student Placement Bureau during the past year. The pressure of this demand has caused keen competition among companies for the graduating students; nearly all available men were placed before graduation.

Since October, 1955, 437 separate recruiting agencies have scheduled 743 interviewing dates at the Institute. If divisions and subsidiaries of interviewing companies were to be counted, the number of groups interviewing on the campus would be well over 800. This employment activity brought 822 company representatives to M.I.T., where they conducted 7,119 student interviews. This is an average of eight interviews for each student using the Placement Bureau and represents a 20 per cent increase over last year's number. In addition to the formal recruitment interviews, 286 companies asked students to apply for positions by letter.

The results of placement activity for 1955–56 graduates are summarized in this table:

	S.B.	*S.M.*	*Professional Degree*	*Sc.D. and Ph.D.*	*Total*	
Civilian Employment	50%	48%	28%	78%	52%	(724)
Graduate Study	29	16	15	.06	21	(300)
Armed Forces	.04	15	51	.04	.09	(132)
Foreign Students	.04	11	.03	.05	.07	(93)
Government Service	.02	.04		.05	.03	(42)
Not yet reported	11	.06	.03	.02	.08	(118)
						(1409)

Starting salaries for candidates at all degree levels continued to spiral rapidly, averaging a 10 per cent increase over last year's rates. The current starting salaries for Bachelor of Science degree graduates averaged $427.00 per month; for Master of Science degree graduates $490.00 per month; and for those with Doctor's degrees,

$675.00 per month. Premiums for working schedules beyond 40 hours per week, graduate study assistance, free furniture moving, and cost-of-living extras now seem to be attractions offered almost universally by industry to the new graduates; cash bonuses were included in isolated instances. This increase in starting salaries has disturbed morale of presently employed graduates of previous years, whose advancement schedules have not kept pace. There was slight variance in salaries offered graduates in the different courses; the aeronautical and electronic industries paid the highest starting salaries.

The current competition for technical personnel has resulted in the modification of many long-term recruiting practices. This year 129 companies, as contrasted to ninety a year ago, visited the campus during both fall and spring semesters. This increase of 43 per cent reflects the trend for companies to spread their recruiting efforts into a year-around activity rather than one concentrated in the spring months. The manpower shortage has caused many of the larger employers to relax their standards of selectivity. Except for strictly technical positions the trend has been to regard the man and his record, regardless of his major subject. Low grades and vagueness of purpose are no longer proven handicaps. There has been a very significant increase in the number of companies, particularly the smaller ones, who now offer training courses of six months' to three years' duration in production and administrative management. The most encouraging sign of the times has been the widespread offering of professional summer work programs to undergraduates as inducement for employment after graduation. Virtually every company recruiting on campus this year was prepared to offer such opportunities, at least on a limited scale. There was also a definite increase of employment possibilities for women in manufacturing concerns this year.

The most serious need in placement is for better guidance to students concerning job possibilities. More openings are needed for foreign students, who are increasingly anxious for practical training in American industry before they return to their native lands.

ALUMNI PLACEMENT

In thinking back over the past year in the Alumni Placement Bureau, the words 'pressure' and 'responsibility' seem the best ones to describe it. The pressure, friendly but persistent, has come from

industry; the feeling of responsibility has been toward the men on our active list.

With 700 more positions than have been listed with us in any previous year, and with the smallest number of 'available' men, this office has been forced to modify its policy of service to industry and emphasize more than before a service to men. Industry has wanted 'every name it could get.' To protect men from utter confusion, we have had to continue to recommend selectively. Even so men have repeatedly written to us, as did a young Course IX-B 1954 graduate who after his release from military service was looking for his first industrial position. He said, "Although I have not yet accepted a job, I have made more contacts than I can handle, and I would appreciate it if you would stop giving out my record." Two weeks later he sent in a final report: "Your efforts were so effective that I was contacted by forty-one companies. Of these forty-one, I visited eleven and received offers from nine. The starting salaries ranged from $5,000 to $7,500 per year. I have accepted an offer from ———."

These two quotations pretty well tell the story of the past year and show that when we say that we have protected men by being selective, the word has, of necessity, been loosely used.

Over the years we have built up close relations with a great variety of organizations. Forty-six per cent of our requests for manpower come to us by personal visits or letters from the top executives of companies. We cannot send them away with no 'leads' at all, but because of this we have spent many hours warning men that they will be inundated, requesting their courteous cooperation, and trying to help them work out a program which will lead to a wise choice of position from the many possibilities presented to them.

A conservative estimate is that 85 per cent of the men who registered with the office this year received from one to ten offers. That we have counted only 163 placements is due to two factors: a large group received promotions and decided not to change positions after all, and others went to companies recommended to them by friends or relatives. It has become routine practice in many businesses to give a new man, as his first assignment, one month of active recruiting among every friend, acquaintance, or classmate he can locate.

It is interesting to go back ten years to compare this year with 1946. Then, too, the pressure was enormous. In that year 1,527 men, most of them World War II veterans, crowded into the office. That year we listed 2,831 jobs or 1.8 jobs per man compared to the 6.5 jobs per man this year. We have not counted how many companies came to us for men in 1946, but in 1956 a total of 883 private companies and 30 government agencies came after our 722 men—or 1.26 companies to every man!

Alumni Placement Office Figures

	July, 1955–June, 1956	*July, 1954–June, 1955*
Number of jobs	4763	3624
Men who went on available list	722	912
Placements	163	159

PRINCIPAL HONORS AND AWARDS TO THE STAFF

ADMINISTRATION

JOHN E. BURCHARD

President, American Academy of Arts and Sciences. Member of the Board of Trustees and the Executive Committee; Chairman of the Education Committee, Mount Holyoke College.

Chairman of the Academic Advisory Board, United States Merchant Marine Academy (Kings Point, N.Y.)

BEVERLY DUDLEY

Certificate of Special Recognition of the American Alumni Council.

Member of the Executive Committee, Boston Section, Institute of Radio Engineers.

General Chairman, New England Radio-Electronics Meeting (1956).

HAROLD L. HAZEN

Chairman of the Education Committee, Engineer's Council for Professional Development.

Trustee, Robert College (Istanbul).

ROBERT E. HEWES
Member of the Executive Committee, American Association of Collegiate Registrars and Admissions Officers.

ERNEST H. HUNTRESS
Member of the Board, Massachusetts Advisory Committee on Scientific, Engineering, and Other Specialized Personnel.

JAMES R. KILLIAN, JR.
Honorary Degrees of Doctor of Laws; Tufts University, University of California, and Amherst College.

WILLIAM N. LOCKE
Honorary Member, Sigma Xi.
Chevalier de la Légion d'Honneur.

JOHN I. MATTILL
Chairman of the Public Relations Committee, American Society for Engineering Education.

C. RICHARD SODERBERG
Exceptional Service Award of the Department of the Air Force.

B. ALDEN THRESHER
Vice-Chairman, College Entrance Examination Board.
Chairman of the Executive Committee, College Entrance Examination Board.

FRANK M. VERZUH
Chairman, Eastern Joint Computer Conference (1955).
Chairman of the Information Data Processing Committee, American Institute of Electrical Engineers.
Chairman of the Numerical Methods and Applications Section, Association for Computing Machinery.

DEPARTMENT OF AERONAUTICAL ENGINEERING

HOLT ASHLEY
Selected by the Boston Junior Chamber of Commerce as "one of the outstanding young men of 1955."

RAYMOND L. BISPLINGHOFF
Nineteenth Wright Brothers Lecturer for the Institute of the Aeronautical Sciences.

CHARLES S. DRAPER
Distinguished Public Service Award of the United States Navy.

EARL W. ERICKSON
First Prize in the Essay Contest, Engineering Societies of New England.

MORTON FINSTON
Chairman of the Membership Committee, New England Section, American Rocket Society.
Chairman of the 1955 Annual Meeting, American Rocket Society and American Society of Mechanical Engineers.

ROBERT L. HALFMAN
Chairman of the Boston Section, Institute of the Aeronautical Sciences.

JOHN R. MARKHAM
Exceptional Service Award of the United States Air Force.

RENE H. MILLER
Secretary, American Helicopter Society.

ROBERT K. MUELLER
Lecturer for the Advisory Group for Aeronautical Research and Development (a division of N.A.T.O.) in seven N.A.T.O. countries.

H. GUYFORD STEVER
Chief Scientist, United States Air Force.
Chairman of the Ballistic Missiles Defense Committee, United States Air Force Scientific Advisory Board.
Chairman of the Science Symposium, Air Research and Development Command.

DEPARTMENT OF AIR SCIENCE

LIEUTENANT COLONEL SIDNEY F. WOGAN
Distinguished Military Service Medal of the Republic of Korea.

DEPARTMENT OF ARCHITECTURE

EDUARDO CATALANO
Honor Award and Special Commendation of the North Carolina Chapter, American Institute of Architects, for a house in Raleigh.
First Prize in the National Porcelain Enamel Design Competition, for an elementary school in Raleigh, N.C. (Co-architect: Horacio Caminos).

DEPARTMENT OF BIOLOGY

CHARLES H. BLAKE
Fulbright Award for study in Jamaica.

JOHN M. BUCHANAN
Member of the Medical Fellowship Board, National Research Council.
Honorary Member, La Asociacion Venezolana para el Avance de la Ciencia.
Chairman of the Session on Purine Metabolism, Federation Meetings of the American Society of Biological Chemists.
Visiting Lecturer, Southeastern Local Sections, American Chemical Society.
Visiting Lecturer, International Symposium on "The Leukemias, Etiology and Pathophysiology" (Detroit).
Visiting Lecturer, International Symposium on "The Chemistry and Biology of Purines" (London).

IRWIN W. SIZER
Honorary Chairman of the Section on Respiratory Enzymes, International Congress of Biochemistry (Brussels).

CENTER FOR INTERNATIONAL STUDIES

DANIEL LERNER
Scientific Director, Institut d'Etudes Européennes.
Chairman of the Committee on International Polling, World Association for Public Opinion Research.
Chairman of the World Association for Public Opinion Research Delegation to the U.N.E.S.C.O. Conference on "Comparability in Cross-National Research."

DEPARTMENT OF CHEMICAL ENGINEERING

MANSON BENEDICT
Member, National Academy of Sciences.

HOYT C. HOTTEL
Chairman of the Committee on Fire Research, National Academy of Science—National Research Council.

ALAN S. MICHAELS
Preceptor, United Engineers and Constructors, Inc.

THOMAS H. PIGFORD
Selected by the Boston Junior Chamber of Commerce as "one of the outstanding young men of 1955."

WALTER G. WHITMAN
Honorary Degrees of Doctor of Science: University of Pennsylvania, Centre College (Kentucky).
Science and Engineering Award of the Federation of Engineering Societies, Drexel Institute of Technology.

GLENN C. WILLIAMS
Chairman, Sixth International Symposium on Combustion.

DEPARTMENT OF CHEMISTRY

ISADORE AMDUR
Fellowship, John Simon Guggenheim Memorial Foundation.

FREDERICK G. KEYES
Semi-Centennial Award of the University of Rhode Island.

NICHOLAS A. MILAS
Visiting Lecturer, University of Barcelona (Spain) and University of Marseilles (France).

LOCKHART B. ROGERS
Fellow, American Academy of Arts and Sciences.

RALPH C. YOUNG
Testimonial of the Advisory Committee to the Office of Ordnance Research, National Academy of Science—National Research Council.

DEPARTMENT OF CIVIL AND SANITARY ENGINEERING

JOHN M. BIGGS
Moisseif Award of the American Society of Civil Engineers.
Chairman of the Committee on Wind Forces, American Society of Civil Engineers.
Vice-Chairman of the Structural Section, Boston Society of Civil Engineers.

ALEXANDER J. BONE
Chairman of the Surveying and Mapping Section, Boston Society of Civil Engineers.

JAMES W. DAILY
Chairman of the Executive Committee, Hydraulic Division, American Society of Mechanical Engineers.

ALBERT G. H. DIETZ
Desmond Fitzgerald Award of the Boston Society of Civil Engineers.

ROLF ELIASSEN
Chairman of the Publications Committee, Federation of Sewage and Industrial Wastes Association.
Chairman of the Committee on Corrosion Research, American Water Works Association.
Member of the National Advisory Health Council, United States Public Health Service.
Member of the National Board of Consultants, Office of the Surgeon General, United States Air Force.
Chairman of the Committee on the Recognition of Specialties in Engineering, Engineers' Joint Council.

ROBERT J. HANSEN
Clerk for the Construction Section, Boston Society of Civil Engineers.

DONALD R. F. HARLEMAN
Hydraulics Section Award of the Boston Society of Civil Engineers.

ARTHUR T. IPPEN
Vice-President, International Association for Hydraulic Research.
Member of the Executive Committee, Hydraulics Division, American Society of Civil Engineers.

ROSS E. McKINNEY
Chairman of the Publications Committee, Sanitary Engineering Division, American Society of Civil Engineers.

CHARLES H. NORRIS
Program Chairman of the Massachusetts Section, American Society of Civil Engineers.

CLAIR N. SAWYER
Chairman, Gordon Research Conference on Stream Sanitation.
First Vice-President, New England Sewage and Industrial Wastes Association.

JOHN B. WILBUR
Member of the Council, Engineering Societies of New England.

DEPARTMENT OF ECONOMICS

MORRIS A. ADELMAN
Fellow, American Academy of Arts and Sciences.
Director, Society of Business Advisory Professions.

WARREN G. BENNIS
Associate Editor, *Social Problems.*

EDGAR C. BROWN
Faculty Research Fellowship, Ford Foundation.

HAROLD A. FREEMAN
Fellow, American Academy of Arts and Sciences.

CHARLES P. KINDLEBERGER
Member of the Board of Editors, *American Economic Review.*

ITHIEL deSOLA POOL
Guest Editor, *The Public Opinion Quarterly.*
Chairman of the Biennial Meeting, World Association for Public Opinion Research.

LUCIAN W. PYE
Director, Inter-University Summer Seminar on "Westernized Elites in Asia," Social Science Research Council.

ROBERT M. SOLOW
Fellow, American Academy of Arts and Sciences.

DEPARTMENT OF ELECTRICAL ENGINEERING

RICHARD B. ADLER
Premium Award of the Royal Aeronautical Society (London).

LEO L. BERANEK
First Chairman of the Acoustical Standards Board, American Standards Association.
Honorary Member, Audio Engineering Society.
Chairman of the Student Membership Committee, Acoustical Society of America.
Vice-Chairman of the Editorial Board, *Journal of Noise Control.*

EUGENE W. BOEHNE
Fellow, American Institute of Electrical Engineers.

RICHARD H. BOLT
Deputy Chairman of the Committee on Hearing and Bioacoustics, National Research Council.
President, International Commission on Acoustics.
Chairman of the Committee on Submarine Noise, National Research Council.

GORDON S. BROWN
Visiting Mackay Professor of Electrical Engineering, University of California.

HAROLD E. EDGERTON

Progress Medal Award of the Photographic Society of America.
Seventy-Fifth Anniversary Citation of the Photographic Society of America.
Fellow, American Academy of Arts and Sciences.
Fellow, Institute of Radio Engineers.
Honorary Member, Society of Photographic Engineers.
Member of the Board of Editors, Society of Photographic Engineers.

TRUMAN S. GRAY

Fellow, American Institute of Electrical Engineers.
Secretary of the Group Subcommittee on Nucleonic and Radiation Instruments; Chairman of the Subcommittee on Organization; Vice-Chairman of the Group Subcommittee on General Activities for the Committee on Instruments and Measurements, American Institute of Electrical Engineers.

ERNST A. GUILLEMIN

Guest Lecturer, Applied Physics Laboratory, Johns Hopkins University.

HERMANN A. HAUS

Chairman of the Committee of the Task Group on Noise, Institute of Radio Engineers.

DAVID A. HUFFMAN

Levy Medal of the Franklin Institute.

THOMAS F. JONES, JR.

Member of the Executive Committee and Chairman of the Educational Subcommittee, Region I, Institute of Radio Engineers.
Member of the Executive Committee and Chairman of the Student Activities Committee, Boston Section, Institute of Radio Engineers.
Chairman of the Student Activities Committee, New England Radio Engineering Meeting.

ALEXANDER KUSKO

Chairman of the Subcommittee on Thermal Ratings of Airborne Apparatus, Blast-Cooling Group, American Institute of Electrical Engineers.

OSMAN K. MAWARDI

Chairman of the Committee on Impedance Standards (American Standards Association), Acoustical Society of America.

J. FRANCIS REINTJES

Vice-Chairman of the Subcommittee on Electronic Circuits and Systems, American Institute of Electrical Engineers.

WALTER A. ROSENBLITH

Fellow, Acoustical Society of America.
Chairman of the Committee on Hearing and Bioacoustics, National Research Council.
Consultant to the Committee on Conservation of Hearing and to the Subcommittee on Noise in Industry, American Academy of

Ophthalmology and Otolaryngology.
Member of the Planning Committee and Chairman of the Subcommittee on Information Services, Second International Congress on Acoustics.
Chairman of the Panel on Convergent Fields, National Academy of Science—National Research Council.

CLAUDE E. SHANNON
Fellow, Institute of Radio Engineers.
Member, National Academy of Sciences.
Stuart Ballantine Medal of the Franklin Institute.

KENNETH N. STEVENS
Fellow, Acoustical Society of America.
Chairman of the Speech Communication Committee, Acoustical Society of America.

JOHN G. TRUMP
Participant, Eighth International Congress of Radiology (Mexico City).

ALBERT B. VAN RENNES
Chairman of the Professional Group on Nuclear Science, Boston Section, Institute of Radio Engineers.

JEROME B. WIESNER
Chairman of Commission VI, International Scientific and Radio Union.
Chairman of the Technical Advisory Committee, American Foundation for the Blind.
Chairman of the Joint Technical Subcommittee on Scatter, Institute of Radio Engineers—Radio Electronics Television Manufacturers Association.
Editor, *Proceedings of the Institute of Radio Engineers.*

KARL L. WILDES
Vice-Chairman, Members for Life Committee, American Institute of Electrical Engineers.

DEPARTMENT OF FOOD TECHNOLOGY

CECIL G. DUNN
Commanding Officer, 1001st Army Reserve Research and Development Group.
President, Boston Bacteriological Club.

SAMUEL A. GOLDBLITH
Chairman of the Northeast Section, Institute of Food Technologists.

ROBERT S. HARRIS
Medal of the Order of Carlos Finlay (Government of Cuba).

BERNARD E. PROCTOR
Nicholas Appert Award of the Institute of Food Technologists.

DEPARTMENT OF GEOLOGY AND GEOPHYSICS

PATRICK M. HURLEY
Vice-President of the Section on Tectonophysics, American Geophysical Union.

ROLAND D. PARKS
Member of the Mining, Geological and Metallurgical Institute of India.

ROBERT R. SHROCK
President, Society of Economic Paleontologists and Mineralogists.

SECTION OF GRAPHICS

DOUGLAS P. ADAMS
Visiting Lecturer in Engineering Sciences, Harvard University.

DEPARTMENT OF HUMANITIES

CARVEL COLLINS
Director, College English Association.
Visiting Professor, Salzburg Seminar in American Studies (Austria).
Visiting Professor, Université d'Aix-Marseille (Nice, France).

GIORGIO D. de SANTILLANA
Fellow, American Academy of Arts and Sciences.

KARL W. DEUTSCH
Fellow, Center for Advanced Study in the Behavioral Sciences (Stanford, Calif.).
Associate, Columbia University Faculty Seminar on Organization.
Consultant, Center for Research on World Political Institutions, Princeton University.

BRISON D. GOOCH
Carnegie Internship in General Education.
Special Fellow, Belgian American Educational Foundation (Brussels).

ROBERT E. MacMASTER
Research Fellowship for study at the Russian Research Center, Harvard University.

THOMAS H. D. MAHONEY
First Vice-President, American Catholic Historical Association.
Trustee, Massachusetts State Library.

JOHN B. RAE
Member of the Editorial Board, *Explorations in Entrepreneurial History.*

SCHOOL OF INDUSTRIAL MANAGEMENT

BILLY E. GOETZ
Secretary-Treasurer, Academy of Management.

HERBERT F. GOODWIN
Gilbreth Medal of the Society for the Advancement of Management.
Director of the Boston Chapter, American Institute of Industrial Engineers.

THOMAS M. HILL
Visiting Lecturer, University of Leeds (England).

INGO INGENOHL
Member, American Psychological Association.

LEO B. MOORE
Member of the Board of Directors, Standards Engineers Society.

ALBERT H. RUBENSTEIN
Secretary of the Professional Group on Engineering Management, Boston Chapter, Institute of Radio Engineers.
Program Chairman for Annual Meetings, Society for Applied Anthropology.

ERWIN H. SCHELL
Fellow, American Society of Mechanical Engineers.

LIBRARY

IRMA Y. JOHNSON
Exchange Librarian, University of Edinburgh (Scotland).

NATALIE N. NICHOLSON
Chairman of the Science-Technology Group, Boston Chapter, Special Libraries Association.

DEPARTMENT OF MATHEMATICS

WILLIAM T. MARTIN
Trustee, American Mathematical Society.

ERIC REISSNER
Clemens Herschel Award of the Boston Society of Civil Engineers.

GEORGE W. WHITEHEAD
Fellowship, John Simon Guggenheim Memorial Foundation.
Fulbright Research Scholar.

DEPARTMENT OF MECHANICAL ENGINEERING

THOMAS P. GOODMAN
Fellowship, John Simon Guggenheim Memorial Foundation.
Fulbright Award for Advanced Research in Germany.
Honors Award of the Instruments and Regulators Division, American Society of Mechanical Engineers.

JOSEPH H. KEENAN
Delegate, Fifth International Steam Tables Conference (London).

ASCHER H. SHAPIRO
Akroyd Stuart Memorial Lecturer, University of Nottingham (England).

MILTON C. SHAW
George Westinghouse Award of the American Society for Engineering Education.
Fellowship, John Simon Guggenheim Memorial Foundation.

CHARLES F. TAYLOR
National Lecturer, American Society of Mechanical Engineers.

MEDICAL DEPARTMENT

JAMES M. FAULKNER
Member, National Board of Medical Examiners.

DEPARTMENT OF METALLURGY

B. L. AVERBACH
American Society for Metals Visiting Lectureship, University of Pennsylvania.

MICHAEL B. BEVER
Co-Chairman of the Education Committee, Institute of Metals Division, American Institute of Mining, Metallurgical and Petroleum Engineers.
Chairman of the Committee on Educational Statistics, American Society of Metals Foundation for Education and Research.
Fellow, American Academy of Arts and Sciences.

MORRIS COHEN
American Society for Metals Visiting Lectureship, University of Notre Dame.
Member of the Council, British Institute of Metals.

PHILIP L. deBRUYN
Secretary-Treasurer of the Boston Section, American Institute of Mining, Metallurgical and Petroleum Engineers.

GEORGE ECONOMOS
Chairman of the Ferrites Section, American Society for Testing Materials.

JOHN F. ELLIOTT
Frank L. Toy Award of the Pittsburgh Chapter, American Institute of Mining, Metallurgical and Petroleum Engineers.
Conference Award of the National Open Hearth Conference, American Institute of Mining, Metallurgical and Petroleum Engineers.

WILLIAM D. KINGERY
Secretary of the Basic Science Division, American Ceramic Society.

FREDERICK H. NORTON
Counselor of the New England Section, American Ceramic Society.

HOWARD F. TAYLOR
American Brake Shoe Professorship.

CARL WAGNER
Fellow, New York Academy of Sciences.

DEPARTMENT OF METEOROLOGY

JAMES M. AUSTIN
Chairman of the Committee on Publications, American Meteorological Society.

HENRY G. HOUGHTON
Secretary, American Meteorological Society.

VICTOR P. STARR
Fellow, American Academy of Arts and Sciences.

DEPARTMENT OF NAVAL ARCHITECTURE AND MARINE ENGINEERING

S. CURTIS POWELL
Member of the Executive Committee and the Council; Chairman of the Committee on Sections, Society of Naval Architects and Marine Engineers.

DEPARTMENT OF PHYSICS

SANBORN C. BROWN
Catedrático Visitante, University of Puerto Rico.
Chairman of the Rumford Committee, American Academy of Arts and Sciences.
Chairman of the Apparatus Committee, American Association of Physics Teachers.

WILLIAM W. BUECHNER
Visiting Professor, University of Mexico.

BERNARD T. FELD
Fellow, American Academy of Arts and Sciences.

ALBERT G. HILL
Distinguished Civilian Service Award of the United States Air Force.
Distinguished Service Award of the Army Ordnance Society.

PHILIP M. MORSE
Member, National Academy of Sciences.
Trustee, Institute for Defense Analysis.

WAYNE B. NOTTINGHAM
Fellow, Institute of Radio Engineers.

FELIX M. H. VILLARS
Fellowship, John Simon Guggenheim Memorial Foundation.

VICTOR F. WEISSKOPF
Max-Planck Medal for Physics of the German Physical Society.

JERROLD R. ZACHARIAS
Certificate of Appreciation of the United States Department of Defense.

DIVISION OF INDUSTRIAL COOPERATION

JOHN F. FRAZER
Chairman of the Membership Committee, Professional Group on Nuclear Science, Boston Chapter, Institute of Radio Engineers.

DONALD L. GUERNSEY
President of the Analytical Group, Northeastern Section, American Chemical Society.

JOHN A. KESSLER
Fellow, Acoustical Society of America.
Secretary, Second International Congress on Acoustics.

WILLIAM H. PINSON, JR.
Instructor, National Science Foundation Institute on Astronomy.
Member of the Advisory Council, Institute on Religion in an Age of Science.

DAVID C. PRIDMORE-BROWN
Imperial Chemical Industries Fellowship for work at the University of Manchester (England).

EGONS TONS
Asphalt Institute Fellowship for study at Purdue University.

JOHN E. WARD
Chairman of the Technical Committee on Feedback Control Systems, Institute of Radio Engineers.

DIVISION OF DEFENSE LABORATORIES

DOUGLAS L. BROOKS
Fellow, Operations Research Society of America.

DAVID R. BROWN
Vice-Chairman of the Committee on Electronic Computers, Institute of Radio Engineers.

WILLIAM R. DICKSON
Award of the American Society of Military Engineers, as the outstanding student in the Corps of Engineers, R.O.T.C. (1955).

STEPHEN H. DODD, JR.
Secretary of the Committee on Computing Devices, American Institute of Electrical Engineers.

JOHN L. DOWNING
Student Award of the Philadelphia Section, Institute of Radio Engineers.

ERNST L. MARTIN
Secretary, Operations Research Society of America.

DAVID L. FALKOFF
Associate Editor, *American Journal of Physics.*

MITCHELL M. HANNOOSH
Vice-Chairman of the Fort Wayne (Indiana) Section, American Society of Mechanical Engineers.

FRANK E. HEART
Vice-President of the Professional Group on Electronic Computers, Boston Chapter, Institute of Radio Engineers.

HAROLD L. KASNITZ
Member of the Board of Directors, Boston Section, American Rocket Society.

ELAINE H. KEITH
Treasurer of the Boston Section, Society of Women Engineers.

ROGER MANASSE
Fellowship, Solar Energy Commission.

EUGENE W. PIKE
Fellow, American Statistical Association.

NEAL PIKE
Hannibal C. Ford Fellowship for study at Cornell University.

PUBLICATIONS FROM THE INSTITUTE

PERIODICAL PUBLICATIONS, BOOKS AND REVIEWS BY THE STAFF, JULY 1, 1955–JUNE 30, 1956*

DEPARTMENT OF AERONAUTICAL ENGINEERING

ASHLEY, HOLT and G. ZARTARIAN. Piston Theory—A New Aerodynamic Tool for the Aeroelastician. *Inst. Aero. Sci. Preprint* 610,1956.

BISPLINGHOFF, RAYMOND L., H. ASHLEY and R. L. HALFMAN. Aeroelasticity. Cambridge, Mass., Addison-Wesley Pub. Co., 1955.

BISPLINGHOFF, RAYMOND L. Some Structural and Aeroelastic Considerations of High Speed Flight. *J. Aere. Sci.* 23, pp. 289–330, April, 1956.

DRAPER, CHARLES S., W. McKAY and S. LEES. Instrument Engineering, Vol. III, Part 1. N.Y., McGraw-Hill, 1955.

*For reprints of periodical publications and reviews, consult the author; for copies of books, consult the publishers or a retail bookseller. This compilation has been prepared under the direction of Miss Eleanor Bartlett, Special Collections and Gifts Librarian.

DRAPER, CHARLES S., W. WRIGLEY and L. R. GROHE. The Floating Integrating Gyro and Its Applications to Geometrical Stabilization Problems on Moving Bases. *Sherman M. Fairchild Fund Paper* FF—13, 1955.

DRAPER, CHARLES S. Flight Control. The 43rd Wilbur Wright Memorial Lecture, London, England. *Royal Aero. Soc. J.* 59, pp. 449–478, July, 1955.

DRAPER, CHARLES S., W. WRIGLEY and L. R. GROHE. The Floating Integrating Gyro and Its Application to Geometrical Stabilization Problems on Moving Bases. *Aero. Eng. Rev.* 15, pp. 46–62, June, 1956.

FINSTON, MORTON. A Thin Wedge in a Slightly Non-Uniform Supersonic Flow. *J. Math. & Phys.* 34, pp. 328–334, January, 1956.

HALFMAN, ROBERT L. and W. R. LAIDLAW. Experimental Pressure Distributions on Oscillating Low Aspect Ratio Wings. *J. Aero. Sci.* 23, pp. 117–124, February, 1956.

HAWTHORNE, WILLIAM R. and M. E. MARTIN. The Effect of Density Gradient and Shear on the Flow Over a Hemisphere. *Royal Soc. London. Proc. A* 232, pp. 184–195, 1955.

HAWTHORNE, WILLIAM R. and W. D. ARMSTRONG. Rotational Flow Through Cascades. *Quarterly J. Mech. & Appl. Math.* 8, pp. 266–292, September, 1955.

HAWTHORNE, WILLIAM R. The Growth of Secondary Circulation in Frictionless Flow. *Cambridge Phil. Soc. Proc.* 51, pp. 737–743, October, 1955.

HAWTHORNE, WILLIAM R. and G. de V. DAVIS. Calculating Gas-Turbine Performance: Rapid Method for Finding Conditions of Optimum Efficiency. *Engineering* 181, pp. 361–365, May 18, 1956.

HOFFMAN, MYRON A., A. J. NAVOY and Y. T. LI. Programmed Cruise Control for Turbojet Aircraft. *Inst. Aero. Sci. Preprint* 603, 1956.

HUNSAKER, JEROME C. U.S. National Advisory Committee for Aeronautics. *Annual Report.* Washington, D.C. Govt. Print. Office, 1955.

HUNSAKER, JEROME C. National Advisory Committee for Aeronautics: Forty Years of Research. *Sperryscope* 13, No. 11, pp. 4–8; No. 12, pp. 20–24, 1955–1956.

HUNSAKER, JEROME C. Social Aspects of Aeronautics. (In *Eighth International Congress on Theoretical and Applied Mechanics Proc.* Vol. 2, 1956.)

LEES, SIDNEY. A Method of Estimating Dynamic Characteristics of Physical Systems. (In *Frequency Response*, edited by R. Oldenburger. N.Y., Macmillan, 1956.)

LEES, SIDNEY and J. O. HOUGEN. Determination of Pneumatic Controller Characteristics by Frequency Response. *Ind. Eng. Chem.* 48, pp. 1053–1063, June, 1956.

LEES, SIDNEY and J. O. HOUGEN. Pulse Testing a Model Heat Exchange Process. *Ind. Eng. Chem.* 48, pp. 1064–1068, June, 1956.

LI, YAO T. Stabilization of Low Frequency Oscillations of Liquid Propellant Rockets with Fuel Line Stabilizer. *Jet Propulsion* 26, pp. 26–33 ff., January, 1956.

MAR, JAMES W. and L. A. SCHMIT. Some Structural Penalties Associated with Thermal Flight. *A.S.M.E. Preprint* 56 AV-9, 1956.

MAR, JAMES W., T. H. H. PIAN and J. M. CALLIGEROS. A Note on Methods for the Determination of Transient Stresses. *J. Aero. Sci.* 23, pp. 94–95, January, 1956.

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SANDORFF, PAUL E. and J. S. PRIGGE, Jr. Thermal Control in a Space Vehicle. *J. Astronautics* 3, pp. 4–8, Spring, 1956.

STEVER, H. GUYFORD, E. A. WITMER and W. HERRMANN. The Growth of the Boundary Layer Behind a Shock Wave. (A chapter in *50 Jahre Grenzschichtforschung*, edited by W. Tollmien and H. Görtler, Braunschweig, F. Vieweg & Sohn, 1955.)

STEVER, H. GUYFORD, J. T. VAN METER, E. E. LARRABEE, J. BICKNELL and T. R. PARSONS. Modern Trends in Dynamic Stability Analysis and Experiment. *AGARD AG18/P8* (Paper Presented at the Joint Session of the Flight Test Techniques & Wind Tunnel & Model Testing Panels, June, 1955.)

STEVER, H. GUYFORD. Technical Military Superiority is Still Needed. (In *Gas Dynamics Symposium Proc.* pp. 282–284, Evanston, Ill., Northwestern Tech. Inst., 1955.)

STEVER, H. GUYFORD. Future of Research for Government. (In *Annual Conference on the Administration of Research Proc.* 9, pp. 96–98, September, 1955.)

STEVER, H. GUYFORD. Science and the Military. *Air Force* 38, pp. 74–75, October, 1955.

STEVER, H. GUYFORD. Electronics in Aviation. *Aero. Eng. Rev.* 15, pp. 57, 126, May, 1956.

TRILLING, LEON and R. H. HAKKINEN. The Calibration of the Stanton Tube as a Skin Friction Meter. (In *50 Jahre Grenzschichtforschung*, edited by W. Tollmien & H. Görtler, Braunschweig, F. Vieweg & Sohn, 1955.)

TRILLING, LEON and E. E. COVERT. Quasi Steady Non Linear Pitching Oscillations in Transonic Flight. *J. Aero. Sci.* 22, pp. 617–627, September, 1955.

DEPARTMENT OF ARCHITECTURE

ANDERSON, LAWRENCE B., H. C. HOTTEL and A. WHILLIER. Solar Heating Design Problems. (In *Solar Energy Research,* edited by F. Daniels and J. A. Duffie. Madison, Wisc. Univ. Wisconsin Press, 1955.)

CATALANO, EDUARDO F. Most Talked-About House of the Year. *House & Home* 8, pp. 94–101, August, 1955.

KEPES, GYORGY. Die Neue und Die Technische Landschaft. *Der Aufbau Wien* 10, pp. 60–65, February–March, 1955.

KEPES, GYORGY. Art and Science. *Art in America* 43, pp. 34–49, October, 1955.

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DEPARTMENT OF BIOLOGY

BEAR, RICHARD S. Configuration of Collagen and Gelatin Molecules in Condensed and Dispersed States. (In *Soc. Exper. Biol. (Gt. Brit.) Symposia* 9, pp. 97–114, 1955.)

BEAR, RICHARD S. and C. C. SELBY. The Structure of Paramyosin Fibrils According to X-Ray Diffraction. *J. Biophys. & Biochem. Cytology* 2, pp. 55–69, January 25, 1956.

BEAR, RICHARD S. and C. C. SELBY. The Structure of Actin-Rich Filaments of Muscles According to X-Ray Diffraction. *J. Biophys. & Biochem. Cytology* 2, pp. 71–85, January 25, 1956.

BEAR, RICHARD S. The Structure of Collagen Molecules and Fibrils. *J. Biophys. & Biochem. Cytology* 2, pp. 363–368, May 25, 1956.

BLAKE, CHARLES H. Concerning Sizes of Bands. *Eastern Bird Banding Assoc. News* 18, p. 41, July, 1955.

BLAKE, CHARLES H. Notes on the Eastern Purple Finch. *Bird-Banding* 26, pp. 89–116, July, 1955.

BLAKE, CHARLES H. A Measure of the Effects of Hurricanes Carol and Edna. *Bird-Banding* 26, p. 119, July, 1955.

BLAKE, CHARLES H. Celluloid Color Bands. *Bird-Banding* 26, pp. 119–120, July, 1955.

BLAKE, CHARLES H. West Indies [Note on Program in Jamaica]. *The Ring* 5, p. 93, November, 1955.

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BLAKE, CHARLES H. Weight Changes in Birds. *Bird-Banding* 27, pp. 16–22, January, 1956.

BLAKE, CHARLES H. The Topography of a Bird. *Bird-Banding* 27, pp. 22–31, January, 1956.

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