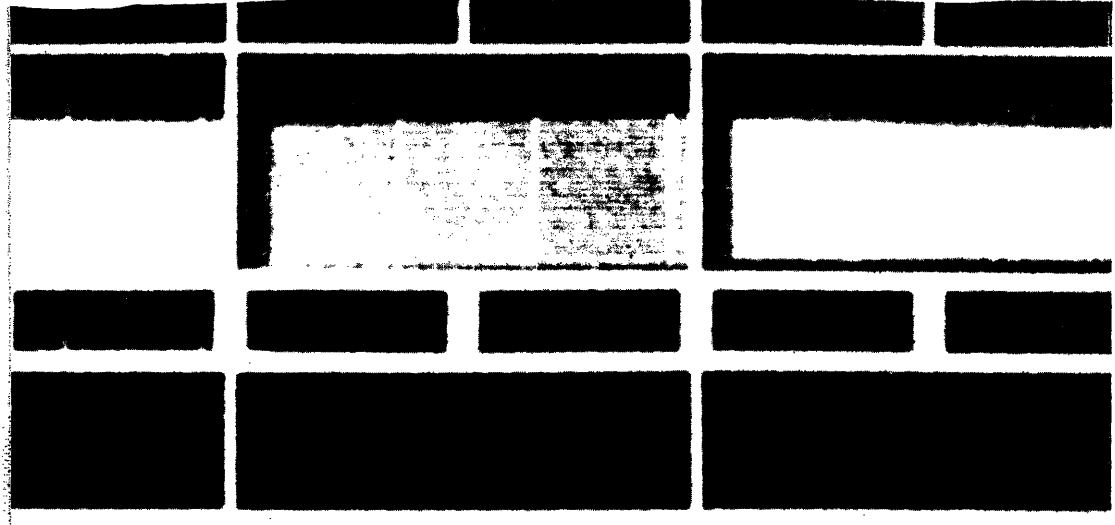
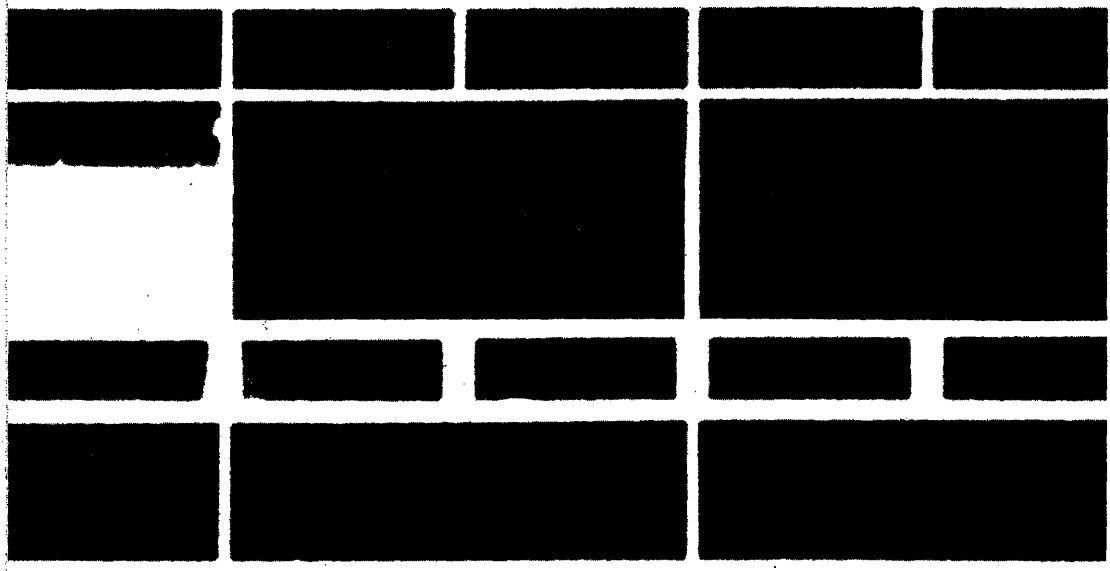
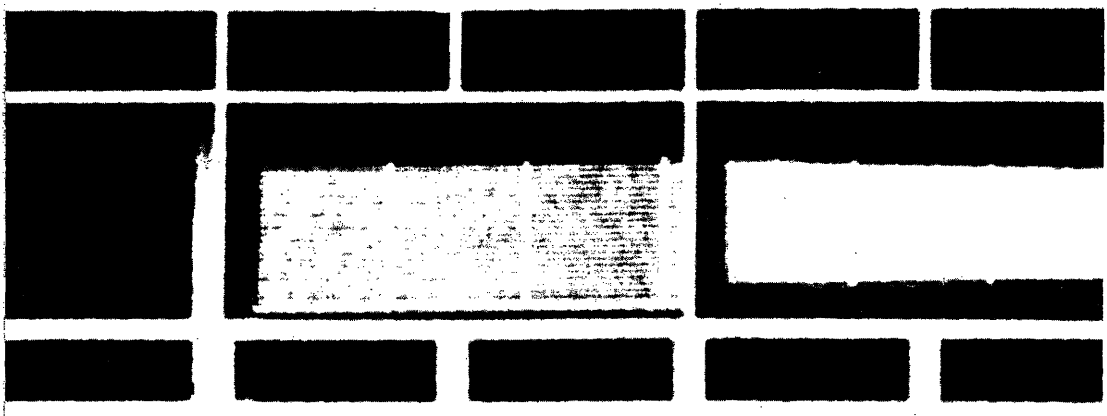


MASSACHUSETTS INSTITUTE OF TECHNOLOGY BULLETIN



PRESIDENT'S REPORT ISSUE



VOLUME 93, NUMBER 2

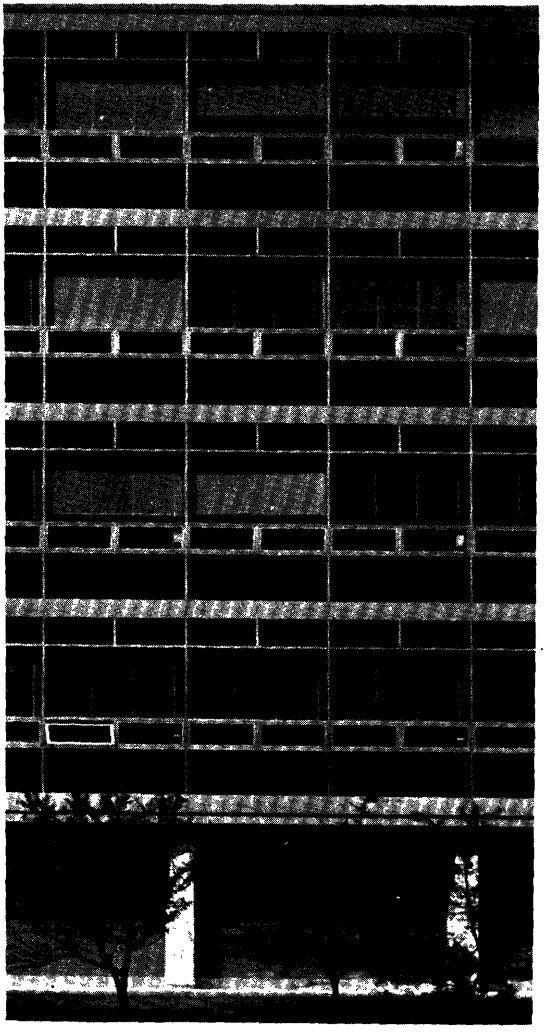
NOVEMBER, 1957

THE NEW KARL TAYLOR COMPTON LABORATORIES

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

PRESIDENT'S REPORT ISSUE

FOR THE YEAR ENDING OCTOBER 1, 1957



Entered July 3, 1933, at the Post Office, Boston, Massachusetts,
as second-class matter, under Act of Congress of August 24, 1912

Published by the **MASSACHUSETTS INSTITUTE OF TECHNOLOGY,**
Cambridge A Station, Boston, Massachusetts,
in March, May, July, September, and November.

Issues of the Bulletin include

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

CONTENTS

REPORT OF THE PRESIDENT

TO MEMBERS OF THE CORPORATION:

I have the honor to present the ninth of my annual reports on the affairs of the Massachusetts Institute of Technology. This year, as in the past, I review the policies and activities of the Institute in their relation to the national setting, recording our response to the nation's changing requirements and accounting for our stewardship of the private foundation we administer to serve the nation's educational and research needs.

The theme of this report is that M.I.T. occupies a nationally strategic position of great responsibility to advanced education and research, especially in science and technology, and that we may best meet this responsibility by a pace-setting stress on excellence and high standards in all our work. Throughout our planning and policy-making and in the modifications in our program, as recounted in this report, appears this stress on excellence and the importance of cultivating and exemplifying it.

REPORT OF THE COMMITTEE ON EDUCATION BEYOND THE HIGH SCHOOL

The Second Report of President Eisenhower's Committee on Education Beyond the High School, published in July, 1957, affords us an interesting opportunity to examine our policies, priorities, and needs in the light of the recommendations of this Committee. Let me select those items from the Committee's report (the quotations are printed in italics) which are relevant to a private institution such as M.I.T. and briefly summarize how we stand in relation to them.

TEACHERS—THE TOP PRIORITY

The Committee recommends to every board of trustees . . . (1) that the absolute highest priority . . . be given to raising faculty salaries, . . . with particular attention to increasing the spread between the bottom and the top . . . (2) that action also be taken to provide at moderate cost such benefits as health and life insurance, etc.

In M.I.T.'s financial planning and in current fund raising, we give top priority to finding the means to increase faculty compensation. In the past five years the average salary of our assistant professors has been increased 15.5 per cent, that of full professors 15 per cent. We have thus achieved modest gains, but these are not enough. (The President's Committee recommends doubling the current national average in the decade ahead.) Substantial progress has been made in augmenting "fringe" benefits, including opportunity for summer compensation which has added an additional average of 10 per cent to our base pay. Retirement benefits have been increased. Group life insurance, which has long been provided at Institute expense, has recently been doubled. Health and medical services to staff members have been enlarged. This past June we provided at Institute expense major medical insurance for nearly all staff members and their immediate dependents. We maintain a special Education Loan Fund to provide low-interest loans to members of the staff who need assistance in financing the education of their children. We also participate in the Tuition Exchange Plan, but the Plan does not take care of all the faculty who wish to use it.

At the suggestion of Alfred P. Sloan, Jr. '95, and with his help and that of the Alfred P. Sloan Foundation, Inc., we have experimented for two years with making monetary awards for outstanding performance to members of the faculty.

Our experience in making these awards has been excellent, and any skepticism we had about the wisdom of introducing this kind of special payment into the academic environment has been removed, provided the funds come from outside the institution and are available on more than a year-to-year basis.

We are now raising a wasting fund to finance selective salary increases introduced this year and to provide for additional increases. Mr. Sloan, through the Sloan Foundation, has offered to grant M.I.T. up to $1,250,000 for this salary fund, provided the Institute obtain $3,750,000 to provide a total of $5,000,000. The Corporation has accepted the challenge of this generous and most timely offer. Under the chairmanship of our fellow Corporation member, Walter J. Beadle '17, we have now launched a special and concentrated drive to raise at least the $3,750,000 needed to obtain the full amount from the Sloan Foundation—and, we hope, to exceed this total to offset continuing inflation and to help on our long-term needs.[1]

The Institute's salary scale is relatively good compared with other major universities (although it is not as high as some), and it is substantially higher than the national average; but our main competition now comes from industry. We have been engaged in many rear-guard actions to hold valuable members of our staff who are offered industrial salaries far higher than we can pay. Even more distressing is the difficulty we have in attracting enough able young graduates to elect academic rather than industrial careers.

[1]Mr. Beadle has associated with him the following regional Vice Chairmen: Oliver L. Bardes '21 of Cincinnati, Charles A. Chayne '19 of Detroit, Francis J. Chesterman '05 of Philadelphia, Cecil H. Green '23 of Dallas, Robert C. Gunness '34 of Chicago, Homer V. Howes '20 of St. Louis, Horace W. McCurdy '22 of Seattle, Antonio H. Rodriguez '21 of Havana, William C. Sessions '26 of Cleveland, David A. Shepard '26 of New York, William J. Sherry '21 of Tulsa, Raymond Stevens '17 of Boston, William L. Stewart, Jr. '23 of Los Angeles, and Irving W. Wilson '11 of Pittsburgh.

We share the sense of urgency of the President's Committee. If our effort to raise a wasting fund to be spent over five years is successful, we can take an unconventional and bold step to raise compensation. Insuring the future strength of M.I.T. requires and justifies our doing so.

The Committee urges the faculty of every college and graduate school to join . . . in a nationwide effort to recruit undergraduates and graduates of high talent for college teaching.

Except in a few fields, the number of our bachelor's degree graduates electing teaching careers continues small in comparison with the need. The attractions of industrial jobs, especially in engineering and the sciences, are too great. I see evidence of improvement; but I also see the need for more systematic encouragement of students to go on to graduate study and to elect teaching careers in our national system of higher education. It is indeed true, as the Committee observes, that "*high-powered recruiters descend upon campuses these days for nearly every career but teaching.*"

Our major contribution to augmenting the supply of teachers is to be found in the growth of our Graduate School, which is, of course, our chief training ground for teachers. Since 1950 our annual enrollment of graduate students has risen from 1,675 to 2,500. We are thus preparing more men and women with the qualifications to teach, provided they can be attracted into academic careers. Through teaching assistantships, of which we have about 270, we also give graduate students exceptional opportunities to learn, through apprenticeship, the art of teaching; and we diligently seek to attract from our graduate student body candidates for our own junior staff. About 20 per cent of our Ph.D. recipients now go into college teaching.

"The training of highly qualified men at the doctorate level," writes Dean C. Richard Soderberg of

our School of Engineering in his current report on the School, "is clearly one of the most important tasks in engineering education, both for industrial development and for education itself. The majority of these men participate in both research and education during their years of graduate study and are thus poised for a career in either industry or education or both.

"The solution to the staffing of the faculties in engineering education all over the nation clearly lies in the further expansion of graduate education, and it is in this direction that we must make our major contribution in men in the years immediately ahead. We believe that by this move we may also make the most significant contribution to undergraduate education in engineering—by maintaining a model undergraduate establishment, limited in size by the availability of highly qualified professional men, some of whom are in advanced training for a career in engineering education."

The growth of graduate study at M.I.T. is in accord with the recommendations of the President's Committee "*that universities expand and strengthen their graduate schools*" and that these schools "*make special efforts to create interest in teaching.*"

We are currently making important contributions to improving the quality of teaching in our courses by the design and "proving in" of new, more fundamental, and more advanced curricula. The preparation of new teaching materials, together with the "relearning" by the staff which is required, represent important contributions to the teaching profession.

The President's Committee observes, "*Great good for all higher education might come from the establishment of a few highly experimental new colleges which could test out radically new methods of achieving better utilization of faculty and space, unfettered by traditional campus practices.*" We believe that

M.I.T. has a responsibility to experiment and test out new methods, doing this within our existing framework.

Last month our Electrical Engineering Department, with funds provided by the National Science Foundation, held an eight-day "workshop" attended by professors of electrical engineering from 104 engineering colleges in the United States and Canada, for the purpose of discussing and evaluating the extensively modified and upgraded electrical engineering curriculum we are now teaching. This conference may prove to be profoundly influential in shaping the future course of engineering education.

The Committee urges all educational institutions to continue to devise ways by which their available faculty may teach more efficiently.

Our faculty continues to be skeptical that such teaching aids as television can be more than marginally helpful at M.I.T.; there is still a strong conviction that for our kind of education there is no substitute for the teacher himself in personal contact with the students in the classroom—and preferably in small classes. Nevertheless, we are experimenting with a variety of new teaching aids. This fall one class in mathematics will use television as an experimental medium of instruction. We are experimenting with motion pictures, notably in the Physical Science Study Project (see page 21); and we have before us the interesting proposal presented by Dr. Edwin H. Land in the 1957 Arthur D. Little Lecture, that important lectures by our best professors be filmed and that we maintain a library of these films so that students may view them when they choose. Some such arrangement might free professors from repeating basic lectures year after year so that they could concentrate on teaching new material.

More important than these kinds of teaching aids are intensive current efforts to modernize and simplify

laboratory instruction and ruthlessly to weed out of our curriculum lower-priority material so that we can move closer to the core of fundamentals.

I can report a fresh and growing preoccupation with the effectiveness of undergraduate teaching and a realization that more experimentation in the art of teaching can yield important gains in efficiency and effective learning. We can do much by encouraging our students to take, as the Committee suggests, "*more responsibility for their own education through greater reliance on independent study and less on daily instruction of teachers.*" We also might well give more systematic attention to relieving skilled teachers from routine tasks, freeing them to concentrate on more important and difficult teaching functions, and "*to adapting different class sizes to accommodate more efficiently the various objectives of learning.*" In remarking on these recommendations, I hasten to point out that M.I.T. has gone far in providing supporting services to its teaching staff. I emphasize, too, that our whole educational philosophy is to provide quality education; our emphasis is on educational effectiveness and the highest standards rather than on increasing "productivity" (although we seek that, too, so long as it is compatible with quality).

THE NEED FOR ASSISTANCE TO STUDENTS

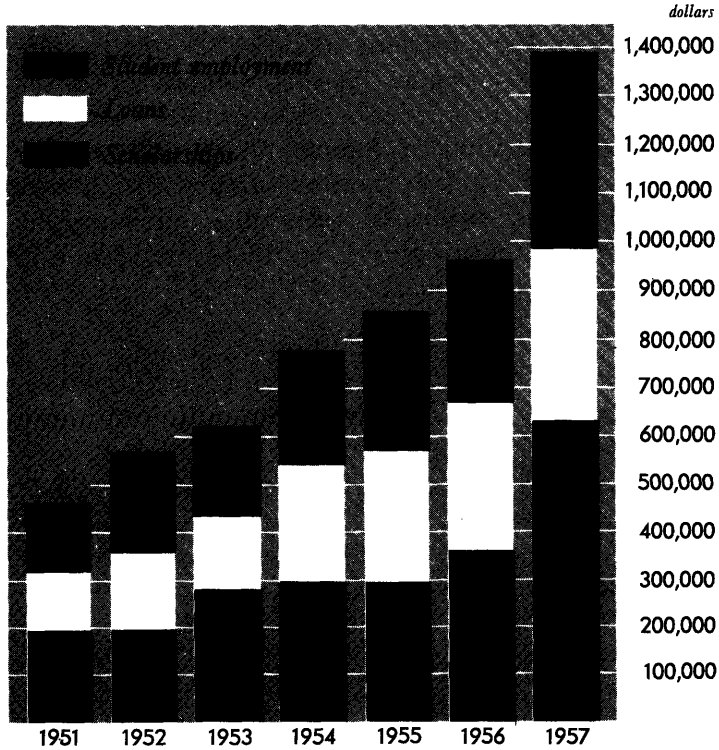
The Committee urges that individual colleges and universities seek to expand the use of loans, in combination with other forms of student aid . . .

Under the leadership of Gerard Swope '95, M.I.T. established a large loan fund in 1930. Since that time we have lent $4 million to five thousand students. Of the students who have borrowed, 98.4 per cent have paid back their loans on time—at the rate of $50 every six months following graduation. These loans bear an interest rate of 1 per cent, and this rate covers all defaults several times over. Thus not only does the fund

revolve, but the corpus of the fund has also been slowly growing. In fiscal 1957 we will lend about $500,000 to our students, both graduate and undergraduate.

The impressive success we have had in helping students through loans supports the Committee's recommendation, although it must be recognized that our graduates, whose employment mainly is in the fields of science and engineering, are in an especially favorable position to pay back their loans. To be successful, a loan fund must have a carefully planned rate of repayment. Some loan funds have foundered—particularly those sponsored by banks—because the rates of repay-

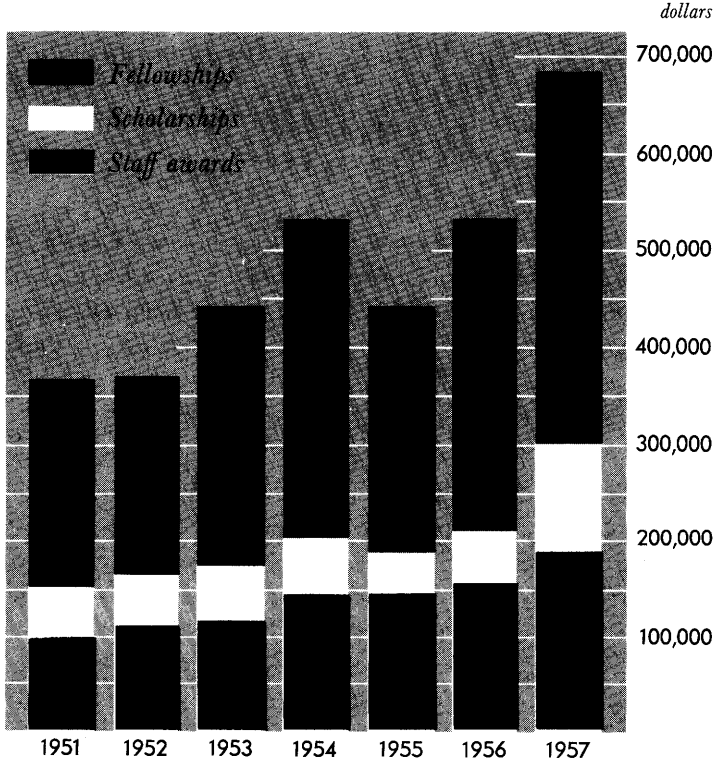
FINANCIAL AID TO UNDERGRADUATE STUDENTS



ment have been too rapid. We also feel certain that the interest rates ought not to be too high. This is not to say that interest and repayment rates ought to be uniformly as low as those of our own M.I.T. Loan Fund. A loan fund should, of course, be operated on a revolving basis so that its benefits will be available for future students. In my judgment, the major objective of a successful college loan fund is not that of making a profit; the objective is to provide financial assistance to students in the form least expensive to them.

As we have administered this loan fund, and as we have watched other loan fund experiments, we have

FINANCIAL AID TO GRADUATE STUDENTS



reached the further conclusion that an atmosphere conducive to borrowing must be carefully cultivated. The first reaction of students and parents contemplating a loan is that they do not want to go into debt for purposes of education. If, however, the student must have assistance in order to assure his education, then it seems that he and his parents should be as willing to consider a loan as they are to ask for a gift in the form of a scholarship. While aversion to borrowing is an admirable quality in certain circumstances, so too is the willingness of a young man to bet on himself and his future. It is a frequently observed fact that parents who express objections to borrowing money for education will readily borrow money in order to purchase a host of family luxuries. This represents a curious inversion of values.

Our experience at M.I.T. has been that the young man who has enough confidence in himself to share a part of the burden of financing his own education has a quality that is very likely to serve him well in his career.

The Committee finds that presently available scholarships are grossly inadequate . . . recommends that private, local, and state sources increase their support of scholarship funds to several times the present amount and number of scholarships . . . that scholarships should include (when feasible) provision of funds for the institution . . . to pay for the cost of educating the student above what he pays through fees and tuition.

While the Institute has had a gratifying increase in scholarships available to its students (see page 50) and has benefited greatly from the growing national scholarship programs financed by industry and foundations, we still find ourselves short of needed scholarship assistance for both undergraduates and graduates. We estimate that over the next ten years we should add, on the average, about $1 million per year to our en-

dowment funds for scholarships and fellowships. As national and regional scholarship assistance grows, the funds available to individual institutions should also grow. Each institution needs the flexibility that comes from scholarships under its own control. Some of the major national scholarship programs are centralized. For purposes of diversity, there should also be programs operated on a decentralized basis. This affords diversity in evaluation procedures, and it also gives us an opportunity to compare the relative effectiveness of centralized selection of recipients with that of selection keyed to the values and requirements of individual colleges.

Private institutions, as they improve faculty compensation and meet rising costs of operation, will inevitably have to increase student fees; but this cannot be done unless student aid is also increased. This relationship between tuition policy and student aid is recognized by the President's Committee when it recommends "*that charges to students in private institutions in general be gradually increased in order at least to maintain the proportion of total costs paid by students; and that programs of student assistance be stepped up to support increases in tuition and other charges.*" This is M.I.T. policy. I must add that private institutions inevitably will have to increase tuition beyond the point of maintaining the present proportion of total costs. Students who can afford to pay a higher percentage of their total education costs must be expected to do so; students who cannot afford the higher fees must be helped. For students of high ability there should be no diminishment of educational opportunity. Every institution must be mindful of the limiting factor of the "discretionary funds" available to American families as it adjusts its tuition and student aid. At present, the M.I.T. tuition covers less than half of the Institute's educational costs; *every* student automatically gets a "scholarship" larger than the tuition he pays.

As we seek to meet these conditions and requirements, we must devise new ways of assisting needy students. Installment payment of tuition and new programs for extending credit (as recommended by the President's Committee) are examples.

The institutional grants which the President's Committee recommends to go with scholarship grants —and which today are made by the major scholarship-granting agencies—are no longer large enough to cover more than a part of the per-student costs of our leading private institutions. These institutional grants for undergraduates run from $500 to $800 for each recipient. Compare this with M.I.T.'s tuition of $1,100 and its total per-student cost of well over twice that figure.

The Committee recommends an experimental, federally supported work program for students. The idea that students be given the opportunity to help themselves by working is very sound, and M.I.T. makes jobs an integral part of its student aid program. In fact, we have more jobs for students than we have takers. For our kind of academic environment, we have no need for a federally supported program. Student earnings at M.I.T. now total over $400,000 a year, exclusive of salaries paid to graduate students holding assistantships.

ADMISSIONS

The Committee does not agree with those who argue that, in order to preserve quality, colleges must sharply restrict enrollments to something like their present level by boosting admissions standards . . .

The Committee is speaking of the national situation as a whole—and certainly it would not be in the national interest to narrow educational opportunity so much that higher education be limited to an elite. In fulfilling the national educational requirements, however, there is need for differentiation among institutions

in accordance with levels of intellectual performance expected of students; and there is acute need for a group of institutions (and M.I.T. numbers itself among this group) to set their standards very high. We are not yet in any danger of pushing academic standards too high in the United States; in fact, even those institutions with the greatest selectivity in admissions have probably not achieved student bodies of the intellectual maturity and capacity of some European institutions, although our students are superbly able.

We at M.I.T., despite our high selectivity, feel that we are not admitting as many superior students as we would like, and I suspect other institutions of high selectivity feel the same way.

One of the reasons for our concern arises from the inadequacy of selection techniques, especially those which have to do with the appraisal of nonscholastic qualities. Great progress has been made in recent years in the use of objective tests to measure scholastic aptitude and accomplishment; our methods of appraising motivation, will power, potential leadership, and personality have not similarly improved. In evaluating a student's record, we have quite inadequate means of spotting danger signals that might be symptomatic of emotional defects which could lead to trouble in college. The Director of our Medical Department, Dr. James M. Faulkner, reports that his Department has been interviewing students who withdraw from M.I.T. and that the majority of these withdrawals are found to be for emotional reasons.

Clearly institutions need better methods for appraising nonscholastic qualifications. Happily the opinion grows among those concerned with testing and admissions that objective scholastic tests are not enough —that the time is here for a "massive assault" to determine if better means can be found to measure those

other qualities which are important to success in college and in professional life. As we seek to do this, however, we must never permit our selective procedures to exclude the unconventional and even eccentric applicant who yet has creative talent which will enable him to make important contributions to our society.

As we become more selective, we must take advantage of an unprecedented opportunity to admit a student body which has intellectual competence as its common denominator but has at the same time a variety of types, personalities, and talents comparable to the wide selection of opportunities open to our graduates.

The size of the Institute's enrollment is under constant review. In the last decade we have nearly doubled in size, with most of the increase coming at the graduate level. M.I.T. has thus responded to the growing needs of the nation for scientific manpower. At present we are trying to stabilize our enrollment, in order to permit our resources to catch up with our growth and thus to insure the continuing excellence of our education. We hold strong convictions that our primary responsibility is to maintain this excellence and that we would serve the nation less well if we permitted a further increase in numbers at the expense of the quality of our education.

While this is our current policy, we readily acknowledge that some growth is both inevitable and desirable, because we have entered into new fields such as nuclear engineering and industrial management and because of the acute need for more graduate education. If we are to grow in enrollment, large additional funds will be required to finance high-quality staff and facilities. The ultimate capital cost of adding one additional student is in excess of $50,000. The President's Committee observes that "*if an unwelcome choice were required between preserving quality and expanding enrollments, then*

quality should be preferred because it would do neither individuals nor the nation any good to masquerade mass production of mediocrity under the guise of higher education." While recognizing that the capacity of the total system of higher education in this nation must increase, we hold that M.I.T.'s primary responsibility is to put quality first and to concentrate on the education of high talent. In this way we can be among the institutions which exert great leverage to lift the level of total performance throughout the educational system.

FINANCING HIGHER EDUCATION

The Committee recommends that each existing institution, if it has not already done so, undertake immediately an intensive and imaginative study of its long-range goals and plans.

The report in 1949 of the M.I.T. Faculty Committee on Educational Survey was a searching examination of Institute goals, and it has been profoundly influential in our educational policy-making and planning. Such clarification of educational policy and planning must underlie our financial policy and planning, and through this report and subsequent studies (such as the current study of educational policy in the School of Engineering) we seek to keep our basic objectives clear and to adjust them to changing needs.

In planning our financial program and the development of our campus and buildings, we are now

1. Formulating a five-year budget so that we may properly anticipate changing financial needs.

2. Preparing a carefully integrated development program for the next ten years.

3. Starting, with the assistance of competent architects and city planners, a searching study of building planning and land utilization. We do this not only to have a carefully thought-through plan for our own needs but also properly to relate our planning to the program of planning and urban renewal in the City of Cambridge.

4. Proceeding with a long-range program to improve student housing facilities, with the benefit of the comprehensive study of student housing made in 1956 by the Corporation Committee on Student Housing (the Ryer Committee).

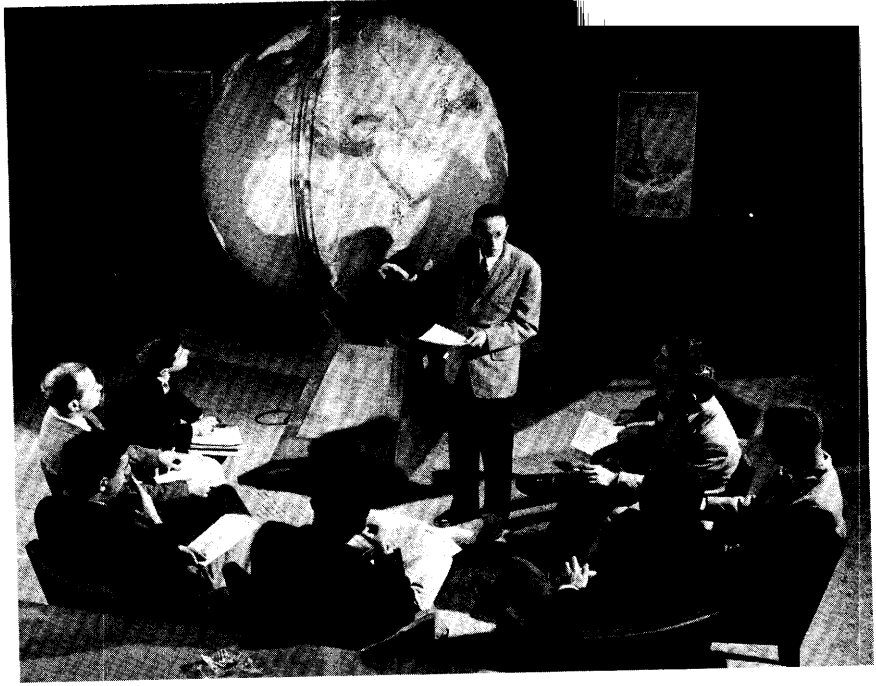
The Committee recommends that increasing and unremitting emphasis be given by boards of trustees, administrators, and faculties to all appropriate measures which can bring about greater efficiency in the management and utilization of the facilities of institutions—including further improvements and innovations in cost accounting, management practices, etc.

By realignments in our administrative organization, described on page 34, we seek to insure this optimum efficiency and economy; but we seek to do so by always giving first priority to the maintenance of those characteristics which make an educational institution unique and effective as an "environment of learning." These characteristics include relative simplicity of management and many imponderable qualities of spirit which could wither in an atmosphere of excessive cost accounting. Efficiency in an educational institution is measured by the educational effectiveness and creativity of its "community of scholars," and not by mass production of numbers. These policies, however, do not preclude a steady effort to improve management, to use our plant more efficiently, and to achieve new economies in operation.

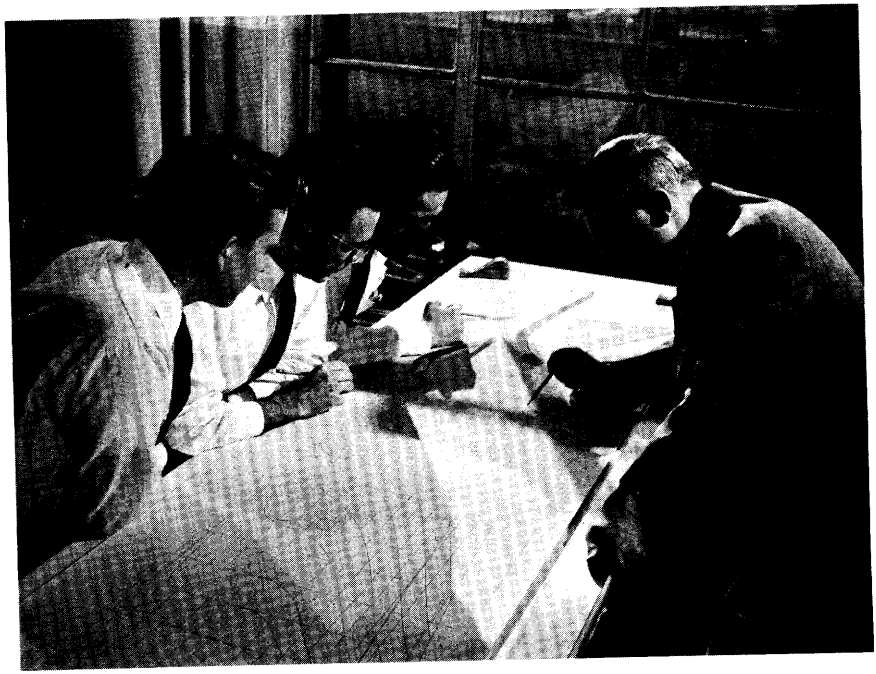
The Institute is in full accord with the Committee recommendation "*that the Federal Government promptly develop and implement a consistent and equitable policy for the payment of full costs, including the indirect cost to the institutions of Federal research programs.*" Officers of the Institute have consistently represented this point of view in many national councils, and at present I am chairman of a committee invited to represent the universities in reviewing reimbursement policies with the government.

Needless to say, we also concur fully in the recommendation that institutions seek greatly increased income from gifts, particularly from their own alumni and from the industries which employ their graduates and which profit from their research. Our Alumni Fund is growing, partly in response to intensive regional solicitation conducted by local alumni. Our Industrial Liaison Program is a highly successful plan for maintaining a large volume of annual corporate grants; and our well-staffed Development Office, operating under policies of our Corporation Development Committee, is steadily enlarging our effort. The problem has been to raise our sights and to convince our constituency that M.I.T.'s needs of today are of an entirely different order of magnitude from those of a decade or more ago. In the light of the continuing decrease in the value of the dollar, we would like to hope that our annual gift total ($8 to $10 million) be doubled.

In discussing the recommendations of President Eisenhower's Committee, I have of course omitted many items. Some of the report is not relevant to M.I.T., and the Institute has many problems and interests which are not reflected in the report. For example, the Committee does not deal with the great questions of educational content. Nevertheless, I hope that this discussion throws light on how Institute policy accords and differs with the findings of this important and thoughtful report by representative American citizens; and I hope that this M.I.T. report is in the spirit of the recommendation "*that institutions give appropriate publicity, aimed at the general public, to their major sources of educational and general income and objects of expenditure so that there will be more awareness of the real costs of education . . .*"



" . . . for our kind of education there is no substitute for the teacher himself in personal contact with his students . . . "



THE YEAR IN REVIEW

From a long list of important advances, modifications, and achievements of the past year, I select the following for special mention:

1. The trend toward flexibility in our undergraduate programs is reflected in modifications made in several undergraduate curricula. The Department of Chemical Engineering has adopted a new program which greatly increases the choices of subjects available to students by replacing many requirements with electives in the upper years. The new Course vests in the student greater responsibility for planning his future; it allows him increased flexibility in preparing for graduate specialization in a variety of fields, including nuclear engineering and biological engineering as well as chemical engineering.

The Civil and Sanitary Engineering Department is experimenting with a curriculum which introduces students as early as their sophomore year to serious professional problems; we thus seek to relate the basic analytical work of the curriculum to its professional context.

The Electrical Engineering Department has continued its development of a greatly changed and upgraded undergraduate program in electrical engineering, involving the introduction of more science into the curriculum. The Department has introduced a new Course, Electrical Science and Engineering, for a highly selected group of students. This new curriculum is of five years' duration and represents an effort to integrate undergraduate and graduate work in a Course unbroken at the end of four years. It leads to the Bachelor of Science and Master of Science degrees, awarded simultaneously.

The Mechanical Engineering Department has established a new optional curriculum in the field of nuclear power engineering in cooperation with the Nuclear Engineering Division of the Department of Chemical Engineering.

The Physics Department has devoted special attention to making undergraduate laboratory work more effective and to providing more opportunities for independent and creative work.

In the School of Humanities and Social Studies, a Political Science Section has been formed to afford a better integration of our teaching and education in this field in the core curriculum.

2. We have widened and deepened our educational and research activities in the earth sciences. Recognizing that meteorology is growing more quantitative and thus requires more and more preparation in the physical sciences, our Department of Meteorology has abandoned its undergraduate curriculum and now concentrates on graduate study. The undergraduate curriculum in the Department of Geology and Geophysics is now well planned to provide an undergraduate education broad and basic enough to prepare students for specialization in meteorology and other earth sciences at the graduate level. Finally, the Departments of Meteorology and of Geology and Geophysics have combined to sponsor the Laboratory of Earth Sciences, of which Professor Henry G. Houghton is Director. This Laboratory will widen and coordinate our educational and research activities in geology, geophysics, meteorology, and oceanography. All of these activities are strengthened by a cooperative arrangement with the Woods Hole Oceanographic Institution.

3. Under the joint sponsorship of the Schools of Architecture and of Humanities and Social Studies, elective courses are now available in the visual arts. These will

provide an opportunity for students actually to participate in studio work and will also include lectures, seminars, and field trips, to gain an intimate acquaintanceship with and understanding of the visual arts.

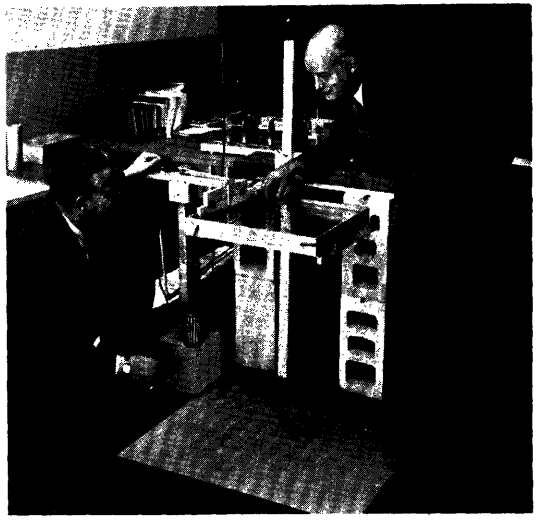
4. The School of Industrial Management has steadily moved away from the descriptive teaching of the components of business toward analytical approaches to the problems of management.

5. Under the direction of Professor Jerrold Zacharias, assisted by Professor Francis Friedman, the Institute has drawn together from both colleges and secondary schools a group known as the Physical Science Study Project, to plan a new approach to the teaching of physics in the secondary school. New experiments and experimental equipment are being devised, with emphasis on simplicity and inexpensiveness. The educational motion picture is being searchingly restudied, and efforts are being made to give it new effectiveness and integrity as a teaching tool. A new text is being written and supplementary manuals on various aspects of physics are being prepared for publication.

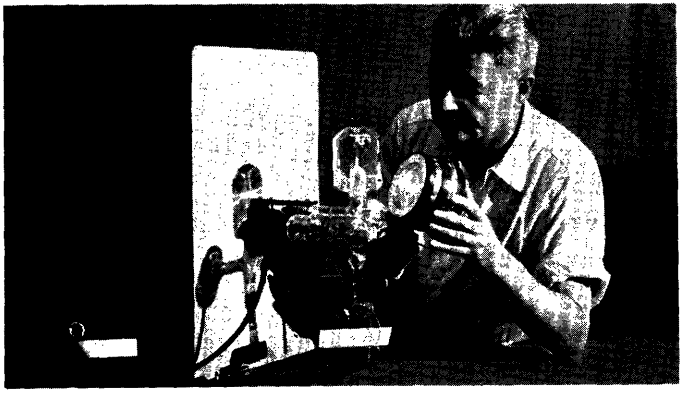
Throughout this project, physics is approached as a cultural subject rather than as an exercise in technology. The new program seeks to provide our young people—whether they are to become scientists or not—with some of the intellectual wealth of science, something of its unique vision for feeling and interpreting nature, and some of the heightened understanding which our citizens should have in order to deal more effectively with the great issues of our time which arise out of science. This project, which we hope may be a prototype for similar projects for other subjects, can make an exceedingly great contribution to better articulation between high school and college and toward raising the general level of scientific understanding. It has been supported thus far by the National Science Foundation, and it is

now expected that other foundations will join in bringing the program to fruition.

In planning these and other modifications and new directions, we have had the helpful counsel of Corporation Visiting Committees.



SIMPLE EQUIPMENT CAN BE BUILT BY ANY HIGH SCHOOL PHYSICS CLASS TO SHOW THE PRESSURE OF LIGHT (BELOW) AND FORMS OF WAVE MOTION (ABOVE).



The Physical Science Study Project is "some of the best news in the teaching of high school physics in many decades, perhaps even this century."
—THE CHRISTIAN SCIENCE MONITOR, JULY 13, 1957

SOME EDUCATIONAL PROBLEMS AND OPPORTUNITIES

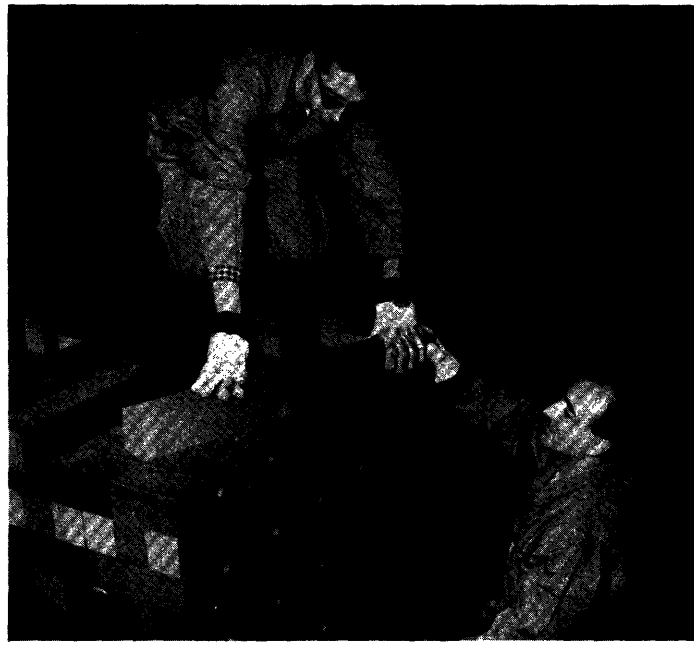
Throughout the Institute there is ferment, self-examination, and experimentation, especially in the field of undergraduate education; and as our curriculum changes and evolves, we encounter a range of difficult problems. A growing number of engineering students wish to increase the content of physics and mathematics in their engineering programs. It appears that we are moving toward a condition where engineering undergraduates will normally study an average of three years of physics and mathematics. (Some of our Courses now prescribe only two.) This growing emphasis on basic science reflects the trend toward a more fundamental and generalized undergraduate curriculum in engineering.

As Chancellor Stratton has said, "Our situation in this respect is probably unique in all the world. The Physics Department, for example, must not only give physics to about 1,800 freshmen and sophomores at a level more advanced than is found in all but a few colleges, but on top of this it is confronted with a demand for an increasing number of subjects in such fields as solid state physics, quantum mechanics, nuclear physics, and a variety of others . . . An entirely comparable situation exists in the Department of Mathematics . . . In one respect all of this is very gratifying; in another, it imposes a tremendous burden on these two particular departments, a burden that shows every sign of increasing and leaves each department with the very difficult problem of knowing how on the one hand to maintain this general education in physics and mathematics at a high level and at the same time to maintain the high quality of its own professional work, both in teaching and research."

Still another current problem is occasioned by the growing numbers of students who wish to elect physics

or electrical engineering as their field of study. Last fall nearly half of the freshman class indicated their intention of registering in one of these two departments.

Another one of our problems is to find time for the faculty to carry through the many ideas and new programs which are being engendered. We need the manpower as well as the willingness to try different patterns. As we undertake many efforts to achieve new syntheses of subject matter and a relentless weeding out of lower-priority material in order to get closer to the hard core of fundamentals in our undergraduate subjects, an immense effort is required over and above the normal teaching responsibilities of the staff—together with much "relearning." An educational program which seeks to break new ground requires a larger faculty than a program which remains static.



GRADUATE STUDENTS CONSTRUCT A SUB-CRITICAL, GRAPHITE-MODERATED PILE IN THE NUCLEAR ENGINEERING LABORATORY.

NEW FACILITIES

During the year, the Institute moved forward with important new additions to our resources for education and research. Alumni Day, June 10, witnessed the dedication of two of these facilities: the Karl Taylor Compton Laboratories and the Computation Center.

The Karl Taylor Compton Laboratories recognize M.I.T.'s growing education and research responsibilities in the physical sciences and related engineering sciences, particularly in electronics and nuclear science. These facilities will be shared by both the Research Laboratory of Electronics and the Laboratory for Nuclear Science. The building is, as Dr. Vannevar Bush '16 remarked at the dedication ceremonies, "just the type which Dr. Compton himself would want to see rise at M.I.T."

The Computation Center, made possible by the International Business Machines Corporation, will enable us to further M.I.T.'s pioneering work in data processing, automation, and computation. The Center will provide computing service to research activities in the physical and social sciences and will further education in the application of computing methods. With its great digital computer (I.B.M. Type 704), it will serve M.I.T. and will also be used by twenty-four other colleges in New England. The Center is housed in the Karl Taylor Compton Laboratories.

In order to supplement existing housing facilities for women students at 120 Bay State Road in Boston, we have converted one section of Bexley Hall on Massachusetts Avenue into an apartment dormitory. The Institute can now provide housing for fifty women students—approximately one-third of our present enrollment.

In addition to these completed projects, three other major facilities are now under construction. This winter will witness the completion of a $2.4 million

nuclear reactor, which will be one of the most versatile constructed anywhere for research and teaching purposes. Under the direction of Professors Manson Benedict and Theos J. Thompson, it will give new impetus to our rapidly growing program of study in the field of nuclear engineering.

This spring, ground was broken for a six-billion-electron-volt accelerator for basic research in high-energy particles. This facility, located on the Harvard campus, will be built, managed, and utilized jointly with Harvard University. It will be completed in about four years, at a cost of $6.5 million.

This fall we will begin construction of the David Flett du Pont Memorial Athletic Center on the West Campus. The du Pont Memorial Center will provide twelve new tennis courts, an $800,000 building adjoining the Armory to provide supplementary facilities for intercollegiate sports at M.I.T., six squash courts, facilities for women, and a locker room for faculty members. These facilities have been made possible by the $1 million bequest of David du Pont '56, who met tragedy in an automobile accident in 1955.

The Institute now owns the Armory on Massachusetts Avenue. It will be vacated by the state when a new National Guard Armory is completed in another part of Cambridge; then, after renovation, it will become an integral part of the Institute's athletic plant.

This fall we will begin the gradual demolition extending over a two-year period of Westgate and Westgate West, temporary wooden structures which have been utilized since 1946 for the housing of married students and their dependents. This step has been necessitated by recent zoning rulings of the Cambridge Board of Appeals and by the deterioration of these temporary buildings. We are now studying plans to determine whether we can find an economic way to build

permanent housing for some portion of the 1,200 married students in our student body.

SPONSORED RESEARCH

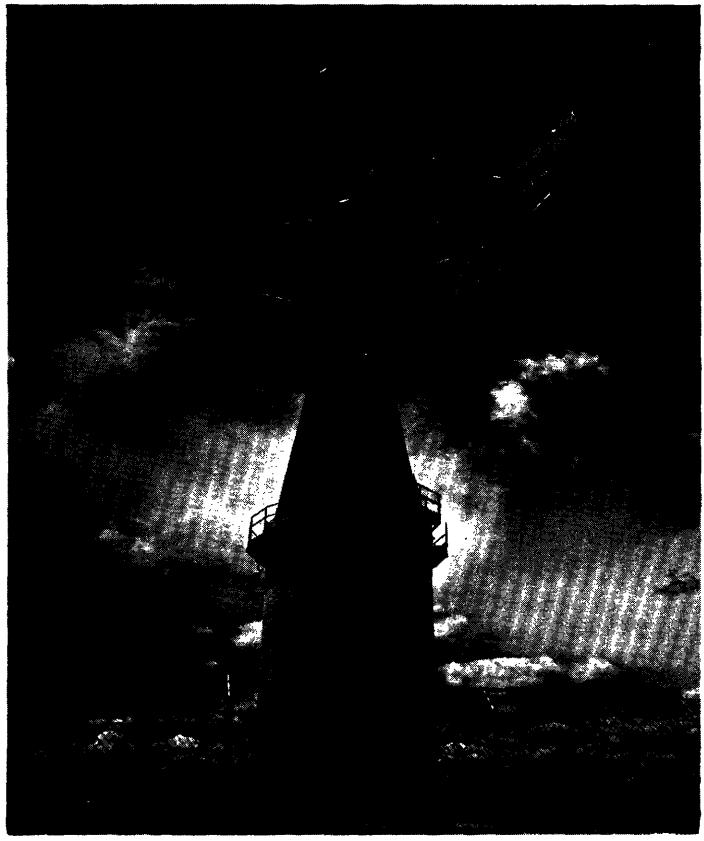
Through the various projects of the Division of Sponsored Research and of all our campus laboratories, we provide unusual educational opportunities for graduate students to participate, under faculty supervision, in research at the frontiers of their respective fields. Faculty participation contributes to the timely introduction of new developments into the academic curriculum, and members of the full-time research staffs associated with these sponsored research projects receive advanced training under outstanding leadership before assuming professional responsibilities in government and industry.

We try always to make as sure as we can that this association brings the maximum benefit, through the years, to the educational process. We are accordingly selective in the research we undertake. The work must hold promise of importance, and it must be in fields in which the Institute has exceptional competence and which are relevant to our mission. We are pleased that much of this work can contribute to the security of our nation, although we are acutely mindful of the large management responsibilities we bear in this regard and the special problems created for an educational institution. These responsibilities we can and must accept in this period when the safety and strength of the nation depends so greatly on superior science and technology and, specifically, on advancing military technology.

Military security declassification permitted the disclosure this year of a milepost in the Instrumentation Laboratory's pioneer work in inertial navigation. From the Laboratory's basic research have come gyroscopes of such precision as to make possible completely self-contained systems, requiring no reference to sun,

stars, or electromagnetic radiations. The particular system announced publicly this year is one that guided an Air Force B-29 from Bedford, Massachusetts, to Los Angeles on February 8, 1953, the first such flight ever to be made.

At the Lincoln Laboratory, substantial progress has been made in the development of the SAGE system and in other extensions of air defense technology. Among the large-scale engineering endeavors of the

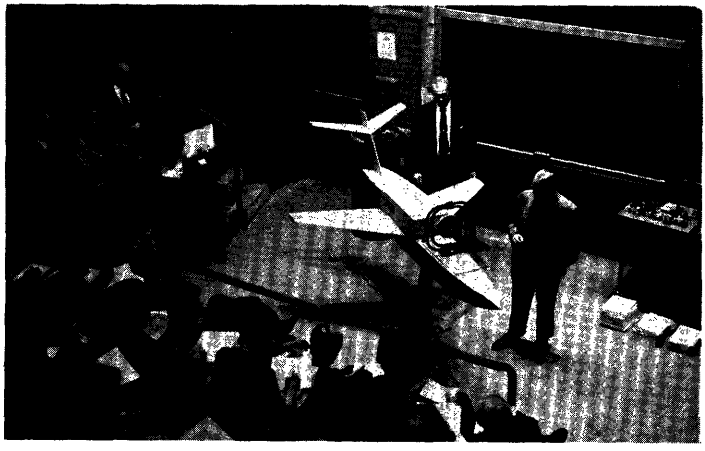


HIGH-POWER EXPERIMENTAL RADAR DEVELOPED BY LINCOLN LABORATORY.

Laboratory is the development, now under way, of a very fast digital computer with exceptionally large memory capacity and considerable flexibility. The magnetic core storage planes of this computer are designed to accommodate 65,536 words of 36 binary digits each, any of which can be stored in or recalled from the memory in any desired sequence at a rate of 167,000 per second.

Another Lincoln engineering feat of importance, completed during the year, is an experimental tracking radar of very high power, having an 84-foot diameter antenna movable in azimuth and elevation, which has been built at a field station in Westford, Massachusetts. This radar is used for research in radio-wave propagation, to include observations of meteor trails, aurora borealis, and artificial satellites.

At the other end of the scale of size from such spectacular engineering accomplishments, a novel microwave amplifier has emerged from the Laboratory's research on the properties of paramagnetic materials. Operating on the principle of the stimulated release of



AT THIS PRESS CONFERENCE THE INSTRUMENTATION LABORATORY FIRST REVEALED SOME OF ITS NOTABLE ACCOMPLISHMENTS IN INERTIAL GUIDANCE.

energy stored in a crystalline material by 9,000 megacycle radiation, the device amplifies signals at 2800 megacycles by as much as 10,000 times. As a result of its low operating temperature—near absolute zero—the amplifier has the attractive quality that its inherent noise is much less than that produced by other types of microwave amplifiers.

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

CORPORATION, FACULTY, AND ADMINISTRATION

One of the notable events of the year was the election by the Corporation of Dr. Vannevar Bush '16 to serve as its Chairman. Dr. Bush recently retired as President of the Carnegie Institute of Washington. We are fortunate and happy to have him back in the M.I.T. community and thus to have the benefit of his incomparable stimulus and leadership.

All of us mourn the passing of four prominent members of the Corporation, men who gave the Institute long years of devoted friendship, counsel, and service: Harry J. Carlson '92, prominent Boston architect and Emeritus Life Member; Dr. William Emerson, the Institute's first Dean of Architecture and Life Member since 1939; William Chapman Potter '97, one of the world's foremost bankers and industrialists and an Emeritus Life Member; and Redfield Proctor '02, former Governor of Vermont, Chairman of the Board of the Vermont Marble Company, and a Life Member.

Several other changes have taken place in the membership of the Corporation during the past year, and we look forward to a long and fruitful association with eight men new to the Corporation's rolls. Thomas J. Watson, Jr., President of the International Business Machines Corporation, has been appointed a Special

Term Member, and William L. Stewart, Jr. '23, Director of the Union Oil Company of California, is a new Life Member. The Alumni Association elected three members to Alumni Term Membership: Charles A. Chayne '19, Vice President in charge of the Engineering Staff of the General Motors Corporation; Theodore T. Miller '22, President of Polymer Chemicals Division of W. R. Grace and Company; and Clarence L. A. Wynd '27, Vice President of Eastman Kodak Company. Gilbert M. Roddy '31, Executive Vice President of Boston Manufacturers Mutual Insurance Company and the Mutual Boiler and Machinery Insurance Company, also joins the Corporation as the new President of the Alumni Association. The Honorable Foster Furcolo, Governor of Massachusetts, and Dr. Owen B. Kiernan, Commissioner of Education, are new representatives of the Commonwealth.

Expiration of term membership has cost us the associations of George W. Merck, President and Director of Merck and Company; Alfred T. Glassett '20, President of W. J. Barney Corporation; and Everett S. Coldwell '15, President, Chairman of the Board, and Director of Ford, Bacon, and Davis, Inc.

Important and distinguished additions have been made to the faculty during the year. Dr. Claude E. Shannon '40 of the Bell Telephone Laboratories, who spent the past year as Visiting Professor of Electrical Communications, accepted a unique joint appointment as Professor of Communication Sciences in the Department of Electrical Engineering and as Professor of Mathematics in the Department of Mathematics. Dr. Shannon brings to us world-renowned leadership in the field of information theory. The appointment of Dr. Cyrus Levinthal as Professor of Biophysics adds strength to our work in the life sciences. Dr. Huston Smith of Washington University has accepted appoint-

ment as Professor of Philosophy. Dr. Smith, whose special field is philosophy of religion, will be the first professor of philosophy at M.I.T. since the early days of the Institute.

Death during the summer months has taken the services of two prominent and beloved members of our faculty and administration: Dr. Murray P. Horwood, Professor of Sanitary Engineering and Director of Sanitation at the Institute, a leader in the field of municipal sanitation; and Miss Olive Barnard, who retired in June as Technical Assistant in the School of Industrial Management, counselor and friend to hundreds of Course XV graduates.

Fourteen members of the Institute family, who had given more than four hundred man-years of service to M.I.T., retired at the end of the past academic year: Dr. Avery A. Ashdown, Associate Professor of Organic Chemistry; Dr. Arthur R. Davis, Associate Professor of Inorganic Chemistry; Walter C. Eberhard, Assistant Professor of Engineering Graphics; Dr. William H. McAdams, Professor of Chemical Engineering; Dr. George Scatchard, Professor of Physical Chemistry; William E. Stanley, Professor of Sanitary Engineering; Arthur L. Townsend, Associate Professor of Mechanical Engineering; Dr. Charles M. Wareham, Associate Professor of Inorganic Chemistry; Dr. Walter L. Whitehead, Associate Professor of Geology; Admiral Edward L. Cochrane, Vice President for Industrial and Governmental Relations; John J. Rowlands, Director of the News Service; Miss Barnard; and Miss Doris Peabody, Director of the Letter Shop.

Among the honors which have come to members of the faculty during the past year are the following: the Medal of Honor of the American Institute of Radio Engineers to Dr. Julius A. Stratton, Chancellor; the Gold Medal Award for Professional Achievement by the

Memphis Chapter of the American Institute of Architects to Dean Pietro Belluschi (Architecture); the Thurlowe Award of the Institute of Navigation to Professor Charles S. Draper (Aeronautical Engineering); the first award of the American Chemical Society in Industrial and Engineering Chemistry to Professor Warren K. Lewis (Chemical Engineering); the Albert Lasker Award for outstanding achievement in medical research to Professor Francis O. Schmitt (Biology); the James H. McGraw Award in technical institute education of the American Society for Engineering Education to Professor Arthur L. Townsend, Director of the Lowell Institute School; the Robert H. Richards Award of the American Institute of Mining, Metallurgical, and Petroleum Engineers to Professor Antoine M. Gaudin (Metallurgy); the President's Award of the Society of Naval Architects and Marine Engineers to Professor Laurens Troost (Naval Architecture and Marine Engineering); the Frederick Ives Medal of the Optical Society of America to Professor Arthur C. Hardy (Physics); the Browder J. Thompson Memorial Prize Award of the Institute of Radio Engineers to Dudley A. Buck (Electrical Engineering); and the Public Welfare Medal of the National Academy of Sciences, the cross of Officier of the French Legion of Honor, and the Exceptional Civilian Service Award of the Department of the Army to the President of the Institute.

Professor Milton C. Shaw (Mechanical Engineering) served as United States Delegate to the United Nations meeting on the economic development of South America; Dean John E. Burchard (Humanities) has served as President of the American Academy of Arts and Sciences; Professor Robert R. Shrock (Geology) as President of the Society of Economic Paleontologists and Mineralogists; Professor Thomas H. D. Mahoney (Humanities) as President of the American Catholic His-

torians Association; and Dean H. Guyford Stever as Vice Chairman of the United States Air Force Scientific Advisory Board.

I should like to make special reference to contributions to the arts made by members of the faculty during the past year. Professors Lawrence B. Anderson and Herbert L. Beckwith (Architecture) have received several prizes for buildings designed by the firm of which they are senior partners, including the Grand Architecture Prize of the 1957 Boston Arts Festival. Dean Pietro Belluschi (Architecture) is to be commended for his design of the First Lutheran Church of Boston, Massachusetts. Professor Ernst Levy and Gregory Tucker (Humanities) have composed and recorded several outstanding musical performances for the violin and piano.

ADMINISTRATIVE CHANGES

The year brought a continuing decentralization of administrative offices, necessitated by the Institute's growing responsibilities and its many and unusual obligations. Under the leadership of Chancellor Stratton, the Deans of the Institute's five schools advanced toward increased authority and responsibility, thereby promoting the special characteristics and objectives of the respective departmental groupings and developing in each school its individual educational personality.

Notable among new appointments was that of Major General James McCormack, Jr., as a Vice President and member of the Corporation to succeed Admiral Edward L. Cochrane upon his retirement July 1. General McCormack, a West Point graduate with a degree from M.I.T., a Rhodes Scholar, and an officer with a record of great distinction, has served as special adviser to me and as President of the Institute for Defense Analyses.

He has administrative responsibility for the Division of Sponsored Research, the Director of which reports to him; and he represents the administration in overseeing the operations of the defense laboratories, including the Lincoln Laboratory, the Instrumentation Laboratory, and the Operations Evaluation Group. The Directors of these organizations also report to him.

In addition to these direct administrative responsibilities, General McCormack advises administrative officers on contractual relationships with industry and government for all sponsored research and administers policies under which staff services are furnished by our Division of Sponsored Research to all M.I.T.'s sponsored research activities. As a corporate officer of the Institute, he participates in the formulation of over-all Institute policy and shares with other corporate officers the responsibility for the administrative affairs of the Institute. We all welcome to our counsels his broad experience in research and technical administration.

Over the past five years the Institute has studied the need for a reallocation, regrouping, and redefinition of executive responsibilities in several important areas. Among our specific objectives has been the achievement of a centralized responsibility for personnel policies for all nonacademic employees. A second goal has been to clarify and simplify the administration of sponsored research. A third and over-all objective has been to provide the best administrative support for the Institute's educational and research activities.

In accord with this program, we have appointed Dr. Carl F. Floe and Malcolm G. Kispert as Administrative Vice Chancellors, Philip A. Stoddard as Vice Treasurer, and Paul V. Cusick as Comptroller.

Dr. Floe, as Administrative Vice Chancellor, will assist the Chancellor in matters relating to the academic programs of the professional schools and interschool

laboratories and to our research program. Mr. Kispert, as Administrative Vice Chancellor, will be responsible for the preparation and management of the Institute's operating budget; he will have executive responsibility for formulating and coordinating personnel policies for all nonacademic employees and for the allocation of space for academic purposes. Mr. Stoddard, as Vice Treasurer, will have executive responsibility for all physical facilities of the Institute, for the planning and execution of programs, for campus and plant development, and for managing our housing and dining facilities. Mr. Cusick, as Comptroller, acting in accordance with policies established by the Vice President and Treasurer, will have executive responsibility for all accounting and business procedures including purchasing, procurement, and contracting. He will serve as the Institute's contracting officer.

OTHER ADMINISTRATIVE APPOINTMENTS

Other important administrative changes were made throughout the year which will bring added strength and vigor to the Institute.

Professor Francis Bitter of the Department of Physics assumed the new post of Associate Dean of the School of Science in October, 1956. The Institute is particularly fortunate to have obtained a person of Professor Bitter's talents and experience in undergraduate education. In the past he has made signal contributions to the teaching of freshman and sophomore physics here and to research as well.

Professor Douglass V. Brown, Alfred P. Sloan Professor of Industrial Management, has assumed the position of Acting Associate Dean of the School of Industrial Management for the coming year during the absence of Professor Eli Shapiro, who has received a Ford Foundation Fellowship.

Professor John T. Howard '35, one of the leading planning authorities in the country, has been appointed Head of the Department of City and Regional Planning. Professor Howard will succeed Professor Frederick J. Adams, who will devote his full time to teaching.

On January 1, 1957, Dr. Irwin W. Sizer, former Acting Head of the Department of Biology, was made Head of that Department. Under his leadership the Department continues its pre-eminence as center for study of the life sciences.

Dr. Carl F. J. Overhage has assumed the post of Director of Lincoln Laboratory, succeeding Dr. Marshall G. Holloway; and Professor William Radford, on leave from our Electrical Engineering Department, has become Associate Director. Dr. Overhage, a former staff member of Eastman Kodak Company, has had a long association with the Institute and the Lincoln Laboratory.

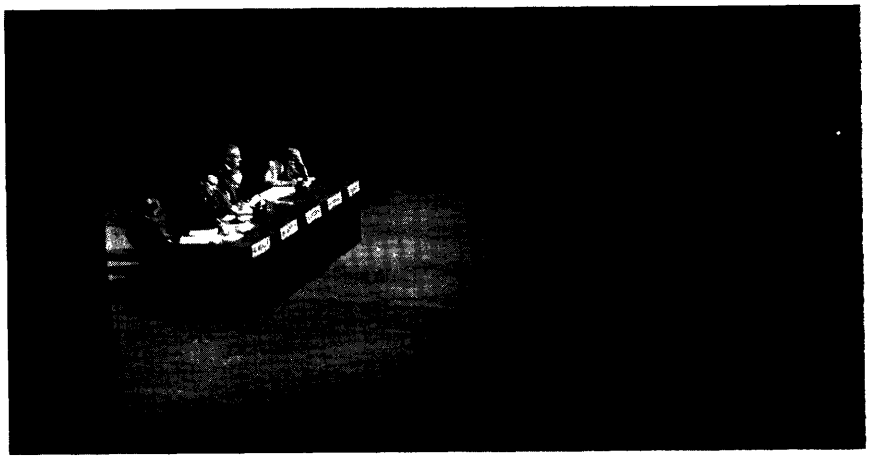
On October 1, 1956, Dr. James G. Kelso became Executive Assistant to the President and Secretary of the Executive Committee of the Corporation. He and Robert M. Briber, Administrative Assistant to the President, carry with skill and tact their heavy responsibilities in managing the multifarious details of our executive offices. I acknowledge, too, the invaluable assistance of Miss Elizabeth Pigott and Mrs. Claire Edwardson, who were appointed Administrative Assistants during the year.

THE M.I.T. COMMUNITY

Visitors came from every continent during the past twelve months, not only to enrich our many professional activities but also to observe and to learn.

The list of such learned guests who have shared their knowledge with us is far too long to give here. I should like to mention, at random, a few of the dis-

tinguished men who have been our colleagues, seminar speakers, and guest lecturers: Dr. Isidor I. Rabi, Professor of Physics at Columbia University and Nobel Laureate, who served as Visiting Institute Professor; Dr. Edwin H. Land, President of Polaroid Corporation, who served as Visiting Institute Professor and delivered the Arthur D. Little Memorial Lecture, "Generation of Greatness," which stimulated the imagination of the entire Institute community; I. Edward Garrick of the National Advisory Committee on Aeronautics, the Jerome Clarke Hunsaker Professor of Aeronautical Engineering; Dr. Stanislaw M. Ulam, senior scientist at the Los Alamos Scientific Laboratory, as Visiting Professor of Mathematics; Dr. Lars G. Sillen, Dean of Chemistry at the Royal Institute of Technology in Stockholm, Sweden, as Arthur D. Little Visiting Professor of Chemistry; Dr. Pierre Aigrain, Professor of Physics at the Ecole Normale Supérieure in Paris, who served as the Edwin S. Webster Professor of Electrical Engineering and delivered a series of lectures on "Electronic Processes in Solids;" John H. Peck,



FIVE DISTINGUISHED GUESTS HELD THE STAGE OF KRESGE AUDITORIUM DURING THIS 1957 CONVOCATION OF THE SCHOOL OF INDUSTRIAL MANAGEMENT.

C.M.G., Director-General of the British Information Services; and Ben Aboud, Ambassador to the United States from Morocco. Lecturers in the Department of Architecture and City Planning included Robin Boyd, Lecturer at the University of Melbourne, as Albert Farwell Bemis Visiting Professor of Architecture; Dr. Constantinos A. Doxiades, noted Greek architect; and a number of other distinguished architects and city planners.

At a notable session this past spring, five hundred of the nation's top industrialists gathered at a convocation celebrating the fifth anniversary of our School of Industrial Management and honoring Alfred P. Sloan, Jr. '95, Honorary Chairman of the Board of General Motors. In addition to faculty members who spoke, four distinguished panelists discussed "The Evolving Role of the Corporate Director" in a session moderated by Dr. Lyman Bryson: Dr. Vannevar Bush '16; Dr. Eugene V. Rostow, Dean of the Yale University Law School; David A. Shepard '26, Director of the Standard Oil Company (New Jersey); and Sidney J. Weinberg, a

THEIR DISCUSSION OF "THE EVOLVING ROLE OF THE CORPORATE DIRECTOR" WAS A HIGH SPOT IN THE SCHOOL'S FIFTH ANNIVERSARY CELEBRATION.

senior partner of Goldman, Sachs and Company. Cleo F. Craig, Chairman of the Board of the American Telephone and Telegraph Company, was the principal speaker at the evening dinner on this outstanding occasion.

These many visitors continue a tradition of professional interchange which is at the heart of all professional advance. In addition, more than eight hundred other guests representing foreign and domestic governments and industries have received the hospitality of the Institute during the past year. Taken together, these figures clearly demonstrate how our community is broadening its interests, activities, and responsibilities.

Our visitors for the coming year will include scientists and educators from all parts of the world. Among them will be Dr. Howard W. Emmons of Harvard University, who will be the Hunsaker Professor of Aeronautical Engineering; Dr. Arthur R. Kantrowitz, Director of the Avco Research Laboratory, as Visiting Institute Professor and Fellow of the School for Advanced Study; Dr. Rollin Hotchkiss of the Rockefeller Institute, as Visiting Professor of Biology; Dr. Roman Jakobson, world-renowned linguist, as Visiting Institute Professor; Dr. Roy Lamson, Professor of English at Williams College, as Visiting Professor of Humanities; and Dr. Armand Borel of the Technische Hochschule in Zurich, Switzerland, as Visiting Professor of Mathematics.

This fall will mark the initiation of the Karl Taylor Compton Lectureship, established in honor of the former President and Chairman of the Institute. We are honored that Dr. Niels Bohr, Nobel Laureate, recipient of the first Atoms for Peace award, and presently Head of the Institute of Theoretical Physics at the University of Copenhagen, will be the first holder of the Compton Lectureship, which has been established to

bring to our campus scholars noted for their universality of thought and influence on human values.

Thanks in large measure to the superb facilities provided by the Kresge Auditorium and the M.I.T. Chapel, the Institute has had a rich and varied musical program during the past year.

These professional events have included a concert by the Boston Symphony Orchestra, now an annual event; special chamber music composed and directed by Professor Ernst Levy; and the regular Humanities Series, which, under the direction of Gregory Tucker, attains greater popularity each year. The two Holtkamp organs of the Chapel and the Auditorium have been used to provide a succession of concerts by distinguished organists, including E. Power Biggs, Flor Peeters, Arthur Poister, Carl Weinrich, Donald Willing, and Karen Johnstad. The organ season was crowned this spring with five recitals by André Marchal, organist at St. Eustache in Paris.

In addition, the musical program of the Institute included outstanding concerts by many M.I.T. student groups. The Choral Society gave performances of Gabrieli's *Jubilate Deo*, Haydn's *Theresa Mass*, Bach's *St. John's Passion* and *Magnificat*, and Brahms' *German Requiem*.

Student interest and activity in dramatics has continued to flourish with the availability of the Little Theatre in Kresge Auditorium. Excellent *esprit de corps* in the Student Drama Shop has permitted training in all phases of play production, as well as a good acting company. Two major productions, *The Country Wife* by William Wycherly and *Misalliance* by George Bernard Shaw, demonstrated the professional standards achieved by this student dramatic group. And in addition, the Drama Shop Celebrity Series presented Robert Graves in an evening of poetry readings.

A SIXTEENTH CENTURY VIOLIN WAS AMONG MANY RARE STRINGED INSTRUMENTS GATHERED FOR A SPECIAL HAYDEN GALLERY EXHIBITION.

As usual, the Museum Committee brought a number of distinguished exhibitions to the gallery in the Charles Hayden Memorial Library. The series included a showing of twenty-one sculptures marking the largest one-man show by Ibram Lassaw; an excellent showing of paintings of the Hudson River School; and a special exhibition of rare string instruments from the collections of Emil Herrmann, Rembert Wurlitzer, and others.

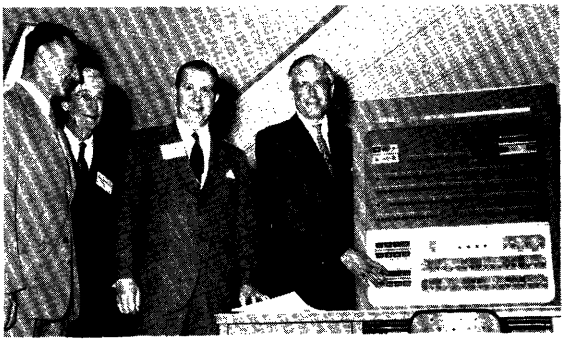
It has been the Institute's pleasure this year to entertain a number of professional conferences and meetings. The Second Conference on Mechanical Translation, attended by delegates from all over the world to hear forty papers in a three-day meeting last fall; a symposium on communication theory, sponsored by the Research Laboratory of Electronics and the Institute of Radio Engineers; the Sixth Weather Radar Conference; the Seventeenth Annual Conference on

Physical Electronics; the 1957 conference of the Hydraulics Division of the American Society of Civil Engineers; the annual Scanlon Plan Conference, held this past year after being omitted the previous year; the annual meeting of the Electron Microscope Society of America, which brought five hundred visitors and extensive technical exhibits to Kresge; a national conference on increasing highway engineering productivity; and the two-day meeting of the Northeast Conference on the Teaching of Foreign Languages, with some nine hundred delegates in attendance. At the beginning of the 1956 fall semester, the Admissions Office held its first Secondary School Guidance Conference, attended by eighty-one guidance counselors from twenty-six states.

The Karl Taylor Compton Awards made this year to students for outstanding achievements fully illustrated our basic concept that learning must extend beyond the boundaries of classroom walls to include living and working with one's fellows. Among the various Compton Awards, I refer especially to two: one given to the Technology Dames, an organization comprising wives of M.I.T. students, for its work in integrating into our community life the wives of students scattered over the metropolitan area; and one made to the Graduate Management Society, an association of graduate students within the School of Industrial Management, for its successful program including orientation of new students, promoting fellowship through social contact, providing supplementary educational opportunities through speakers and discussion groups, and consolidation of student opinion. Six graduate and undergraduate students also won Compton Awards this year, including Jay D. Schmuecker '58, who worked unselfishly and successfully to create in the M.I.T. fraternity system a new attitude toward fraternity initiations.

THE NEW KARL TAYLOR COMPTON LABORATORIES

"The Karl Taylor Compton Laboratories recognize M.I.T.'s growing education and research responsibilities in the physical and engineering sciences . . . "



THE COMPUTATION CENTER OFFICIALLY OPENED WITH THOMAS J. WATSON, JR., PRESIDENT OF I.B.M., STARTING THE GIANT COMPUTER.

DR. VANNEVAR BUSH '16 AT DEDICATION CEREMONIES IN THE COMPTON LABORATORIES' MODERN AUDITORIUM.

THE FACILITIES OF THE COMPUTATION CENTER ARE SHARED WITH STUDENTS AND STAFF IN MANY NEW ENGLAND COLLEGES.

PROJECTORS FOR CLOUD CHAMBER PHOTOGRAPHS IN THE LABORATORY FOR NUCLEAR SCIENCE.

STUDIES IN MICROWAVE SPECTROSCOPY IN THE RESEARCH LABORATORY OF ELECTRONICS

A STATISTICAL ABSTRACT

In 1956–57 the student body numbered 6,000 as compared with 5,648 in 1955–56. We estimate that enrollment this fall will be about 6,300. Veterans numbered about 8 per cent of the total enrollment in 1956–57 as compared with 6 per cent the year before. In 1956–57, 18 per cent of our students were married, the same percentage as the previous year. One hundred and twenty-nine women were enrolled, sixty of whom were graduate students.

Enrollment in the graduate school was 2,312. There were 136 officers from the United States Armed Services enrolled for advanced degrees.

Students enrolled at M.I.T. during 1956–57 held degrees from 465 other colleges and universities, 289 American and 176 foreign.

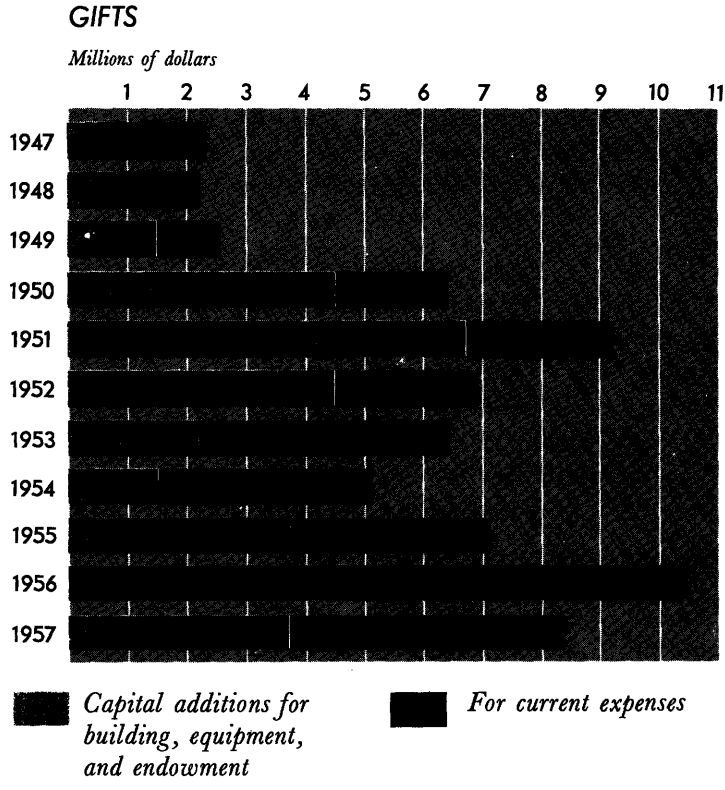
GIFTS

Gifts during the past year amounted to $8,498,000, a decrease of nearly $2 million from last year's record high. Those gifts for endowment purposes totaled $2,381,000, including substantial gifts from the estates of Mary C. Emory, Arthur E. Fowle '93, Glenn L. Martin, and Henry Warren '94 and $1,423,500 received from the Ford Foundation for support of faculty salaries.

Gifts for buildings amounted to $731,000, with major support for the Compton Laboratories and the nuclear reactor contributed by the Kresge Foundation and the National Science Foundation. Substantial aid was also received from the Godfrey M. Hyams Trust, the United Fruit Company, and the Westinghouse Educational Foundation.

The Alumni Fund in the past year established new records in both total amount given and in number of contributors, listing $641,371 as donated by 12,069 individuals. Of the total amount, $356,179 was credited to the Alumni Fund for further designation by its Fund Board; $285,192 was credited directly to funds for purposes specified by the donors.

Gifts available for current use, but temporarily invested amounted to $1,330,000. Corporate support of the Industrial Liaison Program totaled $1,293,000, a record for the Institute.

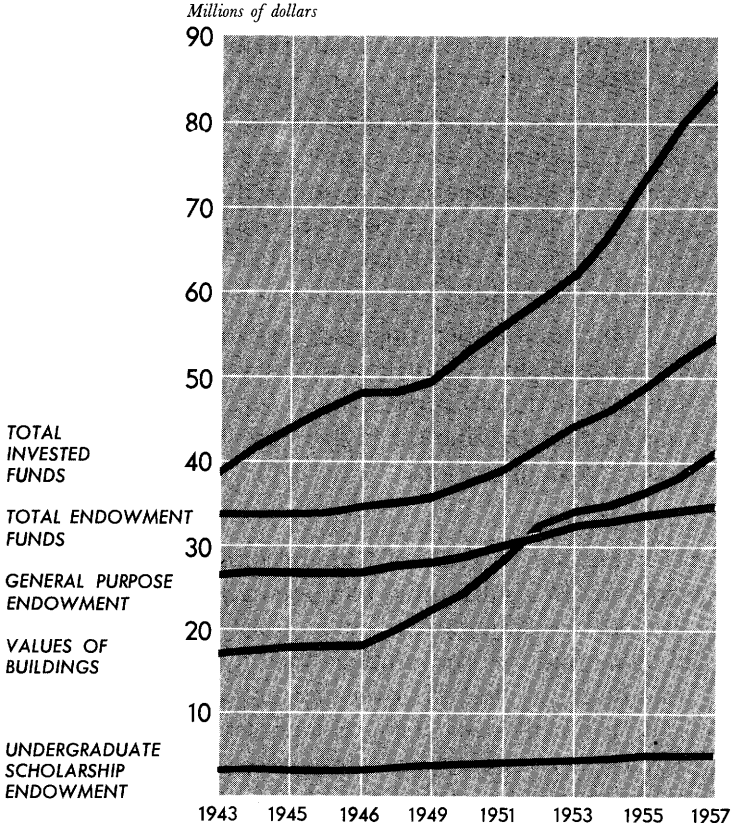


FINANCES

During 1956–57 our academic expenses amounted to $19,489,000, compared with $17,099,000 in the fiscal year 1955–56. These figures for academic expenses do not include the funds expended on projects under the Division of Sponsored Research.

Sponsored research this past year represented an expenditure of $49,118,000, an increase of 15 per cent over the preceding year. Of this approximately $41,000,000 went for the support of the Lincoln Labora-

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



tory and the Instrumentation Laboratory. Many of the sponsored research projects are closely integrated with the teaching programs of the academic departments and materially contribute to their operations, particularly at the graduate level. A substantial portion of the Institute's general, administrative, and plant operating expense is made up of indirect costs of activities required by the sponsored research program; these costs are covered by the overhead received under our contracts.

The Institute's endowment and other invested funds now have a total book value of $85,314,000, an increase over last year of $5,924,000. These are invested in securities with a market value of $128,086,000 as of June 30. Educational plant assets stand at $41,309,000, about $3,329,000 greater than last year.

The rate earned in 1956–57 on the book value of the funds sharing total income of the general investments was 6.14 per cent, compared to 6.29 per cent last year. Of this, 5.5 per cent was allocated to the funds, compared with 6 per cent last year and 4.5 per cent the year before.

Total plant operating expenses increased this year to $3,136,000 from $3,014,000 in 1955–56. Most of the change was due to regular operating expenses of new building facilities and the higher costs of building maintenance and operations.

STUDENT AID

With a tuition increase of $200 becoming effective July, 1956, we felt a substantial increase in assistance to needy students was imperative. It is gratifying to note that financial aid to the student body during this year amounted to slightly over $2 million, an increase of 33 per cent over the previous year. This marked increase was due to the cumulative effect of several important factors, including grants from Institute funds,

from the M.I.T. Alumni Fund, and from other sources.

Total financial assistance to the student body, including salaries paid to graduate students for teaching and research, amounted to 47 per cent of total tuition payments received by the Institute. Probably one-half the members of our student body have received aid in one form or another during the past year.

Financial assistance to undergraduates totaled nearly $1,400,000, bettering by 40 per cent the amount of assistance furnished during the previous academic year. Specifically, $629,188 was awarded in scholarships; $358,252 was granted in loans; and $407,445 was earned in part-time employment around the campus.

At the same time, financial assistance to our graduate students has increased by 28 per cent over the previous year. Grants from industry have generally followed the pattern of providing graduate students with aid to cover a portion of their living costs as well as full tuition.

In all, the Institute awarded to its graduate students during the past academic year 204 fellowships with grants totaling $381,570, and 109 scholarships valued at $115,535. Including staff awards for teaching and research assistantships, our total grants last year amounted to $681,803, nearly $150,000 more than the previous year.

The marked increase in financial assistance reflects the national interest in helping qualified young people obtain an education. This is particularly true of foundations and corporations. This fall, sixty-one freshmen will enter the Institute under the sponsorship of the nation's two largest programs, the General Motors National Scholarships and the National Merit Scholarships. During the coming year the Alfred P. Sloan Foundation, Inc., will increase by 13 per cent the scholarships available to each class under its pro-

gram; we will eventually have fifty-two Sloan Scholars in our undergraduate student body, as compared with thirty-six at the present time. In addition, a number of companies have their own aid programs assisting undergraduates at the Institute.

I should like to make special reference to the contributions of M.I.T. alumni in support of scholarship funds during the past year. Slightly more than $300,000, representing an increase of 6 per cent in total support, was added to the undergraduate scholarship endowment by individual, class, and regional funds. The Alumni Fund Board generously contributed $50,000 to enable fifty-three outstanding young people to enter the Institute as members of the Class of 1960. An additional $35,000 was voted by the Board to continue the support of these students during the academic year. In April, 1957, the Alumni Fund Board approved the establishment of the M.I.T. Alumni Fund National Scholarships, with an appropriation of $100,000 to finance four years of education for outstanding young men and women. Twenty-three members of the Class of 1961 will enter this September holding Alumni Fund National Scholarships, marking the first time the Institute has financed its own national program. All this help is most timely, and we are deeply grateful to the alumni for their loyal support.

The increase in scholarship aid should not overshadow the substantial assistance made available by our loan funds. The total loaned this year reached a new high of $450,587 to graduate and undergraduate students. Ninety per cent of those applying for aid during the past year received support from these sources. It gives me great pride to report that since the start of the Technology Loan Fund, some $4,152,916 has been lent to students.

IN CONCLUSION

In presenting this report, I am the voice speaking in behalf of many associates and the medium for expressing their ideas and accomplishments. I acknowledge with deep appreciation the dedicated services of Corporation, faculty, administration, students, and alumni. Their "efficacious management of our common concerns" keeps our institution moving steadily ahead.

In conclusion, I speak without any possible invidious distinction of one colleague, Chancellor Julius A. Stratton. His leadership and wisdom are priceless assets of this institution.

Respectfully submitted,
J. R. KILLIAN, JR.
President

October 7, 1957

PERSONNEL CHANGES THROUGH SEPTEMBER 15, 1957

CORPORATION

DEATHS

Harry J. Carlson, *Emeritus Life Member*
William C. Potter, *Emeritus Life Member*
William Emerson, *Life Member*
Redfield Proctor, *Life Member*

TERM EXPIRATIONS

George W. Merck, *Special Term Member*
Everett S. Coldwell, *Alumni Term Member*
Alfred T. Glassett, *Alumni Term Member*
Theodore T. Miller, *President of Alumni Association*
Hon. Christian A. Herter, *Governor of the Commonwealth*
John J. Desmond, Jr., *Commissioner of Education*
Admiral Edward L. Cochrane, *Vice President for Industrial and Governmental Relations*

APPOINTMENTS

Vannevar Bush, *Chairman*
Major General James McCormack, Jr., *Vice President for Industrial and Governmental Relations*
William L. Stewart, Jr., *Life Member*
Thomas J. Watson, Jr., *Special Term Member*
Charles A. Chayne, *Alumni Term Member*
Theodore T. Miller, *Alumni Term Member*
Clarence L. A. Wynd, *Alumni Term Member*
Gilbert M. Roddy, *President of Alumni Association*
Hon. Foster Furcolo, *Governor of the Commonwealth*
Owen B. Kiernan, *Commissioner of Education*

FACULTY

APPOINTMENTS

VISITING

Charles Abrams, *Professor in City Planning*
Pierre Aigrain, *Webster Professor in Electrical Engineering*
Derek H. R. Barton, *Arthur D. Little Professor in Chemistry*
Laurits Bjerrum, *Professor in Civil Engineering*
Niels Bohr, *Compton Lecturer*
Armand Borel, *Professor in Mathematics*
Sherwood F. Brown, *Professor in Physics*
Lennart Carleson, *Professor in Mathematics*
Shing-Shen Chern, *Professor in Mathematics*
W. Phillips Davison, *Professor in Economics*
Howard W. Emmons, *Hunsaker Professor in Aeronautical Engineering*
Rollin D. Hotchkiss, *Professor in Biology*
William R. Hawthorne, *Institute Professor*

Hendrik S. Houthakker, *Professor in Economics*
Roman Jakobson, *Institute Professor*
Arthur R. Kantrowitz, *Institute Professor*
Roy Lamson, *Professor in Humanities*
M. S. Longuet-Higgins, *Professor in Mathematics*
Hans Meyerhoff, *Professor in Humanities*
William H. Miernyk, *Professor in Economics*
Lewis Mumford, *Bemis Professor in Architecture*
Giulio Pizzetti, *Professor in Civil Engineering*
Huston C. Smith, *Professor in Humanities*
Harry G. Rhoden, *Associate Professor in Mechanical Engineering*
Fritz Ursell, *Associate Professor in Civil Engineering*
Peter F. Blackman, *Assistant Professor in Mechanical Engineering*
Kenneth A. Fegley, *Assistant Professor in Electrical Engineering*
Jurgen Moser, *Assistant Professor in Mathematics*
Barrett O'Neill, *Assistant Professor in Mathematics*

PROFESSORS

Irving Kaplan, *Nuclear Engineering*
Cyrus Levinthal, *Biology*
Francis E. Low, *Physics*
Claude E. Shannon, *Electrical Engineering and Mathematics*

ASSOCIATE PROFESSORS

Roger W. Brown, *Economics*
Robert H. Cannon, Jr., *Mechanical Engineering*
John B. Hersey, *Geology and Geophysics*
Philip Mandel, *Naval Architecture and Marine Engineering*
Edward A. Mason, *Chemical Engineering*
William W. Seifert, *Electrical Engineering*
William S. von Arx, *Geology and Geophysics*

ASSISTANT PROFESSORS

Denys O. Akhurst, *Electrical Engineering*
Edward Arthurs, *Electrical Engineering*
Judson R. Baron, *Aeronautical Engineering*
Francis M. Bator, *Economics*
Arthur J. Boucot, *Geology and Geophysics*
Allan H. Bonnell, *Chemical Engineering Practice*
Davis J. Chambliss, *Economics*
Frank B. Cuff, Jr., *Metallurgy*
Chadwick J. Haberstroh, *Industrial Management*
George F. Hadley, *Industrial Management*
Fenno Hoffman, *Humanities*
Henry Hornik, *Modern Languages*
Kerson Huang, *Physics*
Hans Mark, *Physics*
Winston R. Markey, *Aeronautical Engineering*
Henry P. McKean, Jr., *Mathematics*
Perry A. Miles, *Electrical Engineering*
Marvin L. Minsky, *Mathematics*
Jose Navarro, *Metallurgy*

Stanislaw Olbert, *Physics*
David C. Pridmore-Brown, *Mechanical Engineering*
Robert O. Preusser, *Architecture*
Daniel B. Ray, *Mathematics*
Warner R. Schilling, *Economics*
David A. Thomas, *Metallurgy*
Wallace E. Vander Velde, *Aeronautical Engineering*
Arnold R. Weber, *Economics*
Robert C. Wood, *Economics*
Joseph V. Yance, *Industrial Management*

PROMOTIONS

TO PROFESSOR

Warren Ambrose, *Mathematics*
Robert L. Bishop, *Economics*
John M. Blum, *Humanities (Resigned June 30, 1957)*
Bernard T. Feld, *Physics*
Robert J. Hansen, *Civil Engineering*
Harold S. Mickley, *Chemical Engineering*
Rene H. Miller, *Aeronautical Engineering*
Walter A. Rosenblith, *Electrical Engineering*
George E. Valley, Jr., *Physics*
George W. Whitehead, *Mathematics*
William A. Wilson, *Mechanical Engineering*

TO ASSOCIATE PROFESSOR

Nesmith C. Ankeny, *Mathematics*
Walter A. Backofen, *Metallurgy*
Raymond F. Baddour, *Chemical Engineering*
William H. Dennen, *Geology and Geophysics*
David J. Epstein, *Electrical Engineering*
David A. Huffman, *Electrical Engineering*
Thomas B. King, *Metallurgy*
William L. Kraushaar, *Physics*
Leo B. Moore, *Industrial Management*
John F. Nash, *Mathematics*
Norman A. Phillips, *Meteorology*
Lucian W. Pye, *Economics*
Robert R. Rathbone, *Humanities*
J. Lowen Shearer, *Mechanical Engineering*
Kenneth N. Stephens, *Electrical Engineering*

TO ASSISTANT PROFESSOR

James H. Brown, *Metallurgy*
Walter F. Cannon, *Humanities*
Stanley E. Charm, *Food Technology*
F. Albert Cotton, *Chemistry*

John Dugundji, *Aeronautical Engineering*
George J. Fuld, *Food Technology*
Brison D. Gooch, *Humanities*
S. William Gouse, *Mechanical Engineering*
Edward Herbert, *Biology*
Robert A. Lauderdale, Jr., *Civil Engineering*
Norman H. Meyers, *Electrical Engineering*
William R. Moore, *Chemistry*
Stylianos D. Pezaris, *Electrical Engineering*
Roger W. Prouty, *Humanities*
James E. Roberts, *Civil Engineering*
Robert A. Schluter, *Physics*
Campbell L. Searle, *Electrical Engineering*
Richard D. Thornton, *Electrical Engineering*
Nathan S. Wall, *Physics*
John M. Wozencraft, *Electrical Engineering*

CHANGES OF APPOINTMENT

Frederick J. Adams, *to Professor in City Planning*
Richard L. Balch, *to Associate Professor in Physical Education and Director of Athletics*
Douglass V. Brown, *to Acting Associate Dean of the School of Industrial Management*
E. Neal Hartley, *to Acting Head of the Department of Humanities*
Henry G. Houghton, *to Director of the Laboratory of Earth Sciences*
John T. Howard, *to Head of the Department of City Planning*
Irwin W. Sizer, *to Head of the Department of Biology*
Robert M. Whitelaw, *to Assistant Professor in Physical Education and Director of Physical Education*

DEATHS

Murray P. Horwood, *Professor in the Medical Department and Director of Sanitation*
William Emerson, *Professor Emeritus in Architecture*
Lauren B. Hitchcock, *Professor Emeritus in Mathematics*

RETIREMENTS (WITH TITLE PROFESSOR EMERITUS)

William H. McAdams, *Professor in Chemical Engineering**
George Scatchard, *Professor in Chemistry**
William E. Stanley, *Professor in Civil Engineering**
Avery A. Ashdown, *Associate Professor in Chemistry**
Arthur R. Davis, *Associate Professor in Chemistry**
Arthur L. Townsend, *Associate Professor in Mechanical Engineering**
Charles M. Wareham, *Associate Professor in Chemistry*
Walter L. Whitehead, *Associate Professor in Geology*
Walter C. Eberhard, *Assistant Professor in Mechanical Engineering**
Herman Klugman, *Assistant Professor in Modern Languages**

*Appointed Lecturer for 1957–58.

RESIGNATIONS

Richard S. Bear, *Professor in Biology*
Marshall G. Holloway, *Professor and Director of Lincoln Laboratory*
John A. Hrones, *Professor in Mechanical Engineering*
Francis W. Sears, *Professor in Physics*
John E. Arnold, *Associate Professor in Mechanical Engineering*
Raymond A. Bauer, *Associate Professor in Economics*
William Van A. Clark, Jr., *Associate Professor in Industrial Management*
Albert R. Kaufmann, *Associate Professor in Metallurgy*
Joseph C. R. Licklider, *Associate Professor in Economics*
Thomas H. Pigford, *Associate Professor in Chemical Engineering*
George P. Shultz, *Associate Professor in Economics*
Harl P. Aldrich, *Assistant Professor in Civil Engineering*
Theodore S. Baer, *Assistant Professor in Humanities*
Norman Beecher, *Assistant Professor in Chemical Engineering*
Richard C. Booton, *Assistant Professor in Electrical Engineering*
Elery F. Buckley, *Assistant Professor in Electrical Engineering*
Jack B. Chaddock, *Assistant Professor in Mechanical Engineering*
John A. Clark, *Assistant Professor in Mechanical Engineering*
Edward S. Cohen, *Assistant Professor in Chemical Engineering*
Floyd E. Gillis, Jr., *Assistant Professor in Industrial Management*
Werner H. Gumpertz, *Assistant Professor in Civil Engineering*
Robert A. Hard, *Assistant Professor in Metallurgy*
George R. Healy, *Assistant Professor in Humanities*
Herbert M. Jenkins, *Assistant Professor in Economics*
Sidney Lees, *Assistant Professor in Aeronautical Engineering*
Roy Olton, *Assistant Professor in Economics*
Charles C. Reynolds, *Assistant Professor in Metallurgy*
Richard C. Sanborn, *Assistant Professor in Biology*
Herbert A. Shepard, *Assistant Professor in Economics*
Henry Sherman, *Assistant Professor in Food Technology*
Paul E. Smith, Jr., *Assistant Professor in Electrical Engineering*
Warren S. Torgerson, *Assistant Professor in Industrial Management*
John F. Twigg, *Assistant Professor in Mechanical Engineering*
Earle F. Watts, *Assistant Professor in Mechanical Engineering*
Roger W. Wescott, *Assistant Professor in Humanities*

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

APPOINTMENTS

Col. Gilbert G. Brinckerhoff, Jr., *Professor and Head of the Department of Military Science*
Capt. Osborne S. Cox, *Associate Professor in Military Science*
Major John E. Keator, *Associate Professor in Air Science*
Major Tracy E. Mulligan, *Associate Professor in Military Science*
Lt. Col. LaMonte A. Tucker, *Associate Professor in Military Science*
Comdr. Robert A. Weatherup, *Associate Professor in Naval Science*
Lt. Herbert O. Burton, *Assistant Professor in Naval Science*
Capt. Norman A. Jolie, *Assistant Professor in Air Science*
Capt. John Mays, *Assistant Professor in Military Science*

Lt. Richard T. Remers, *Assistant Professor in Air Science*
Capt. Edward P. Stefanik, *Assistant Professor in Military Science*
Lt. Robert N. Strickland, *Assistant Professor in Air Science*
Capt. William W. Taylor, Jr., *Assistant Professor in Military Science*

RESIGNATIONS

Col. Charles M. McAfee, Jr., *Professor and Head of the Department of Military Science*
Lt. Col. Joseph S. Brinkley, *Associate Professor in Military Science*
Major William J. Keating, *Associate Professor in Military Science*
Major Vernon E. Robbins, *Associate Professor in Military Science*
Lt. Col. Sidney F. Wogan, *Associate Professor in Air Science*
Capt. Theodore R. York, *Associate Professor in Air Science*
Capt. Frederick W. Dederich, *Assistant Professor in Air Science*
Capt. Forest S. Gibson, *Assistant Professor in Military Science*
Lt. John G. Landers, *Assistant Professor in Naval Science*
Capt. Max N. Ruhl, *Assistant Professor in Military Science*
Capt. Willard D. Tease, *Assistant Professor in Air Science*

ADMINISTRATION CHANGES

APPOINTMENTS

Robert J. Davis, *Director of Union Relations*
Thaddeus W. Kowilcik, *Manager of Statistical Services*
Carl F. J. Overhage, *Director of the Lincoln Laboratory*
Kendall B. Randolph, *Industrial Liaison Officer*
Lamar Washington, Jr., *Industrial Liaison Officer*
Richard W. Willard, *Statistical Analyst*

RETIREMENTS

Admiral Edward L. Cochrane, *Vice President for Industrial and Governmental Relations**
John J. Rowlands, *Director of the News Service*

*Appointed Special Assistant to the President for 1957–58.

RESIGNATIONS

Frank M. Baldwin, *Director of Dining Services*
Joe Jefferson, *Placement Officer*
Harold R. Lawrence, *Industrial Liaison Officer*
Ralph L. Wentworth, *Industrial Liaison Officer*

CHANGES OF APPOINTMENT

Professor James M. Austin, *to Director of Summer Session*
Professor Francis Bitter, *to Associate Dean of the School of Science*
Professor Lynwood Bryant, *to Director of the Technology Press*
Admiral Edward L. Cochrane, *to Special Adviser to the President*
Paul V. Cusick, *to Comptroller*
Harold E. Dreyer, *to Coordinator of Personnel Services*

Carl F. Floe, *to Administrative Vice Chancellor*
Thomas W. Harrington, Jr., *to Placement Officer*
Joe Jefferson, *to Placement Officer (later resigned)*
James G. Kelso, *to Executive Assistant to the President*
Bruce F. Kingsbury, *to Assistant Director of the Physical Science Study Project*
Malcolm G. Kispert, *to Administrative Vice Chancellor*
Major General James McCormack, Jr., *to Vice President for Industrial and Governmental Relations*
Albert F. Sise, *to Director of Salaried Personnel Relations*
Philip A. Stoddard, *to Vice Treasurer*
Professor J. Edward Vivian, *to Faculty Assistant to the Vice President for Industrial and Governmental Relations*
Frederic W. Watriss, *to Assistant Treasurer*
Warren D. Wells, *to Associate Registrar*

SCHOOL OF ARCHITECTURE AND PLANNING

The aims of architecture and planning are both technological and humanistic. At an early stage our students are induced to investigate every possible solution of a problem in the light of their knowledge of facts and in accordance with natural laws of structural behavior, yet with sympathetic and creative consideration for the demands of the human spirit. Our educational aim is to lead them to discover for themselves that in architecture there are no ready-made rules; that decisions must rest rather on wisdom, the search for which will last a lifetime — a wisdom which has roots in the past but feeds on the present. So knowledge and imagination — that is, the discipline of facts and the excitement of ideas — play an equal part, giving students a sense of motivation and establishing for them standards and values which will serve them well through a lifetime.

Of course, the ideals which the School tries to set for itself, even if clearly stated, are seldom attained in full; the means to achieve them need constant reviewing in the light of a changing world and of other limiting circumstances. Furthermore, we are dealing with young students of various degrees of aptitude, background, and interest — few of them mature or motivated. It would be ideal if we could apply in full the energies of our staff towards educating only the talented, but up to now we have had no sure way to discover them. An attempt to do so with architectural students began last year through the efforts of the American Institute of Architects and the Association of Collegiate Schools of Architecture. The results will not be known for some time, but we hope that they will be useful in the future in screening the most promis-

ing students and permitting the less gifted to enter other more congenial fields. The advantages of selecting students are most obviously shown in our graduate year, where for many years we have been allowed to choose the best people from the United States and foreign countries and have created a most favorable educational climate. Last year we had over eighty applications for twenty openings in architecture and a similar ratio for the fifteen openings in city planning. As usual these were brilliant classes, whose members at graduation were eagerly sought by the relative professions.

In architecture the question comes up repeatedly whether we should concentrate our resources on the graduate class at the expense of the undergraduates, as has already been done in city planning. We have a great responsibility to educate as many graduate students as we can, because in this field our position is really unique; whereas many other schools contribute to the supply of undergraduates, and our concern should be to educate only the best. In the last two or three years there has been increasing dissatisfaction with the level of independent design ability achieved by the candidates for the Bachelor in Architecture and a growing conviction that the School would be better if the weaker students could be more effectively kept out of the upper years. The best bachelor's students are, however, often very good indeed, and a significant number of mature students enter with advanced standing and usually do well in professional work. If we could eliminate the unfit undergraduates, we might somewhat increase the number of graduate students without any increase of space or staff. This would be operating on the principle of deploying our effort as far as it will go among the most gifted students available, no matter at what level they are to be found. It is also assumed that the same faculty can be effective at elementary and advanced levels. But in order to prune the undergraduate Course, we would have to do two things: set up special testing procedures on top of regular Institute tests, and become very much tougher in grading in the early years of design. Even so, we would certainly be hard put to reduce enrollment greatly, especially in view of the increasing number of college transfer applications. It would also be undesirable to have the classes too small. We do think the undergraduate school needs to be improved by both greater fluidity in disqualification and greater ease in accepting visually gifted

candidates. Perhaps the Course should be divided, with two or three years of general education and introduction to architecture followed by a two-year stint of concentrated work. These last two years would concentrate on design and other professional work, a program to which the bachelor's graduates from other institutions could be admitted with some deficiencies. Some reduction in numbers might accompany such a revision.

TEACHING PROGRAM — ARCHITECTURE

The Department offered two summer programs, one dealing with The Artist, Materials and Technology and conducted by Professor Richard Filipowski, and the second on Plastics in Building, conducted by Richard W. Hamilton and Professor Marvin E. Goody, in cooperation with the Section of Building Engineering and Construction; both were well attended and successful.

New York City housing expert Charles Abrams, under appointment with the Department of Economics, gave a subject in Building Economics, a new architectural elective.

During the year the Faculty of the Institute approved the humanities electives in Visual Arts (Field 10), to be given by Professors Albert Bush-Brown and Robert Preusser. One subject offers opportunity to participate in drawing and painting, the objective being to acquaint students with visual values and their broad applications. Involvement in the creative process clarifies the relation of art experience to scientific and engineering pursuits. Confidence and ability to create visual form will be developed through participation in the studio. Supplementary seminars and demonstrations related to studio problems and projects will further encourage perceptual awareness and powers of discrimination, judgment, and analysis of nonverbal experience. In addition to the studio work, weekly lectures will give a comprehensive understanding of art in human experience and its contribution to an aesthetically satisfying visual environment. The other subject is in history and criticism; it will acquaint students with the great paintings, sculpture, and architecture of the past. The principal intent of this subject is to develop capacity for making objective critical judgments upon quality in art and to relate the visual arts to the intellectual, emotional, and social disposition of their creators. Two illustrated lectures will be given each

week, the third meeting being reserved for small group conferences in which students discuss topics raised by the lectures and reading. Field trips to important sites and to museums will be conducted each semester.

Graduate status was given to the subjects in Theory of Architecture and Architectural Criticism.

TEACHING PROGRAM — CITY PLANNING

The Department of City and Regional Planning has had a very active year both in teaching and research. With twenty-five regular students and seven special students during the second term, enrollment in the two-year graduate Course in city and regional planning reached a new peak. Drafting room facilities were used to capacity, and in certain lecture subjects some restriction had to be placed on the number of students from Harvard registering under the cooperative arrangement between the two institutions. Similar pressure on available classroom and drafting room space next year is indicated by the fact that approximately sixty applications for September admission as regular graduate students had been received by June 1, although there will be room for not more than fifteen first-year students. Foreign students made up about one-quarter of the class during the past year; the countries represented included the United Kingdom, Sweden, Uruguay, Mexico, Greece, Burma, and Indonesia.

A new graduate elective subject, Theory of City Form, was offered in the second term by Professors Kevin Lynch and Lloyd Rodwin, and Professor Rodwin continued his collaboration with Professor Charles Haar of the Harvard Law School in conducting a seminar during the first term on Land Use Problems in Developing Areas. Lawrence K. Frank's seminar in Human Dimensions of Planning, first given in 1955–56, was offered again during the past year.

RESEARCH ACTIVITIES

The research project for Monsanto Chemical Company on the design of an experimental plastic house has been completed and the house has been built in California.

The design of the solar house has been completed and construction begun in Lexington, Massachusetts.

Professors Kevin Lynch and Gyorgy Kepes have continued their research work on the perceptual form of the city

under a grant from the Rockefeller Foundation, which has recently been extended for a further two years.

ADDITIONS TO STAFF

The regular staff of the School of Architecture and Planning was joined by many lecturers from the United States and abroad, stimulating to both students and staff.

The Department of City Planning was fortunate in having Dr. C. A. Doxiadis of Athens, Greece, as a Bemis Visiting Lecturer in City Planning during the latter half of the second term. Dr. Doxiadis, who is an internationally known expert in the field of housing and planning, presented a series of lectures on his concepts of urban and regional planning and their application to specific projects which his firm has carried out in Iraq and Pakistan.

Last year's architectural graduate students had as their thesis advisers during the summer Minoru Yamasaki, eminent architect from Detroit; Paul Rudolph, recently appointed Chairman of the Department of Architecture at Yale University; Roy Jones, former Dean of the School of Architecture of the University of Minnesota; Samuel Homsey, architect from Delaware; and Ronald Brunskill of England and Nathan Shapira of Israel, Visiting Fellows sponsored by the Commonwealth Fund.

The Department of Architecture was happy to welcome to its permanent staff in the fall Professor Eduardo Catalano and Bruno Leon. They both came to us from the University of North Carolina and had worked together there. Professor Catalano is a dedicated teacher and an active and gifted designer.

We were fortunate to have with us as Visiting Bemis Professor of Architecture for the year Robin Boyd of Melbourne, Australia, practicing architect, lecturer, and author.

As Visiting Lecturers in Architecture this year we had Oskar Stonorov of Philadelphia; John Harkness of Cambridge; and Bernard Rudofsky of New York, who, besides teaching design to our graduate class, delivered some excellent lectures on Japanese architecture.

We again participated in the exchange program with the Royal Academy of Fine Arts of Copenhagen — Professor Lawrence B. Anderson, Head of the Department of Architecture, spent the spring term in Denmark; the Academy's department head, Professor Kay Fisker, spent the term at M.I.T.

STAFF ACTIVITIES

Professor Frederick J. Adams has asked to be relieved of his administrative duties as Head of the Department of City and Regional Planning in order that he may devote more time to study and research and compilation of material. We are happy that he will still be a Professor in the Department and will be available for his most valuable advice.

Professor John T. Howard, who was appointed to succeed Professor Adams as Head of the Department, presented papers during the past year on various aspects of city planning at conferences of the American Association of Scientific Workers, the Narragansett Section of the American Institute of Planners, the American Society of Planning Officials, and the Brookline Community Council. He also took part in panels on regional planning over local radio and television stations.

Professor Roland B. Greeley served as chairman of a session on neighborhood planning at the annual conference of the American Society of Planning Officials held in San Francisco last March and has continued to serve as vice-chairman of the Research Division of the United Community Services of Greater Boston. He also was in charge of the Special Summer Program in City and Regional Planning, which has been offered annually by the Department since 1938.

Professor Burnham Kelly served as part-time Visiting Lecturer at the University of Michigan during the past year, where he helped to prepare the ground for the creation of a substantially enlarged program in urban planning. He has also been in charge of a study of the problems of the producer of housing for the American Council to Improve Our Neighborhoods (ACTION), assisted by a team consisting of Robin Boyd, Bernard Spring, and Carl Koch of the Department of Architecture; Werner Gumpertz, James Murray, and Albert Dietz of the Department of Civil and Sanitary Engineering; and Hideo Sasaki and John Dunlop of Harvard University.

Professor Lloyd Rodwin served as consultant to the United Nations on the relationship of economic and physical development in developing areas; to the Puerto Rico Housing Authority on the Self-Help Housing Research Program; and to the Puerto Rico Planning Board on general policy and organization. He also presented a paper on economic aspects

of regional planning at the annual meeting of the Regional Science Association.

Professor Frederick J. Adams spent the month of February in India; here he was consultant to the United Nations on a study of problems of regional development in the areas surrounding three towns being built by the Ministry of Iron and Steel for workers in the new steel mills now under construction.

Henry A. Millon will take a leave of absence for a year, having won a fellowship to the American Academy in Rome and a Fulbright Award to Italy, both in the area of architectural history.

Bernard P. Spring was selected to participate in the Voorhees, Walker, Smith, and Smith summer office-experience program for teachers during the summer of 1957.

Reginald K. Knight, who has been on a leave of absence during this past year, was the winner of an international architectural competition for the Enrico Fermi Memorial Pavilion in Chicago.

This year the American Institute of Architects celebrated its centennial year; the convention was held in Washington, D. C. Dean John E. Burchard of the School of Humanities chaired one of the meetings and Dean Pietro Belluschi gave the closing address. Professor Albert Bush-Brown has been collaborating with Dean Burchard in preparing the A.I.A. social history of American architecture in honor of this event, and it will be published in December, 1957.

Miss Caroline Shillaber, Head Librarian of the Rotch Library of the School of Architecture and Planning, was selected to serve as consultant in establishing a new library for the architectural engineering firm of Doxiadis Associates in Athens, Greece, and also for their branch in Bagdad; she travelled to Greece this winter in connection with this project. The School would like to recognize formally the excellent cooperation and efficient service it receives from the library of which Miss Shillaber is in charge.

STUDENT HONORS

Thymio Papyannis of Greece, one of our undergraduate students in architecture, was elected the first president of the new National Association of Students of Architecture, which is

sponsored by the American Institute of Architects. He has done an outstanding job of organizing this long-needed association.

Jacques Binoux, Grunsfeld Fellow from France and a candidate for the Master in Architecture degree, won the 1957 Thesis Award of the National Institute for Architectural Education for his thesis entitled "A Stratoport." Thirteen schools from ten different states participated in this competition.

We are proud of the fact that eight graduating students of the School won Fulbright Awards to Europe, and also of the fact that one of our graduate students this year, Hanford Yang, won first prize in a national competition with his design for a home for the aged. Another national competition for the design of a plastic house was won by one of our undergraduate students in architecture, William Goodwin; third prize was won by John Dyal, and five other students in architecture won prizes or mentions in the same competition.

CITY PLANNING VISITING COMMITTEE

The recommendation of the Burdell Committee that a separate Visiting Committee be appointed for the Department of City and Regional Planning was implemented by the administration in October. A strong committee was appointed and at its first meeting, on April 8, 1957, the members voted to endorse the proposals of the Burdell Committee for the expansion of the Department's research program through the establishment of a Center of Urban and Regional Studies and of a Ph.D. program in planning. The Committee hopes to meet again in the fall to consider other aspects of the Department's teaching and research program.

CITY PLANNING ALUMNI MEETING

The Department of City and Regional Planning, second oldest in its field, has an alumni body of over two hundred — the largest number of any planning school. On the initiative of a group of former students, an Alumni Weekend was held at the Institute in October; nearly sixty former students, some accompanied by their wives, came together to discuss some of the problems facing the School and the profession. During the course of the proceedings, action was taken to set up a permanent organization to provide a means whereby former students of the Department could maintain an active interest in its future development.

PIETRO BELLUSCHI

SCHOOL OF ENGINEERING

The nation's total number of graduates in engineering at all levels showed a gratifying increase for the year 1956, indicating that the efforts towards expanding engineering education are showing some results. Coupled with prospective reductions in military developments, this increase gives prospect of a much less acute situation in the shortage of engineers. However, there is a continued, intense need for men with advanced training. In particular, the problem of staffing the educational institutions in engineering continues to be a very difficult one.

The total enrollment in engineering at M.I.T. for the year 1956–57 was 3,693, representing 61.5 per cent of the Institute's student population. Of these, 1,352 were graduate students, showing a continued shift into graduate education in engineering. The situation with respect to the departments which have a numerically smaller undergraduate enrollment in engineering — Aeronautical Engineering and Metallurgy in particular — also appears to be correcting itself. Electrical Engineering continues to enroll the largest number of students, and there is no letup in the pressure for admission in this area. The Department of Electrical Engineering has initiated studies of means for limiting the growth of undergraduate enrollment, bringing into the open many perplexing problems of undergraduate engineering education. Some of these problems will be touched upon later in this report.

The School of Engineering has continued its efforts to find clearer precepts for a philosophy of engineering education. A meeting of the faculty of the School was held on October 27, 1956. The major part of the program was devoted to a discussion of the role of the engineering sciences in the curriculum, which indicated many conflicting attitudes within the School and showed that much work remains to be done before a clear synthesis of the entire complex of the engineering sciences will emerge. At this meeting the Dean announced the appointment of a Committee on Engineering Education, consisting of Professors Edwin R. Gilliland (Chairman), Laurens Troost, and Jerome B. Wiesner. This Committee has held many meetings with members of the faculty of the several departments in the School. A similar meeting has been scheduled for October 26, 1957, when the Committee will present its first interim report, and the faculty will have an opportunity for discussion of several major topics.

In terms of the number of graduates relative to other educational institutions, M.I.T. makes its greatest contribution to engineering education at the graduate level. The table below presents the statistics now available on the degrees which have been awarded at the doctorate level in the major fields of engineering since 1950. These figures indicate that M.I.T.'s accumulated participation since 1950 is 12.6 per cent. The

Summary of Degrees at the Doctorate Level in Engineering

	Total United States		*M.I.T.*			
			1950–56 Inclusive		*1956*	
	1950–56 Inclusive	*1956*	*Number*	*Per cent of total*	*Number*	*Per cent of total*
Aeronautical	211	36	31	14.7	4	11.1
Chemical	1,066	136	83	7.8	14	10.3
Civil and Sanitary	326	59	39	11.9	5	8.5
Electrical Engineering and Engineering Physics	965	153	97	10.1	19	12.4
Mechanical Engineering and Engineering Mechanics	618	77	81	13.1	11	14.3
Metallurgy	382	72	118	31.0	21	29.2
Total	**3,568**	**533**	**449**	**12.6**	**74**	**13.9**

statistics for 1956 show that this position is being more than maintained. These figures are about ten times larger than the corresponding percentages for our participation in the undergraduate field.

The activity in the professional engineer degree, initiated at M.I.T. a few years ago, shows a gradual growth. The total number of such degrees awarded is now 472, 61 of which were presented in 1957. More than half of these graduates were naval engineers; most of the remainder were in aeronautical, electrical, and mechanical engineering. While the doctor's degree is focused principally in the direction of research and scientific attainments, the engineer degrees have as their objective the development of competence along professional engineering lines. With the increasing need for true professional training in engineering, we expect that these degrees will play a much more important role; indeed, we hope that eventually they may come to be recognized on a national scale.

The training of highly qualified men at the doctorate level is clearly one of the most important tasks in engineering education. The majority of these men participate in both research and education during their years of graduate study and thus are poised for careers in either industry or education or both. No comprehensive statistics are yet available on the proportion of these men who pursue careers in engineering education, but a preliminary survey suggests that an appreciable number do so sooner or later, even under the present circumstances of intensive enticement from certain branches of industry.

The solution to our national shortage of faculties for engineering education clearly lies in the further expansion of graduate education. We believe that by limiting the size of our undergraduate body according to the availability of highly qualified teachers, some of whom are themselves in advanced training, we may make our most significant contribution to undergraduate education in engineering. Our objective here is to maintain a model undergraduate establishment where the dominating motive is quality rather than quantity.

The departmental reports, presented in a separate section of this report, indicate a considerable diversity of academic development in engineering, reflecting different demands of the various fields and the range of creative forces within the departments. This diversity in professional education is

clearly a sign of health. The coordination of the undergraduate and graduate programs within the departments and a greater degree of coordination among the departments in the early years of the undergraduate program present a variety of problems, which are the topic of a separate section of this report.

PERSONNEL

During the year the School of Engineering has greatly benefited from the participation of many distinguished visitors and additions to the staff, who have shared their knowledge with us as colleagues, seminar speakers, and lecturers.

The Jerome Clarke Hunsaker Professorship in Aeronautical Engineering was held by I. Edward Garrick, Chief of the Dynamic Loads Division at the Langley Laboratory of the National Advisory Committee for Aeronautics. In March, 1957, he presented the 1957 Minta Martin Aeronautical Lecture entitled, "Some Concepts and Problem Areas in Aircraft Flutter," a noteworthy contribution to the subject. The chair will be held by Dr. Howard W. Emmons of Harvard University during the coming year.

Under sponsorship of the Webster Professorship in the Department of Electrical Engineering, Dr. Pierre Aigrain, Professor of Physics at the Ecole Normale Supérieure in Paris, spent the month of May at the Institute. His lectures on "Electronic Processes in Solids" proved to be unusually stimulating.

These short-term appointments to the endowed professorships appear to be very effective in bringing to the Institute a series of distinguished men. Eventually we hope that they can be filled on a permanent basis.

Dr. Arthur R. Kantrowitz, Director of the Avco Research Laboratories, has accepted appointment as Visiting Institute Professor and Fellow of the School for Advanced Studies for the next academic year. Dr. Kantrowitz will begin his activities in the fall and will retain his connection with the Avco Manufacturing Company.

In the Department of Civil Engineering, Professor T. William Lambe of the Soil Mechanics Division was appointed Head of that Division. Dr. Karl Terzaghi served as part-time lecturer with the Soil Mechanics Division during the year, and Dr. Laurits Bjerrum, Director of the Norwegian Geo-

technic Institute, was Visiting Professor of Soil Mechanics during the spring term.

Retirements in the School of Engineering as of June 30, 1957, included Assistant Professor Walter C. Eberhard of the Department of Mechanical Engineering, Professor William H. McAdams of the Department of Chemical Engineering, Professor William E. Stanley of the Department of Civil Engineering, and Associate Professor Arthur L. Townsend of the Department of Mechanical Engineering. All of these men will remain on the staff as Emeritus Lecturers, and Professor Townsend will continue as Director of the Lowell Institute School as well.

FACILITIES

Perhaps the most immediate and urgent needs of the School of Engineering are for additional space, which is now the determining factor in planning further additions to our activities. This year has therefore been one of consolidation with respect to major facilities. For example, a consolidation of research in materials now being carried out will provide additional space for academic and research programs.

The work on the reactor has progressed satisfactorily, and this is discussed in detail in the section of this report devoted to chemical engineering.

We hope to make several major additions to the School when funds become available. Among these may be mentioned student commons rooms for electrical engineering and metallurgy; a fully equipped carriage for the towing tank in the Department of Naval Architecture; and a new shock tube in aeronautical engineering.

THE CHALLENGE OF PROFESSIONAL EDUCATION IN ENGINEERING

Present achievements give justifiable grounds for pride and assurance of progress in the future. Yet there are many aspects of engineering education which cause concern. Nationally, those institutions which restrict their efforts to undergraduate education face perplexing problems of staffing, which, coupled with increasing enrollments, cannot fail to weaken this part of our educational resources. Even in institutions which, like M.I.T., derive strength from graduate education and research, difficulties which we do not yet fully understand are emerging. Measured by the old standards our

progress seems satisfactory, but the requirements of the profession and the demands of the new generation of students appear to be developing faster than our rate of improvement.

At M.I.T. in particular, the program of graduate education and research has made striking progress in the past decade, and we succeed in attracting to this program a group of highly selected graduate students who on the whole show great devotion to their profession. We cannot make the same claim for the undergraduate program. Our undergraduate admissions system is rational and well organized; our student counseling has the benefit of much sincere effort and devotion from the staff; our standards of instruction have steadily improved; our facilities for extracurricular activities have shown steady growth. But in the face of all this we see signs in the undergraduate student body of discouragement, dissatisfaction, and disillusionment, which throws doubt on our ability to attract the best professional material or to stir our students to their best efforts. Young men are clamoring for admission to the engineering profession at a high rate, but we do not feel assured that we have succeeded in making effective use of the high degree of selectivity which this situation should promote.

There are good reasons to assume that these problems have been thrown into sharper relief by rising standards of professional performance rather than by any decline in the quality of the nation's youth. The development of graduate education has brought to us a larger group of professionally promising and devoted students. In this way the standard of performance which we expect of all students has been gradually raised.

The intensive competition for admission to higher institutions of learning throws increasing emphasis on the scholastic basis of selection, and it is possible that this process has reduced the emphasis on other traits of character equally significant to a professional career in engineering. The modern undergraduate is clearly superior to his predecessor in scholastic accomplishment, but we may question whether we are equally successful with respect to attitude and character development.

A national shortage of facilities for engineering education is another factor which has created problems. Students who have academic failures during the early years find it increasingly difficult to gain admission to another school. This situation adds to the responsibilities of the freshman admission

system, yet it is clearly difficult to assess professional promise on the basis of information available at freshman age.

In fairness to the modern engineering student, something should be said about the attitudes of the society for whose service he is preparing himself. The intensity with which current graduates are sought after by industry is a remarkable social phenomenon. Most undergraduates have several offers of jobs before graduation, and our young men would require superhuman strength of character not to be influenced adversely by this situation.

Our difficulties are not lessened by the fact that our society fails to accord the engineer as a professional man esteem comparable to the degree of its dependence upon him for sustenance and comfort.

These problems are of importance to other schools as well, but it is in the School of Engineering that the requirements of undergraduate and graduate education are in the most serious conflict. Since our contribution to the engineering profession in the United States through the undergraduate school is relatively small and is likely proportionately to decline further, we must justify our role in undergraduate education by exceptional performance; this requires a higher degree of selectivity of students than we are likely to achieve under the present system. How to maintain our leadership in professional graduate education and also build up an exceptional undergraduate program is one of the basic challenges which M.I.T. must face.

C. Richard Soderberg

AERONAUTICAL ENGINEERING

The Department of Aeronautical Engineering has experienced a most gratifying increase in undergraduate and graduate enrollment during the 1956–1957 academic year. This improvement, coupled with the continued strong demands for aeronautical graduates, is a good indication of the value of the Department's policy of educating the students to give a sound background in science as well as the broad viewpoint needed to take responsible charge of complex developments in either research or engineering.

The activities of the Department have been directed toward carrying out and improving already established policies rather than toward radical innovations in either methods or goals. Progress toward the objective of a strong faculty teaching a balanced pattern of out-in-front courses covering all the essential phases of aeronautics has continued. Several junior members have been added to the faculty, and efforts are being made to attract additional senior-level professors.

In order to keep the Department's teaching in the forefront of the rapidly changing fields constituting modern aeronautics, modifications in course subject matter have been accelerated during the past year; changes have taken place largely on the basis of faculty activities in sponsored research and contacts with industry. More attention in particular is being given to all phases of airborne guided missiles and ballistic missiles. Well-attended courses are being taught in the over-all engineering of missiles and orbital vehicles, with a balanced coverage of aerodynamics, structures, propulsion, and control. The study of vertical take-off aircraft and helicopters is also being stressed both in courses and in research projects. Future plans call for a strengthening of all of these regions, with more elective freedom for students who must carry out comprehensive engineering problems on some type of aeronautical vehicle.

Aerodynamic activities of the Naval Supersonic Laboratory, the Wright Brothers Wind Tunnel Facility, and the Fluid Dynamics Research Group have brought additional distinction to the Department during the past year. Contributions have been made in aerodynamic heating, in high-speed fluid dynamics, heat transfer, and in the flow of dissociating and ionizing gases. The work of the Fluid Dynamics Group is receiving world-wide recognition, and increasing numbers of students are being attracted from industry, other universities, and foreign countries.

The Aeroelastic and Structures Laboratory has continued its active programs in supersonic flutter, shock and impact, aeroelastic effects on helicopter blades, and gust loads. The new subject of aerothermoelasticity is absorbing a considerable proportion of the Laboratory's effort, with the probability that it will become increasingly important. High-temperature effects on structures due to aerodynamic heating and to radiation have been described in many reports and

publications that have reinforced the outstanding position of the Laboratory in this area of research.

The Gas Turbine Laboratory has continued to concentrate its efforts toward working out a basic understanding of the process of boundary-layer separation, particularly in turbomachinery. The Laboratory has achieved distinction in this field and is receiving financial support from a group of industrial and government organizations.

Measurement and control work has continued at a high level during the past year. Not only is the number of graduate students in this area increasing, but also engineers from many companies in the United States and foreign countries are visiting the laboratories to study, work on projects, and discuss control problems. The wide acceptance by industry and government services of recent developments, and the public recognition of the importance of contributions made by the Department, have been especially pleasing. The Optimalizing Cruise Control System designed in the Aerophysics Laboratory and built by a commercial firm is now being tested for use in long-range jet aircraft. The all-maneuver fighter-type flight control system developed in the Instrumentation Laboratory is being manufactured commercially. This Laboratory's basic contributions to inertial navigation — through the design, construction, and successful flight demonstrations of systems for long-range bombers and similar demonstrations of the Laboratory's submarine inertial navigation system — have been widely reported in newspaper and magazine articles. In addition, awards received by members of the Laboratory for inertial system work have added to an already long list of achievements recognized by the armed services and professional societies. The Instrumentation Laboratory is continuing to work in the forefront of control system developments and is now supplying manufacturing information for a number of components which are to be placed in production in the near future.

CHARLES S. DRAPER

CHEMICAL ENGINEERING

After much study the Department has recommended a significant change in policy in the undergraduate program; this proposal has received faculty approval and will become operative next fall. The primary purpose is to increase the choices of subjects available to the students by replacing many specified requirements with electives in the upper years. The new approach will place greater responsibility on the student for planning his future and will allow him more flexibility in preparing for graduate specialization in a variety of fields, such as chemical engineering, nuclear engineering, and the biological areas.

M.I.T.'s plans to offer outstanding graduate instruction in the new field of nuclear engineering are making excellent progress. Student interest is so great that numerous well-qualified applicants for admission, even including some holders of Atomic Energy Commission fellowships, cannot be accepted. We plan to restrict enrollment at about the present level of eighty to avoid excessive loads on staff and facilities. Many of these students want to continue to the doctorate, and we anticipate a marked growth in thesis research as the experimental facilities become available.

The Atoms for Peace Program, which was initiated by President Eisenhower and has now become a cardinal issue in international relations, directly affects our nuclear engineering operations. M.I.T. is rapidly gaining recognition here and abroad as the leading school for nuclear engineering education in the United States. A steady stream of visitors, including many foreign guests, come here to learn of our activities and plans. It seems likely that the present flood of applicants for admission will rise even higher. For example, when the new International Atomic Energy Agency establishes fellowships for the education of young scientists and engineers from all over the world, it may be anticipated that many of those selected will want to come to M.I.T.

This situation puts heavy responsibilities on us. As a private institution, we determine the selection and size of our student body. Yet our decisions will inevitably affect to some degree the programs of our State Department and Atomic Energy Commission and of the International Agency. These are problems of the near future which must be resolved with understanding and statesmanship.

A laboratory subject in Reactor Physics was initiated last February, using temporary quarters in the Chemical Engineering building. This Laboratory has now been transferred to the new Reactor Center on Albany Street, about one-third of a mile away. A notable experiment in this first subject was the construction of a sub-critical graphite pile by the students. The pile will have manifold uses and has already supplied data which will be useful in starting up the reactor next winter.

Construction of the reactor, which is known as the M.I.T. Research Reactor and abbreviated to MITR, is proceeding satisfactorily. It is expected to go critical by the end of 1957 and to be in full operation for research and educational use by the following April.

The Chemical Engineering Department has consistently emphasized the value of the one- to two-year graduate program leading to the Master of Science as the terminal degree. These Master of Science programs usually include a term in the Practice Schools. On the other hand, its policy on proceeding to the doctorate has been rather conservative, in that it desires full assurance that a man has both qualifications and true interest in research before he embarks on a doctoral thesis.

We believe that these basic policies are sound and should continue to guide our actions. However, graduate students today have a much greater interest in proceeding beyond the master's degree to the doctorate. This probably reflects the increased needs of industry for men with higher levels of training, as has been pointed out by the Department's Visiting Committee. The Department now has more men who are engaged almost entirely on doctoral thesis work than ever before, and the trend promises to continue. This is creating additional requirements for thesis supervision, especially for those members of the staff who are most active in research.

In recent years the research program has tended to move more into fields which were formerly regarded as classical physics, such as the molecular properties of gases, liquids, and polymers. Earlier enthusiasm for investigations of equipment performance has been replaced by more emphasis on basic studies of the mechanism of physical and chemical processes. The prime objective of the research program is educational: to develop the student's ability to specialize and to provide the creative atmosphere which is essential to good education.

The areas of research in the Department are determined chiefly by the interest of individual members of the staff and comprise widely diversified topics, from fluid mechanics to polymers, combustion, and organic chemistry. This diversity is suggested by the following samples of thesis investigations by present doctoral candidates:

Effect of Surface Active Agents on Crystal Growth and Crystal Habit.
Distillation Computations Using Whirlwind Computer.
Mechanism of Flow of Gases through Microporous Solids.
Boundary Layer Theory.
Radiant Heat Transfer through Absorbing Media.
Eddy Diffusion at Reduced Pressures.
Fission Products: Study of the Production of Individual Nuclides as a Function of Reactor Operation.
Effect of Polymer Crystallinity on Graft Polymerization.

The first award of the American Chemical Society in Industrial and Engineering Chemistry was presented this spring to Professor Warren K. Lewis. This award is granted "to stimulate fundamental research in industrial and engineering chemistry and in the development and application of chemical engineering principles to industrial processes." It fittingly recognizes Dr. Lewis' pre-eminence both in developing the profession of chemical engineering and in applying basic theory to the creation of new processes in the chemical and petroleum industries.

WALTER G. WHITMAN

CIVIL AND SANITARY ENGINEERING

In this age of ever-accelerating technological development, it may well be that the word "civil" in civil engineering is in need of a reinterpretation. In its original concept, "civil" pertained to the fact that in this branch of engineering the science and art of applying the forces and materials of nature were directed toward the benefit of the civilian population; and protection against the perils of nature, such as hurricanes, earthquakes and floods comprised a significant portion of its challenge. Today protection against man-made perils is becoming the more crucial aspect of civilian need. Each new technological advance carries with it the potential for either

fruitful use or frightful abuse. It is essential that one area of engineering center its attention on the impact of technology on our civilization and on the beneficial integration of technological advance to our culture; and this, I believe, constitutes the particular and overwhelmingly vital role of the civil engineer for the future.

We appear to be rapidly approaching a point where the survival of some of man's basic institutions and, indeed, of man himself, is becoming endangered. The impact of the automobile on the plight of our cities — of industry on the pollution of our lakes and streams and even of the air we breathe — of the airplane on the noise levels to which we are being subjected, are all examples of the ever greater need of applying science and technology to the improvement of man's environment.

Today this need, which has been gradually developing, is dramatically heightened by the urgent as well as almost insurmountable problems involved in seeking methods that will afford some degree of protection against the blast, heat, and contamination effects that will accompany the misuse of nuclear energy. It is becoming fully as important to employ technology to safeguard all that we hold dear as it is to direct our energies toward the further enhancement of technological advance itself.

To this end the civil engineer must have an understanding of modern science and technology so that he can use it as a weapon aimed at survival. But he must have more than this, for as soon as one attempts to harmonize the conflicting forces and tendencies that are bound to accompany the integration of technological advance into civilian needs, he finds that the so-called "engineering method," while frequently invaluable, has its limitations. Judgment, the ability to work with people, and skill in the communication of ideas — these all become relatively more important in civil engineering than in those areas of engineering that are primarily dedicated to technological advance.

The emphasis on excellence in undergraduate education which has keynoted the efforts of the Department of Civil and Sanitary Engineering for the past two years has again been a dominant feature in its operations during the past year. The early introduction of professional work, which challenges judgment and intuition as well as analytical ability and which

cuts across the boundaries of the humanities as well as of science, has continued — not only through the second-year subject in Civil Engineering Projects but also this year, for the first time, by means of a major revision in the introduction to structural engineering that takes place during the junior year. The rather revolutionary educational concepts that are being initiated in this program are beginning to attract national attention.

The Department has maintained its high level of research during the year. Among the projects under way, the Transportation and Surveying Division has designed an entirely new approach to integrating photogrammetric and electronic computer systems for semi-automatic data procurement, processing, and analysis. This system is based on the development of a digital model of a band of terrain that is stored directly on computer input material and taken directly from the stereoplotter. Any number of trial alignments and grade lines can be passed through a single set of terrain data, permitting an extremely high degree of flexibility and efficiency in evaluating a large number of location and design solutions.

The effects of earthquakes and explosions on structures can be studied at model scale only at the risk of uncertainties, one of the most important of these being the inability to represent the prototype gravity stresses at model scales. Should inexpensive and practical ways be developed for simulating gravity stresses, small-scale tests could be utilized for predicting the behavior of prototype structures. The Structural Division is studying this problem. It appears that prestressing techniques provide a practical means of creating the desired gravity stresses in a model.

A model study of a breakwater location for Newport, Rhode Island, is underway at the Hydrodynamics Laboratory. This investigation is aimed at determining the optimum location for a three-thousand foot breakwater to protect piers against wave action. Since this is to be the base for the Atlantic Destroyer Fleet, possible harbor pollution has to be considered. The breakwater location must, therefore, also take into consideration a minimum obstruction to the cleansing action of tidal currents. The model basin constructed for this project will serve for future basic studies of littoral drift, sediment transport, and of the intrusion of salinity into fresh-water estuaries.

JOHN B. WILBUR

ELECTRICAL ENGINEERING

For the third consecutive year, sophomore enrollment in electrical engineering ranged between 20 and 25 per cent of the total class. Freshman Course preferences in the spring of 1957 indicated a similar situation for entering sophomores in the fall of 1957. Thus, for the first time in about five years the Department appears to be free from the problem of growth.

With this large enrollment, the student body in Course VI has a distribution of talent between theoretical and applied aspects of engineering essentially the same as that in M.I.T. as a whole. Some fifty-odd students each year have exhibited a strong flair for a presentation of subject matter that is even more scientific than that offered by the revised curriculum. These students show excellent promise for graduate study and careers in creative research. A substantial percentage of them should continue toward the doctorate. Accordingly, the Department last spring recommended and received Faculty approval for a new curriculum — Electrical Science and Engineering, Course VI-B — for a portion of its undergraduate students.

The first group of students will enter Course VI-B as juniors in the fall of 1957. Their work will be distinguished from the work of students in Courses VI and VI-A by the extent to which it will include higher mathematics and physics and emphasize the electrical science aspects of the core curriculum subjects. The Course is normally of five years' duration, with the degrees of Bachelor of Science and Master of Science awarded simultaneously. The initiation of Course VI-B opens another frontier for the development and application of new scientific principles; it comes as the new note and text material arising from the recent revision of Course VI approaches publication.

Many electrical engineering departments in sister institutions are strengthening the scientific content of their curricula. Their interest in the work of this Department continues at a high level. In response to many requests, a proposal was submitted to the National Science Foundation to offer a Curriculum Workshop at M.I.T. for about fifty professors of sister institutions in order to criticize, review, and appraise examples of recent curriculum syntheses emphasizing the electrical sciences. The proposal was approved and the Workshop is scheduled for early September, 1957.

With the Department continuing to draw almost 25 per cent of the undergraduate students, the ratio of graduate students to undergraduate students in electrical engineering is the lowest in the Institute. Corrective procedures include a vigorous program of counseling of undergraduates, especially during the sophomore year, to retard growth of undergraduate enrollment and hopefully to bring about some reduction; and a program to increase graduate student enrollment. The standards for graduate admission are such as to maintain the calibre of the students at the high level which the Department has held for several years. A policy of requiring formal application for admission to the Graduate School by all Course VI, VI-A, and VI-B students was initiated. Thus no students in the five-year Courses (VI-A and VI-B) automatically proceed to the Graduate School.

The Department now enrolls nearly as many candidates for the engineer degree as for the doctor's degree and believes that the engineer degree program uniquely fulfills the needs of a large number of able students. A requirement initiated last year and implemented by Professors Truman S. Gray and J. Francis Reintjes, whereby each engineer degree student participates in orderly and creative application of science and technology in engineering and reports orally on his work and objectives, has given special stature to the program.

The revision of electrical engineering subjects taken each year by some four hundred students in other engineering departments has been continued by Professor Thomas F. Jones and his assistants. Subjects are emerging which show promise of meeting the most important long-term needs of these engineers for knowledge of electrical technology in the practice of their specialties. The class work is supplemented by laboratory exercises illustrative of the principal topics and their application. In addition to the series of experiments performed individually, unusual laboratory demonstrations are presented by the teaching staff. The content of the subjects is the result of a wide survey to study the long-term needs of engineers in industry. The survey indicates that top priority be attached to a thorough background in electrical instrumentation techniques, competence in the use of electrical methods in systems analysis, and a good understanding of the quantitative nature and practical implications of the interactions between charges, fields, and matter. Studies are con-

tinuing to identify, refine, and organize the subject matter and to determine means of presenting it effectively.

One of the most recently developed disciplines in the field of electrical engineering is switching circuitry. Long considered an art, it is now being evolved along patterns that are characteristic of a science, under the direction of Professor Samuel H. Caldwell. Starting with a one-semester subject offered to twenty-seven graduate students in 1951, the topic now embraces a two-semester treatment and attracts about fifty students each semester. Summer registration for the first-term subject is about twenty-five. Twenty graduate theses, three of them at the doctoral level, have now been completed on topics in this area. The topic has been expanded by graduate thesis work and a continuing program in the Research Laboratory of Electronics, where we have now laid bare its scientific challenge. The objective now is to develop the scientific method of synthesis to the point where we can think methodically far beyond present problems, rather than depend on hunches or personal skill.

Research in the Acoustics Laboratory is currently centered around the subject areas of speech communication, under the supervision of Professor Kenneth N. Stevens; physical and atmospheric acoustics, under Professor K. Uno Ingard of the Department of Physics; and general acoustics, including studies of finite amplitude waves, under Professor Richard D. Fay. With the resignation of Professor Richard H. Bolt as Director, administrative responsibility for the Laboratory has been vested in the Department of Electrical Engineering, with the assistance of John A. Kessler as Executive Officer. Some thirty-five graduate students were associated with the Laboratory during the year. Eight bachelor's and seven master's theses received Laboratory support in varying degrees. Eighteen papers were published in professional journals.

The Laboratory for Insulation Research, under the leadership of Dr. Arthur R. von Hippel, can now be said to have terminated its initial pioneering effort with the completion of a Special Summer Program, "Molecular Engineering," attended by about eighty scientists and engineers from August 20 through August 31, 1956. Professors Richard B. Adler and David J. Epstein and Dr. Alexander Smakula of the Electrical Engineering Department, together with faculty members from chemistry, physics, metallurgy, and mechanical

engineering, served as lecturers in this program. The field of molecular engineering has become established to the extent that it will be a core subject of instruction for undergraduate students in electrical engineering by the fall of 1958. A book entitled *Molecular Science and Engineering*, comprising the summer session lectures in a concise presentation, should be in print by late 1957. The normal improvement and strengthening of existing research groups continues, and a group for the study of magnetic resonance has been added. Facilities for electron microscopy and electron diffraction will be installed shortly. In addition to its fundamental research effort on materials, supported by the three services under Office of Naval Research contract, the Laboratory conducts studies aimed at storing the theoretical maximum of electric energy in a minimum of volume; this latter work is under sponsorship of the Atomic Energy Commission. For this purpose, field emission and electric breakdown have to be brought under close control.

Achievements in the Laboratory for Insulation Research include successful preparation of transparent ferromagnetics; realization of the various transition stages between insulators and metals through a series of titanium-oxygen compounds; refining of insulating crystals by zone melting to a purity of about one-hundred to one-thousand times that previously available; broad-band dielectric spectroscopy from d-c to the ultraviolet for a deeper understanding of ferromagnetic semiconductors; control of imperfections in single crystals; new methods of producing pure starting materials of extremely fine grain for ceramic research; and the publication of Volume V of the "Tables of Dielectric Materials."

Professor John G. Trump and his staff in the High Voltage Research Laboratory continued their cooperative program with the medical staff of the Lahey Clinic in Boston on the use of both megavolt electrons and X-rays in the treatment of malignant disease. The two-million-volt X-ray therapy is now in its sixth year and has been applied to over two thousand patients, using methods of physical and clinical application which are to some extent being adopted by other treatment centers. Sterilization by high-energy electrons of human arteries and bone for banking and surgical use has now extended to more than thirty hospital groups.

The basic physical studies of the High Voltage Research Laboratory are concerned with the voltage-insulating proper-

ties of high vacuum; the methods of initiating and accelerating streams of positive and negative ions; and improved techniques for producing high vacuum. Emphasis has also turned toward the production of more intense streams of high-energy electrons and ions for the needs of industry and science.

The areas of active research in electrical energy conversion have broadened in scope and direction during the past year. The extensive analytical and computer studies of the dynamics of electrical machines and systems, carried on during the last several years, has been completed through the efforts of Professors Paul Smith and Mahmoud Riaz. An associated project headed by Professor Alexander Kusko, studying the effects of cooling systems, losses, and environment on the size and weight of aircraft alternators, has also been completed. The interest in high power level single-phase and multi-phase magnetic amplifiers has continued to expand under the direction of Professor Herbert Woodson, and a design procedure yielding predicted dynamic performance, taking into account the physical properties of core materials, is being developed. The studies of the electrodynamics of moving material bodies and their extension to energy conversion problems have resulted in a new formulation of electrodynamics by Professor Lan J. Chu. A new activity started during the past year has as its ultimate aim the development of new electrical energy conversion sources. As one part of the program, Professor Osman Mawardi has started investigation on the behavior of moving electrical conducting fluids in strong magnetic fields. A second phase of this program, under Professor White, has started preliminary work on thermal electric converters utilizing semiconductors. During the year the above work supported the research activities of seven faculty and fifteen graduate students, yielding thirteen technical publications, two doctoral theses, twelve master's theses, fourteen bachelor's theses, and five Air Force Technical Notes.

The Stroboscopic Light Laboratory, under the leadership of Professor Harold E. Edgerton, continued with the development and study of flash lamps of all types and their application to the solution of specific problems in science, industry, and education. Small sources of intense light output per unit area were developed and show promise for microscope illuminators

and for specialized cameras, such as those that photograph the retina. The development of cameras and lights for deep-sea photography continues. Photographs were taken in July, 1956, at the bottom of the Romanche Trench, almost on the equator, midway between Africa and South America. The photographs showed a rocky bottom which is of great interest to marine geologists. A brittle star and other forms of life were clearly shown, indicating that there is life at this depth of about 4,000 fathoms.

The Computer Components and Systems Laboratory expanded its scope and academic effort during the year. Interests and growth in the area of high speed, small size, and increasingly reliable computer elements have brought about an allocation of all the space on the third floor of Building 10 to this effort for the coming academic year. Components research under Lincoln Laboratory sponsorship has been concerned principally with the fabrication of microscopically small digital-computer elements by means of thin-film phenomena. Other aspects of the approach are the cryotron component and the logic peculiar to this device. Basic investigations of its superconductive, magnetic, and cryostatic implications are being pursued as part of one doctor's and two master's theses. Basic theoretical investigations are being pursued in the general field of crystal structure, magnetic phenomena, thin film, gold blacks, and colloids. Work is also progressing in the character and pattern recognition domain. Possibilities of "thinking" machines are being discussed and evaluated. Optical processing possibilities and all the implications involved in a parallel computer as contrasted to the sequentially operating computer are being reviewed.

The Servomechanisms Laboratory, under the direction of Professor Reintjes, continues its activities in the areas of instrumentation, computation, and control, with a strong team of graduate students and staff. During the past year a three-year research program in digital-measurement techniques was brought to fruition with the completion of a digital flight test instrumentation system, to be used by the Air Force in its evaluation and improvement of airborne fire-control systems. This instrumentation system includes many developments in high-performance instrument servomechanisms, analog-to-digital conversion, and digital data processing. The group working on computers for operational flight trainers

centered its activities on a novel pulsed-analog method of generating functions of two or more variables.

The one-week Special Summer Program in "Analog-Digital Conversion Techniques," which was the outgrowth of the Servomechanisms Laboratory's effort in digital instrumentation, was organized last year by Professor Alfred K. Susskind and proved very popular; it is being repeated this year. Advance registration indicates an attendance of over 150 representatives from industry and government.

Graduate thesis work in research in instrumentation for submarine diving and steering stations, conducted under the direction of Professor George C. Newton, Jr. during the past several years, resulted in a system which centralizes at one location all important information for steering a submarine in course and depth. A prototype system has been installed in the *U.S.S. Albacore* and is now undergoing tests. During the year, the investigation of methods for controlling underwater torpedoes culminated in successful water tests at Newport and Key West of a research vehicle equipped with a high-performance tri-axial autopilot. The research group is now engaged in a study of information-processing schemes leading to an engineering evaluation of torpedo behavior.

The program in advanced radar techniques, initiated a year ago under the direction of Professor Reintjes, continues with emphasis upon the application of modern materials and devices to radar circuitry. New analytical approaches to the design of magnetic amplifiers for control purposes are being explored as part of a doctoral program.

The machine computation group of the Servomechanisms Laboratory continues to make progress toward the use of digital computers for programming numerically controlled machine tools. At the request of the Aircraft Industries Association, a special eight-day intensive course in programming methods was conducted during March for the benefit of commercial organizations utilizing tools of this type. Fifty-six representatives from thirteen aircraft companies attended the course. Some hundred-odd machines incorporating numerical control techniques pioneered by the Servomechanisms Laboratory are now on order with the machine-tool industry.

In close coordination with the Communications Biophysics Group of the Research Laboratory for Electronics, James F. Kaiser conducted an intensive study of correlation

computers with a view toward obtaining a simple, high-speed, flexible computer for correlating brain-wave data.

The Department sponsors the Research Laboratory of Electronics jointly with the Department of Physics, and the Dynamic Analysis and Control Laboratory jointly with the Department of Mechanical Engineering; the work of both these are described elsewhere in this volume. Approximately 30 per cent of the research energies of the faculty and graduate students of the Electrical Engineering Department support these two interdepartmental activities.

GORDON S. BROWN

MECHANICAL ENGINEERING

In an era of unprecedented technical activity and consequent demand for our graduates, the Department of Mechanical Engineering has continued to prosper. During the year 249 degrees were granted, of which 144 were bachelor's, 81 master's, 10 engineer's, and 14 doctor's degrees. Registration in the graduate division reached a peak. For the first time the number of resident graduate students exceeded two hundred, of which 30 per cent had received their undergraduate education at M.I.T., 46 per cent in other American universities, and 24 per cent in foreign countries. A notable development of the past year is that a growing number of large industrial firms are sending some of their best young employees to graduate school, completely financed. This practice, which promises to become widespread, is bringing into the graduate division at an increasing rate students of the highest caliber, more mature than those coming straight out of college.

The honors group, consisting of some ten seniors of outstanding ability, has been operating for twelve years under the initiative and guidance of Professor Joseph H. Keenan and continues to be the principal source of our own undergraduates for the graduate division. Upon finishing their studies, these men are taking important places in industry and on the faculties of various universities, including our own. For some time it has been felt that something similar might be done for the best men in the junior class as well; through the initiative of Professor Ascher H. Shapiro, a beginning has now been

made whereby five members of the outgoing sophomore class have been invited to join a special program, more advanced than the standard junior course and including some subjects usually postponed until the graduate years. This will enable these few specially gifted men to advance at a rate limited only by their own capabilities.

The Cooperative Course II-B, comprising roughly 25 per cent of the juniors and seniors registered in the Department, continues — under the guidance of Professor William M. Murray — to offer a curriculum containing a period of practical work in industry.

The Department continues to be active in the Special Summer Programs of some two weeks' duration given to large numbers of engineers in industrial practice and to college teachers; these cover the latest developments in a variety of fields. As in previous years, the Department is responsible for some 25 per cent of the summer courses given at the Institute.

As a result of a general discussion on the subject of materials with the Visiting Committee of the Department in January, 1957, the curriculum in that field has been modified to give more emphasis to modern solid state developments and to lead to a new optional program for seniors.

Another new optional curriculum for seniors and graduates has been established in nuclear power engineering in cooperation with Professor Manson Benedict's Nuclear Engineering Division of the Department of Chemical Engineering. The curriculum depends for the fundamentals of nuclear science on subjects offered by the Physics Department and by Professor Benedict's group; it is supplemented by subjects in the mechanical aspects of power plant design given by the mechanical engineering faculty, in particular by those members of it who specialize in design, heat transfer, and materials.

The freshman subject in Graphics, which became a responsibility of this Department last year, has been reorganized by Professor James B. Reswick. The principles of descriptive geometry, machine drawing, and representation in general are still taught as before, but this is done in a new and more attractive manner. Each student completes five projects, one in each of the five major fields of engineering and science. The emphasis on freehand sketching is greater than heretofore.

During the year the listing of subjects offered was reviewed critically, and a substantial number in which attendance had

been diminishing with the years were eliminated. New subjects were established in graphics, fluid mechanics, dynamics, statistical mechanics, and nuclear power engineering.

The policy of encouraging younger teachers to spend a year away from the Institute, generally abroad under an exchange arrangement with a foreign teacher, is being continued. During the year under review three assistant professors were abroad, one each in England, Germany, and Sweden; in return a teacher from the University of Cambridge and one from Göteborg, Sweden, spent the year here. In addition, one full professor spent a semester in Germany. For the coming year four exchanges have been arranged with the Universities of London and Cambridge in England, Darmstadt in Germany, and the California Institute of Technology. In addition, one instructor will spend the year in Göttingen, Germany, without exchange. Most of these arrangements are financed by grants from the Fulbright Act and from the large foundations.

The program of research continues actively; practically every professor has one or more projects under his supervision, and these projects are responsible for a very large percentage of theses written by graduate students. The list of titles, consisting of more than fifty items, covers the entire field of mechanical engineering, including textile technology; it is too long and varied to be outlined here.

JACOB P. DEN HARTOG

METALLURGY

The Department of Metallurgy continues its active and effective research program in all fields of metallurgy, mineral engineering, and ceramics. Graduate enrollment has reached the maximum that can be accommodated with present laboratory facilities. Undergraduate enrollment has shown an upturn, with forty students registered for the sophomore year.

In addition to Special Summer Programs on "Iron and Steel Making," "X-ray Diffraction," and "Ceramic Forming Processes," a symposium was held on "The Physical Chemistry of Iron and Steel Making." Proceedings of the latter conference, which was attended by scientists from this country and abroad, are being published by the Technology Press in conjunction with John Wiley and Sons.

A number of important research results have been obtained during the year. Professor Herbert H. Uhlig has shown that stress-corrosion cracking, which has long been recognized as a primary fault of austenitic stainless steels, is related to the precipitation of carbides and nitrides during plastic deformation. Steels which are free from nitrogen and carbon are found in an accelerated test to be essentially immune to this type of cracking.

The metal chromium has a high melting point and is resistant to oxidation. However, its inherent brittleness makes it unsuitable for use as a high-temperature material. Although at elevated temperatures the metal is sufficiently ductile to permit forging, embrittlement occurs on cooling to room temperature. The transition from ductile to brittle behavior has been shown by Professor Nicholas J. Grant to be a function of purity and alloy content. Certain alloying elements have been found to lower the transition temperature significantly, resulting in material which is ductile at room temperature and below. This seems to offer real hope that chromium-base alloys may be developed to extend the operating temperature range of jet engines.

The usual application of X-rays in the determination of metallic structures yields information on the average positions of atoms within the crystal lattice. A recent extension of diffraction techniques by Professor Benjamin L. Averbach has made possible the measurement of atomic displacements from the average lattice sites. The new results will be important in the interpretation of the properties of solid-solution alloys.

In Professor Morris Cohen's group, Dr. Walter Owen has demonstrated that brittle fracture, which is a common source of failure in structural steel, is attended by the prior formation of microcracks. These microcracks involve considerable local plastic deformation, even at very low temperatures, where the metal fails by cleavage fracture.

Among a number of interesting thermodynamic researches, the recent calorimetric studies of Professor Michael B. Bever and Dr. Werner Schottky deserve mention. They have measured the heats of fusion and of formation of III-V intermetallic compounds. From these quantities it is possible to arrive at the free energy of formation of the compounds with

the aid of a theory recently proposed by Professor Carl W. Wagner. Quantitative data have also been obtained on the amount of energy that is stored in metals as a result of plastic deformation.

JOHN CHIPMAN

NAVAL ARCHITECTURE AND MARINE ENGINEERING

The industrial base of this Department, which is one of the smaller ones of the Institute, has been greatly expanded by the increase in shipbuilding activities in this country. Because of the present limited enrollment of undergraduate students, it is impossible to meet the overwhelming demand for graduates in this field. In an attempt to help overcome the present severe shortage of professional naval architects, marine engineers, and marine management personnel, the Department has published a brochure entitled, "Naval Architecture and Marine Engineering." The intent of this brochure is to give young men searching for advanced academic pursuits information about career opportunities in the marine industry and about the formal education necessary for these professional careers, with particular reference to the educational philosophies and opportunities at M.I.T. It is also of interest to mention that the combined degrees of Bachelor of Science in Naval Architecture and Marine Engineering and of Master of Science in Shipping and Shipbuilding Management, in the recently established five-year program of Course XIII-B, were awarded to a student for the first time this year.

The Department continues its important role in the training of naval officers as well as its distinguished position in certain fields of research.

At the request of the Brazilian government, Professor Laurens Troost was given a three months' leave of absence to establish a new course in naval architecture at the University of Sao Paulo. Professor George C. Manning, who will be retiring from the Institute at the end of the academic year 1957–58, obtained a year's leave of absence at the end of the current year to succeed Professor Troost at this Brazilian university. Professor J. Harvey Evans was granted a three months' leave of absence at the end of the current year to assist in the reconstruction of the Department of Naval Architecture of the University of Seoul, Korea.

The Class of 1960 in Naval Construction and Engineering (Course XIII-A) is composed of seventeen U. S. naval officers, eight U. S. Coast Guard officers, and four foreign naval officers, making a total of twenty-nine new students and a total enrollment of seventy-four in this Course. Twenty-two professional degrees and simultaneous Master of Science degrees were granted during the year in Course XIII-A. Three foreign naval officers have registered as undergraduates in Course XIII.

In the Hart Nautical Museum an inventory of the Clark Collection and Forbes Collection prints, representing a total of about three thousand items, was carried out. A loan of some forty prints from the Forbes Whaling Collection was made to the Old South Dartmouth Historical Society and Whaling Museum at New Bedford for a special display during this summer. Progress is being made in constructing models to depict the history of advances in the mechanical propulsion of ships.

It is of interest that William Baker, naval architect for *Mayflower II*, is an alumnus of this Department.

During the year the propeller tunnel, in addition to its normal instructional use, has been extensively used for research of fundamental nature. Under contract with the David Taylor Model Basin, a program to determine and correlate the effective inertia of propellers, related to various vibration problems, has been carried out. Progress has been made in developing instrumentation to measure dynamic stresses in propellers and to determine hydrodynamic hull forces due to propeller action. The latter project will be continued next year as part of a basic research program to which the Bureau of Ships and the Society of Naval Architects and Marine Engineers are also making significant research contributions.

During the year the ship model towing tank continued high activity in instruction, thesis, and research. Seven graduate students participated in four thesis projects and three undergraduate students in theses associated with the towing tank. Research work in the seakeeping behavior of ships continued in three projects sponsored by the U.S. Navy, Society of Naval Architects and Marine Engineers, and Holland-America Line. The tank was represented at the American Towing Tank Conference held in Washington, D. C., in September, 1956, when two papers were presented

by the tank director; it will be represented again at the International Towing Tank Conference to be held in Madrid, Spain, in September, 1957. The flexibility and scope of research work is at present seriously limited by the lack of a mono-rail towing carriage and the lack of permanently assigned personnel for tank operation.

The Ship Structures Laboratory continued its research in the field of the buckling strength of flat panel plates. A generous grant-in-aid from the Society of Naval Architects and Marine Engineers for extension of this work has permitted progress in connection with more complicated plate edge support conditions, a problem of particular concern in ship structures. The pace of accomplishment, however, is slowed by the difficulty in finding a replacement for last year's full-time technical assistant, who resigned to accept a position in industry. Additional equipment has been delivered during the year, so that this laboratory now represents a valuable adjunct to the Department's academic instruction and thesis work.

LAURENS TROOST

SCHOOL OF HUMANITIES AND SOCIAL STUDIES

We have now finished the second year of our new program under which M.I.T. students may earn a bachelor's degree by various combinations of economics or political science (Course XIV) or of philosophy or history (Course XXI) with a significant group of subjects in science or engineering. This program is enjoying a healthy growth. The Political Science Section has made steady progress toward a substantial role in our academic and professional life. Its first senior class completed the requirements for the degree in June. The first full year under the revised program in economics has worked well, and the class of seventeen seniors was the largest we have graduated. In Course XXI about twenty students are registered in each of the classes of 1958 and 1959. The great interest in this Course continues to be in philosophy and literature subjects, while the anticipated interest in the American Industrial Society Program has not appeared. Indeed, that interest is so small that the program has been discontinued as a separate option, although a student who wishes to emphasize American studies is encouraged to do so by individual registration.

One of the important purposes of the Course XXI arrangement is to prepare students for postgraduate work in schools of medicine, law, or business. Dr. James M. Faulkner, Director of the Medical Department, has provided invaluable advice in working out problems of the premedical curriculum. We need now to make the same study of legal and business education with the help of equally competent advisers.

New students in the Science Teaching Program, formerly registered in Course IX-C, will henceforth be registered in Course XXI.

All of these degree programs, in both Course XIV and Course XXI, could profitably engage the interest of a few but not many more first-class students. We need a positive recruiting program in terms of contacts with secondary schools, guidance directors, and alumni advisers; we need publicity for freshmen and pre-freshmen. These particular opportunities for combining serious scientific study with equally serious concentration on some aspect of the social sciences or the humanities are certainly not common in university programs — in the rigor of their scientific requirements they are probably unique with M.I.T. They should steadily attract a fair sized group of very able students. The less able are unlikely to find the program attractive.

UNDERGRADUATE SUBJECTS AND THE CORE CURRICULUM

We remain proud of the freshman-sophomore required core in humanities and the subsequent upperclass elective concentrations which constitute M.I.T.'s version of general education. This program continues to attract many observers. At the request of the International Educational Exchange Service of the Department of State, M.I.T. agreed to be one of ten American universities which would each be host to three Indian professors sent to America by the Indian Ministry of Education. On February 28, Dr. N. N. Murti, Principal of Ramnarain Ruia College, and G. C. Bannerjee, Principal and Professor of English at Ismail Yusuf College, both of the University of Bombay, arrived here together with Dr. T. G. K. Charlu, Reader in Geology at Roorkee University. During their seven-week stay they visited many of our classes and talked with members of the faculty and administration. We also arranged for them to visit Harvard, Amherst, Yale, Northeastern, the University of Massachusetts, Phillips Andover Academy, and representative public schools at both high and elementary levels. In completion of this program Professor Howard R. Bartlett, Head of the Department of Humanities, will pay a return visit to some of the Indian universities in the autumn of 1957.

As to details of the core, consolidation and refinement rather than innovation have marked the year. The largest

change has taken place in the sophomore option on the United States, which has now been established on a broader base and given a more humanistic inclination. The core staff has put special emphasis this year on improving our training in writing, and a special composition committee has addressed itself to this problem with good results. A comparable committee on reading skills, otherwise called the "comprehension committee," has been discussing this important question, which is *not* one of remedial reading. Two sets of problems are involved. One is practical in the extreme — a matter of teaching, explicitly and consciously, the skills of intelligent critical reading. The other is a matter of hoping that, once a basic prose comprehension has been achieved, overt attention to literary form in all kinds of literature will enhance the student's perceptions, sensitivities, and taste and may make possible more effective tie-ins with art, architecture, and music. This committee has been at work in the spring term. By fall it will have made available working guides to the ground rules for that kind of sound reading practice which falls half way between reading for the "story" and reading for some kind of "explication," new-critical, sociological, or otherwise. Starting with the great variety of formal devices at an author's disposal, considering the interrelationship of form and meaning, and providing sample studies of *Antigone*, Thucydides, and a Shakespeare play, the committee report will endeavor to set forth a technique for deepening the student's sense of the complexity of individual works and for enabling him to comment on the latent sense in which Thucydides is drama or even tragedy as specifically as he can now describe the historical facts which the book purports to present. The first faculty reactions to the preliminary findings are mixed, as might have been predicted, but the directors of the core studies hope that some instructors will see fit to try the suggested approaches in the next academic year.

This particular study points up the fact that our core program must and does encounter problems which, it seems to me, are common to any effort in general education involving many students and many teachers. The principal problems demand:

1. Striking the right balance between commonality and independence in a large and multisectioned teaching operation.

2. Structuring the course materials to achieve the proper balance between the abstract and the concrete and among the several traditional scholarly disciplines properly represented in the core subjects.
3. Integration of training in techniques of reading and writing with what are, in principle, "content" courses.
4. Securing a high and reasonably consistent standard of quality and rigor among the teachers of the core.
5. Training new instructors almost yearly and retaining a sense of involvement on the part of the older members of the staff.

A prodigious work, as Glaucon remarked to Socrates on another occasion — but so, in truth, is all education. Some of these problems will need vigorous attention next year and none of them can ever safely be put out of mind.

GENERAL EDUCATION AND THE UPPERCLASS ELECTIVES

Registration in each elective of the upperclass program continues to grow, partly because the total number of upperclassmen has increased but equally because more and more M.I.T. upperclassmen are taking more studies in humanities and social sciences than those minimally required for the degree. This year 3,086 students registered in some subject in the Department of Economics; this is an increase of 533 over last year, which was in turn an increase of 103 over the year before; 3,258 registered in some subject in the Department of Humanities, which of course has all the freshman and sophomore instruction; 1,508 registered in upperclass subjects, an increase of 223 as against an increase of 305 in the year previous. All these numbers are encouraging to us. As between different subjects, the student interest followed much the same pattern as last year, with the greatest numbers electing history, philosophy, literature, psychology, or economics. But upwards of four hundred students elected subjects in political science or music and more than three hundred elected industrial relations. There was a corresponding increase in Professor William D. Stahlman's elective subject in Philosophy and Scientific Methodology, which despite its difficulty is now chosen by about one freshman in every seven.

Despite our general satisfaction with the core and the upperclass elective program, the time has seemed ripe for a re-examination of our purposes and accomplishments, to be

accompanied by an outside appraisal. To this end I invited the assistance of a distinguished group of colleagues from other institutions: Dr. Robert K. Merton, Professor of Sociology at Columbia University; Dr. Kenneth E. Boulding, Professor of Economics at the University of Michigan; Dr. Carlos Baker, Professor of English at Princeton University; Dr. Paul Weiss, Professor of Philosophy, Henri Peyre, Professor of French, and Dr. Harold D. Lasswell, Professor of Law and Political Science, all from Yale University; and Bruce Catton, historian and editor of *American Heritage*, have met with us and independently under the chairmanship of Professor Lasswell. Their report, soon to be received, will give us much to ponder. As so often in the past, the grant made to us some years ago by the Carnegie Corporation has supported this useful study.

Two of the individual electives perhaps deserve more extended attention here.

A year ago, I pointed out four major problems. One concerned the over-all position of psychology at M.I.T., which I regarded and continue to regard as critical. The general situation, which transcends the interests of this School, continues to need serious and urgent attention. But much progress has been made on the more local matter of revising the undergraduate psychology subjects, which continue to be very popular. This has been done by an internal committee under the chairmanship of Professor Douglas M. McGregor of the School of Industrial Management. This committee now proposes a division into two groups starting from a common introductory subject, Introductory Psychology; the first group is to include so-called "classical" subjects such as learning, perception, motivation, and the psychology of language; the second group, dealing roughly with social psychology, will include studies of personality, group behavior, and mass communication.

A year ago I also cited as a problem our failure to offer an elective sequence in the arts along the lines proposed by the excellent Hayes Committee Report of 1952–54. I am happy to say that the School of Architecture has now taken the matter in hand and with the great cooperation of Professor Lawrence B. Anderson, Head of the Department, a fine program has been worked out, principally by Professor Albert Bush-Brown and Robert O. Preusser. We feel particularly indebted to Professor Bush-Brown for the initiative and skill

he has shown in the entire matter. The new group of subjects, all offered by the architectural faculty, will afford another way to satisfy the upperclass humanities requirements and will be available this autumn. A brochure describing the subjects is available upon request. With this happy denouement we found it appropriate to publish the Hayes Committee Report, entitled *Art Education for Scientist and Engineer*. This document, which covers much more than the parochial interests of M.I.T., has already seemed of great significance to numerous students and teachers of art throughout the country. It is available on request.

MODERN LANGUAGES

The core curriculum in French continues to thrive. Professor William F. Bottiglia has introduced the innovation of building critical vocabularies from the outset so that students may begin critical work at an early moment. Professors Morris Halle and Joseph R. Applegate have revised our teaching of elementary German to emphasize oral competence. They have begun plans for properly equipped listening and recording rooms. An extensive study of existing equipment has shown that it is unsatisfactory; so a joint project has been started with the Department of Modern Languages of Purdue University to design better language practice equipment. Foundation support is being sought to bear development costs.

REPORT WRITING

Professor Robert R. Rathbone's work on report and thesis writing in the School of Engineering continues to grow. Last year he taught upwards of 250 students from the Departments of Mechanical Engineering, Electrical Engineering, and Metallurgy, all on a quasi-personal basis. Professor Albert G. H. Dietz requested a program for his graduate students. A writer's handbook was prepared for seniors in civil engineering. The Seminar in Technical Writing enrolled thirty-seven, the largest ever. Eighty seniors in mechanical engineering submitted their thesis proposals and progress reports to Professor Rathbone for criticism, and most of these required individual conferences. The request for help on theses has now spread to the Electrical Engineering Department. Professor Rathbone performs all these important tasks brilliantly and unselfishly,

but the load has become too great for one man. We have provided for the needed expansion by the appointment of James B. Stone to assist him.

GRADUATE INSTRUCTION

I invariably discuss undergraduate instruction first, to emphasize its great importance in the mission of our School. But we have an equal responsibility to make our able faculty available to a limited number of graduate students in those areas where we are particularly strong both in numbers and in quality. Indeed, we could not begin to perform our undergraduate mission so well if we did not have a group of ardent graduate students and a vigorous research program.

At present all our graduate studies leading to degrees are in the Department of Economics and Social Science, and this work is in very healthy condition. The Department does not want many more graduate students than the seventy it had this year, which, incidentally, was the largest number ever.

The new special program in international communications drew a fine group of specialists from governmental and academic life for advanced study and research. Developed by the Center for International Studies, it engaged also the forces of the Political Science Section and formed one unit of the graduate studies program in political science, supplementing the already existing offerings in international relations, American foreign policy, and political theory.

I have no doubt that the quality of the staff now assembled in the School not only justifies but demands the development of a full doctoral program in political science, particularly as it polarizes around science and technology. We ought to request and obtain authorization to confer such a degree during the next academic year.

Such a statement usually raises the legitimate question as to what the aspirations of this School may and ought to be, located as it is in a limited university whose primary concern has been and, of course, will remain centered upon the physical sciences and their applications. What the longer future may suggest or what a successor may propose I cannot, of course, predict. But it seems reasonable to suggest that for the next several years we should continue to foster the present strong graduate programs in economics and industrial relations, fully implement a corresponding one in political science, and move

as rapidly as possible towards the establishment of a center for research and advanced study in the philosophy, history, and perhaps sociology of science, conceived on the broadest lines and operated by the Department of Humanities. To attain these objectives and to find a solution for the interschool problem of the role of psychology at M.I.T. constitute what seems to me an immediate program that is both reasonable and obtainable over the next five years.

RESEARCH

In previous years I have dwelt at length on many details of research carried on by members of this faculty. This was because, with the exception of some members of the Department of Economics and Social Science who held a long tradition of scholarly activity, our School was changing from a faculty whose overwhelming commitment was to teaching and service courses to a larger and different faculty which, while retaining that obligation, is also vigorous in its creative scholarship and offers more degree work in its own fields. It seemed desirable to emphasize the transition. Now, however, the change has been accomplished and the publications list is sufficient testimony to most of the effort.

The Department of Economics continued its high rate of productivity, and the faculty of the Department of Humanities reached a new high with the publication of at least five books, twenty-six articles, fifteen reviews, and sixteen papers presented at meetings of professional societies.

Substantial progress continued in the Machine Translation Project through the cooperation of the Department of Modern Languages and the Research Laboratory of Electronics. The new I.B.M. 704 Computer in the M.I.T. Computation Center was a valuable aid to this work.

I call particular attention to the work of Professor Noam Chomsky in studying the structural basis of language from a logical and philosophical point of view. His book, published this year, has been favorably received as a new interpretation of a subject usually considered too difficult to treat. This work may provide a new theoretical foundation for all work on the machine processing of verbally expressed information.

A large amount of the research in the School is carried on under the auspices of either the Industrial Relations Section or the Center for International Studies. Each of these

subdivisions issues its own annual report, which may be consulted for details. Both groups have continued to work productively along lines laid down in previous years. Most of the senior economists of the Center working on the Economic and Political Development Program were home this year from Italy, India, and Indonesia working up the materials gathered in the field; the majority of the present projects in United States-Communist Bloc Relations will have been completed by the time this report goes to press. A new program is being developed to focus on political, social, and economic changes inside the U.S.S.R. and the East European satellites since the death of Stalin. Corresponding progress is reported in the programs dealing with international communications and with American society in its world setting.

All this research provides, naturally, the nutriment without which the School's graduate and undergraduate teaching programs would lack vitality. One can only express pleasure with the present position.

CENTER FOR INTERNATIONAL STUDIES

The third problem I posed in my report of a year ago concerned the ways in which the potentially invaluable contributions of the Center for International Studies could be integrated into the general research and teaching program of the School. Though much remains to be done and a still fuller integration is of pressing importance, it is possible to report substantial progress.

The Center has clearly affected the character of our course work both by its effect on regular staff members who have worked in the Center and by the direct teaching contributions of Center personnel. The impact on the graduate program has, not unnaturally, been more obvious than that on the undergraduate program, but both have benefited. Members of the Center staff taught almost thirty courses in economics, political science, history, social psychology, and sociology, a substantial increase over last year. Additions to the graduate program through the new training work in international communication have already been cited.

One of the Center's objectives is to direct part of its energies toward public service, both on the national scene and in the world at large, and to serve modestly as a bridge between the world of the scholar and the world of the policy

maker. Not all the research program can or should be directly relevant to policy formation; the greatest portion, while in areas of concern to the government official, does not and is not meant to suggest guides for action. However, a number of senior people in the Center do devote some of their energy to adapting academic research to the needs of government officials or of the public at large.

For example, Professors Max F. Millikan and Walt W. Rostow, with the aid of their colleagues, prepared a paper on *The Objectives of United States Economic Assistance Programs* as one of a number of key papers prepared in various institutions at the request of the Senate Special Committee to Study the Foreign Aid Program; Professors Millikan and Rostow also testified before Congressional committees on some aspects of our foreign economic policy. Members of the Communications Program staff have been asked to spend some time next year evaluating and revising the materials used by the International Exchange Service of the State Department in orienting American Fulbright Scholars going to India. These problems have suggested the addition to the senior staff of two or three men familiar with practical problems of international affairs. Dr. Lincoln P. Bloomfield, a political scientist and formerly a special assistant to the Assistant Secretary of State for International Organization Affairs, plans to take a fresh look at the role and prospects of the United Nations in relation to the strategic goals of United States foreign and military policy. Arnold Rivkin, a lawyer serving until recently as Associate General Counsel in the International Cooperation Administration, is drawing up a project to examine the social, political, and economic problems facing the new nations and dependent territories of Africa. This study will be a basis for the formation of appropriate policies for the United States in that area.

So much of the Center's work is abroad that our people travel a great deal to foreign countries. During the past year Professors Wilfred Malenbaum, Benjamin H. Higgins, Paul N. Rosenstein-Rodan, and Daniel Lerner, as well as William C. Hollinger, George Rosen, Walter Neale and Professor Millikan, visited one or more foreign countries all the way from India, Indonesia, and Japan to Italy, Austria, and France.

There are sometimes delicate problems in connection with our work abroad, and there may be an increasing number of them. But these can be handled by sensible people. In some countries we have furthered arrangements which serve to increase the quantity and scope of research being carried on there. For example, the Institut d'Études Européennes, created a few years ago at the initiative of Professor Lerner to administer an interview program in France, appears to have established itself as an independent research center, and funds are being sought to assure its continued operation. In Italy, Professor Rodan has been instrumental in promoting the development of a research and training program in the Association for the Development of the South (SVIMEZ), for which support is anticipated from American foundation sources; Professor Rodan is a member of the Advisory Board. Finally, the Center has been requested by the Universidad de Los Andes in Bogotá to assume responsibility for setting up in that university an economic development institute to study the growth problems of Colombia and other Latin American countries. Whether this project can be undertaken may depend upon whether the Center can find a suitably trained and experienced economist to direct it.

As usual, the Center has attracted countless distinguished foreign visitors. It is quite impossible to list them all here, but as high points I should mention the visits of Ambassador Mehta from India; Ambassador Ben Aboud from Morocco; the President of Morocco's Consultative Assembly, Mehdi Ben Barka; a group of distinguished editors from India; and a group of prominent business leaders from Japan. The Center also continued its practice of inviting foreign scholars to join the staff as Visiting Fellows and had guests from Turkey, Japan, and Canada on that basis this year.

The affairs of the Center have become too large, too complicated, and too specialized to remain within the purview of the Corporation Visiting Committee on the Department of Economics. A Special Visiting Committee of the Corporation has, therefore, been appointed and had its first visit this year. The chairman of this eminent Committee is Robert A. Lovett. The other members are James M. Barker, McGeorge Bundy, C. D. Jackson and Alfred L. Loomis.

STAFF ACTIVITIES

A staff such as ours is called upon for many outside duties. I have already mentioned some of the activities of the staff of the Center for International Studies. Some of the more interesting or unusual assignments outside the Center follow.

Professor Paul A. Samuelson testified before the Subcommittee on Fiscal Policy and Growth of the Congressional Joint Committee on the Economic Report; Professor Morris A. Adelman continued his membership on the Advisory Committee on Enterprise Statistics of the Census Bureau; Professor E. Cary Brown spent the year at Oxford University; and Professor George P. Shultz served on the committee of The National Bureau of Economic Research to prepare a conference on labor economics.

In November Professor Charles A. Myers was a member of the United States delegation to the first Inter-American Management Congress in Santiago, Chile. In June, 1957, he went in a similar capacity to the Eleventh International Congress of Scientific Management in Paris. For the first six months of the academic year he served on a public committee appointed jointly by the Secretaries of State, Commerce, and Labor to review the United States' participation in the International Labor Organization.

Professor William N. Locke was Chairman of the Northeast Conference on the Teaching of Foreign Languages; Professor Karl W. Deutsch spent the year at the Center for Advanced Study in the Behavioral Sciences; Professor John B. Rae was at Case Institute of Technology on exchange; Professor Lynwood S. Bryant became Director of the Technology Press; and Professor Robert S. Woodbury was on leave to aid the United States National Museum in the establishment of a collection of early machine tools. Professor Carvel Collins lectured at the University of Paris; Professors Giorgio de Santillana and William D. Stahlman attended the Eighth International Congress for the History of Science in Florence and Milan. The Department of Humanities continued to furnish the House Masters of East Campus, Burton House, and Baker House in the persons of Professors Ernst Levy, E. Neal Hartley, and Norman N. Holland.

The centennial year of the American Institute of Architects afforded me many pleasant speaking occasions in Chattanooga, Minneapolis, Ann Arbor, and Washington; but perhaps

my most interesting assignment was when, under the auspices of the National Research Council and the Ministers of Education of France and Norway, I was one of a group of eight American educators who conferred about problems of modern higher education, first with a group of French colleagues in Paris and Blois, and later with a comparable group of Norwegians in Oslo. Both meetings were pleasurable and revealing.

STAFF CHANGES

The full list of staff changes is published elsewhere in the President's Report. Here I must regretfully report three serious losses and pleasurably announce some important additions.

Three of our first-class younger men have resigned to take posts of distinction in other universities. Professor John M. Blum leaves us to fill a major professorial chair at Yale University; Professors George P. Shultz and Raymond A. Bauer have resigned to accept full professorships at Chicago and Harvard, respectively. Each of these men has made first-class contributions to our community and each will be seriously missed, but our disappointment is modified by the fact that they go to such good places and in such good positions. None is, strictly speaking, replaceable; and I must pay tribute in particular to Professor Blum's leadership in his department and his steady, imaginative, and forceful contributions to the development of our core curriculum and of Course XXI. We wish them all well and know that the wishes will come true.

On the other hand it is a pleasure to report that Dr. William F. Bottiglia has joined us from Ripon College as Associate Professor of French; and Dr. Roger W. Brown from Harvard as Associate Professor of Psychology. Dr. Hans Meyerhoff, Associate Professor of Philosophy at the University of California at Los Angeles, who was on our staff for the spring term as a visitor, has fortunately been able to arrange an additional year's leave of absence and will be with us all next year. We are grateful to Professor Herbert Marcuse of Brandeis University for the help he has given as a replacement for Professor Karl W. Deutsch. We have had two distinguished Visiting Professors in the Department of Economics: Dr. Evsey D. Domar, Professor at Johns Hopkins University, and Dr. Frank H. Hahn of the University of Birmingham,

England. Professor Paul Weiss of Yale University conducted two colloquia in philosophy; Stanley P. Wasson, Assistant Professor of History at Case Institute of Technology, was a capable exchange for Professor Rae; Dr. Anita Rodgers, Lecturer at the University of Melbourne, was Visiting Fellow in Modern Languages in the spring term.

CONFERENCES

The Scanlon Plan Conference was omitted last year because of the death of Joseph Scanlon, its brilliant founder. It was resumed this year with a very successful program and an unusually large attendance. There were many touching tributes to Joe Scanlon throughout the meetings, which were ably directed by his former associate, Frederick Lesieur.

The second conference on mechanical translation sponsored at M.I.T. was held under the chairmanship of Professor Victor H. Yngve. At the first conference in 1952, the seventeen people who attended represented practically everyone in the world who had given any serious thought to the problem. At the second conference there were so many that a simple working meeting was impossible. Forty working papers were received and discussed in a three-day conference at Endicott House, followed by a public meeting in Kresge Auditorium attended by more than 175. This conference agreed that the major problems remain linguistic. Word-for-word translation is possible now, but this represents an achievement of questionable economic value and little scientific interest.

In April, under the chairmanship of Professor Elting E. Morison of the School of Industrial Management, a number of us from various parts of M.I.T. and Harvard joined at Endicott House with representatives of the Commissioner General for the United States Exhibit in the Universal and International Exhibition at Brussels, 1958, to discuss the nature of the American displays.

In May a four-day conference was held at Endicott House under the management of Professor Rostow's project on American society in its world setting. This brought together a distinguished group of participants from many parts of the United States to discuss papers prepared in advance by Abraham Kaplan, George F. Kennan, Clyde Kluckhohn, Henry A. Murray, and J. Robert Oppenheimer, in addition to Professor Rostow.

FUNDS

In addition to grants for the Center for International Studies and numerous grants to individual members of the staff, including three Guggenheim awards, the following new and more general funds have become available.

The Ford Foundation has granted $75,000 to be spent by the Department of Economics over a five-year period for support of problem-oriented research in economics and administration. The Maurice and Laura Falk Foundation of Pittsburgh has granted $48,000 for a program of field and case studies in politics in conjunction with the undergraduate Course. This will enable the Political Science Section to further the political education of engineers by getting students into community situations where there are significant political problems involving planning, highway, airport, power, and other developments. It will also assist in establishing internship arrangements with state and local authorities so that students may learn more about the procedures of decision-making and the problems of public administration.

Our most crying need for new funds will be for the establishment of several chairs either on a permanent or a long wasting grant, built on an actuarial basis. There should be at least one more senior chair in economics, two or three in political science in addition to the ones already established by the Ford Foundation grant, three in the history and philosophy of science, and three in the School of Architecture in support of the new arts program, provided that the program attracts students as we expect it will. Altogether we certainly need funds for such purposes in the order of two to three million dollars.

In last year's report I mentioned the fourth problem of space. During the year a special committee of the School, under the chairmanship of Professor Bartlett, has been making a realistic study of our needs, which are contingent to some extent upon the nature of the growth of the School of Industrial Management. This shows that though we may use various expedients to hold the fort for a year or so, time is running out on us. In the light of other campus planning, I can see no alternative to the construction within the next two years of either an addition to the Hayden Library building, which will not be easy, or of a small building in the great area to the north of Hayden. Such a building should offer some

new and modern classrooms as well as staff offices. In either case, modest building funds will be required — and "modest" these days means at least a million and a half dollars.

Finally, I must call attention to the fact that the Carnegie Corporation grant of $150,000, which we have nursed so carefully and, I pride myself, spent so productively, will be exhausted at the end of the next academic year. This "freedom" money has been the most seminal single fund the School of Humanities has had for its general growth, although several funds for more specific purposes have been much larger and of course also of great value. We must find a way to have comparable support in magnitude and purpose for the years which lie ahead.

EXTRACURRICULAR ACTIVITIES

All the main lines of our music program, as provided by the Concert Band, the Brass Choir, the Symphony Orchestra, the Glee Club, and the Choral Society, continued to function at the high level which we perhaps now take too much for granted. Under Professor Klaus Liepmann's direction there were performances of Gabrieli's *Jubilate*, Haydn's *Theresa Mass*, Bach's *St. John's Passion* and *Magnificat*, and Brahms' *German Requiem*. The Choral Society's most ambitious project, which must have been very gratifying to Professor Liepmann, was a tour of Germany by its sixty-eight members, under his direction, during the summer of 1957. The trip was greeted with acclaim both in Germany and in this country. The common German comment was one of gratification that the M.I.T. chorus denied the frequent European stereotype of America as a materialistic society.

The two Holtkamp organs of the Chapel and the Kresge Auditorium were much used. Frequent recitals were given in the Chapel, and David Johnson, the organist, was often called on to play at various chapel services, including twenty-one weddings. Major concerts were given in the Auditorium by a succession of distinguished organists, including E. Power Biggs, Flor Peeters, Arthur Poister, Carl Weinrich, Donald Willing, Karen Johnstad, and Mr. Johnson. The organ season was crowned with five recitals by André Marchal, famed organist at St. Eustache in Paris. M. Marchal recorded five programs for Unicorn Records on the M.I.T. organs.

A special concert of compositions by Professor Levy and Hugo Kauder was given on March 15, when Professor Levy conducted a chamber orchestra of Boston Symphony players in the Kresge Auditorium. The regular Humanities Series, under the fine direction of Gregory Tucker, became self-supporting to all practical purposes. We can now look forward to expanding the series both in number of concerts and in quality, although the latter can hardly be improved over its present standard.

Interest in the Student Drama Shop has much increased, as Professor Joseph D. Everingham and Mrs. Helen Bottomly continue to strengthen the organization. There has now been enough time to train student lighting designers, crew chiefs, stage carpenters, stage managers, and set designers, as well as a good acting company with an excellent *esprit de corps;* now we can also work out ways of continuing this training as student generations come and go. There were two major productions, *The Country Wife* of William Wycherly and *Misalliance* by G. B. Shaw. In addition to the major productions, the students themselves produced three evenings of one-act plays during the year. Two of these were written, as well as directed, by students. The Drama Shop Celebrity Series presented Robert Graves in an evening of poetry readings to an audience of about nine hundred.

Under the direction of William T. Krasnow, the debating squad of twenty-seven continues to do well. We participated in 22 tournaments and won about two-thirds of the 168 rounds of debate. For the second time since 1950, the team qualified for and was invited to the National Championship Tournament at West Point. Nine different M.I.T. debaters won individual speaking honors at one or more tournaments.

I am happy to report that the student Lecture Series Committee has come to stand entirely on its own feet and its activities are therefore reported in student publications.

MUSEUM

As usual, the Museum Committee, under the direction of Professor Herbert L. Beckwith, ran a number of minor shows in the lobby of Building Seven and nine major shows in the Hayden Gallery. Three of the latter — on Greece of the Fifth Century B.C., France of the Thirteenth Century A.D.,

and the Renaissance in England and Italy — were in support of the core curriculum as in years past; three were borrowed from other agencies; and three were prepared by the Museum Committee. The latter included a showing of twenty-one sculptures by the American, Ibram Lassaw, his largest one-man show to date and the first in New England; a showing of twenty-eight paintings of the Hudson River School, loaned by the Fruitlands Museum in Harvard, Massachusetts, and the Vose Galleries of Boston; and a special exhibition of rare string instruments from the collections of Emil Herrmann, Rembert Wurlitzer, and others, arranged in collaboration with Professor Liepmann.

PROBLEMS

A year ago I cited four "troubles." Three of these have been resolved or are on the way to resolution, as this report has told. The problem of the place of psychology at M.I.T. remains to be dealt with, but this is an interschool problem. In concluding this account of the year's activities, I cannot help wondering whether I am growing old. For the first time in several years it seems impossible to conjure up any dynamic, new, and pressing question. We do need to fund more professorial chairs, to integrate the Center for International Studies more fully with the general academic life, to begin developing a center for the study of the history and philosophy of science and technology. We do need to find a few more good undergraduates in Courses XXI and XIV; we must never become complacent about the quality of our staff and must continue to find productive and imaginative newcomers; we shall have to provide more offices and classrooms. These are not trivial questions, but they are not frightening questions either. We must not sit down on a stone in the shade, and there are some things which we must work steadily to achieve in the near future; but perhaps we can do this at a steady pace rather than at the quickstep which has marked so much of the past decade. In short and in sum, it has been a good year.

JOHN E. BURCHARD

SCHOOL OF INDUSTRIAL MANAGEMENT

The School of Industrial Management is now five years old. As I look over the annual reports which have preceded this one, I relive the trying experience of having to report mainly on our hopes and having to record the slow steps in the year-to-year progress of acquiring and assimilating new staff. Only as this took place could programs be formulated and tried out.

Now the School is an established enterprise taking its recognized place along with the four older schools at M.I.T. This report can record programs in being and the accomplishments of staff and students. Our Fifth Anniversary Convocation, which I will describe later, symbolized, for all of us, this coming of age. And it is only the beginning.

The thought processes in establishing a school are ever-evolving. Concepts take shape as men are acquired and work together motivated by a common aim. One finds difficulty in saying when an idea took form, for the original spark may have been faint indeed. But the interplay of good minds, always with an imaginative approach, brings forth gradually and sometimes haltingly a concept which permits us to say — let's move forward on this. This is the building process.

From the beginning, nothing has deterred us from our belief that we were training men for the world of action and for the world of tomorrow. They must acquire basic understandings along with techniques of analysis, and there must always be the realization that these techniques and knowledge find expression in the dynamism of American life.

Our aim has been to prepare men for the general management of enterprises rather than to train for functional or staff specialties. A man's role in management — be it in sales, production, finance, accounting, or administration, as a beginner or after years of practice — can be better performed

if he has a working understanding of the total business enterprise and the complex interrelationships of its organizational parts. Management is not yet a science, but an art immensely and increasingly benefited by the application of scientific methods to its many complex and interrelated parts.

THE CONVOCATION

A convocation was held in Cambridge on April 9, 1957, to commemorate the fifth anniversary of the School and to spread effective understanding of its programs and purposes. More than five hundred men from industry and business, universities, foundations, and other organizations gathered in Kresge Auditorium despite the snowstorm that greeted us that morning. They came from all parts of the United States and Canada. Over half of this audience was made up of officers and directors of companies.

The Convocation had two objectives: first, to acquaint representatives of American industry with the fact that there was now established at M.I.T. a School of Industrial Management, taking its place with the long-established Schools of Engineering, Science, and Architecture; and second, to give some sense of the direction the programs of the School were taking and the standards of excellence the School sought to establish.

All of this could not be accomplished within our time limits. It was necessary to choose from among the several fields three areas which would typify significant developments. Professor Jay W. Forrester spoke on "Systems Technology and Industrial Dynamics," Professor Douglas M. McGregor on "The Human Side of Enterprise," and Professor Eli Shapiro on "Financial Forces in Industrial Growth." The warm reception of the speeches and the continuing demand for copies of the proceedings are ample proof of their significance.

The afternoon session was devoted to a subject of growing significance to the students and practitioners of management — the role of the corporate director. The panel which discussed this topic, much to the pleasure of the audience, was composed of Dr. Vannevar Bush, Dean Eugene Rostow of the Yale Law School, David A. Shepard, Director of the Standard Oil Company (New Jersey), and Sidney J. Weinberg. The moderator of the panel was Dr. Lyman Bryson.

President Killian, presiding at the dinner session, paid

tribute, speaking for all of us, to Alfred P. Sloan, Jr., for making possible through the Sloan Foundation the establishment of the School of Industrial Management at M.I.T. Mr. Sloan, in his brief and impressive reply, stated his aims in establishing such a school and his ambitions for it. The principal speaker of the evening was Cleo Craig, then Chairman of the Board of American Telephone and Telegraph Company. His speech, "Tomorrow's Managers," was a notable address long to be remembered by those privileged to hear it.

Thus this Convocation brought into focus the present status of the programs which have been developed as a result of the building process of the last five years.

THE UNDERGRADUATE PROGRAM

The students enrolled in Course xv, the undergraduate program of the School, devote three-quarters of their four years to the study of science, engineering, and the required humanities subjects given by the various departments in the Schools of Science, Engineering and Humanities. In the remaining one-fourth of this time they come under the faculty of the School of Industrial Management where they receive an introduction to an understanding of the business process. This leads them into the areas of accounting for managerial purposes, marketing, quantitative approaches to production problems, administration, and organization.

These subjects undergo constant improvement, moving steadily away from the descriptive aspects of the components of business and toward the analytical approach to the problems of management.

The School receives a steady transfer of students in the junior and senior classes who discover that they are inclined toward the management of industry rather than toward professional engineering or some field of science. This is a natural discovery for a certain number of students who start out believing that they wish to become engineers or scientists and find instead that their aptitudes lie in other directions. Course xv is designed for the M.I.T. undergraduate who wishes to make his contribution to society as a manager of people rather than of things. As long as the rigor of our program is maintained and its academic standards are held high, this transfer movement is to be encouraged.

We have experienced a second year of success with our Honors Program, which grants special attention to outstanding seniors. A number of exceptional students, selected by the faculty, are granted the opportunity to work with a staff member of mutual choice on some problem agreed upon between them. The tasks undertaken give these students, who are equipped to carry an extra work load, an exposure to practical problems which helps prepare them for the industrial realities they will experience upon graduation.

The enrollment in Course XV continues at about its historical percentage of the undergraduate body at M.I.T. Bachelor's degrees in June numbered seventy-nine, more than 10 per cent of all bachelor's degrees awarded by the Institute.

THE GRADUATE PROGRAM

The enrollment in the two-year graduate program continues to grow in accordance with our planning. The dimensions of the program are based, of course, on the number and qualifications of the instructing staff. During the academic year just closed, 107 students were enrolled, up 75 per cent from the year before; they came from fifty American collegiate institutions and eighteen foreign universities. Of this number, 9 had completed their undergraduate work at M.I.T., either in Course XV or in other departments of the Institute.

We have found it increasingly possible to provide our best graduate students with both experience and financial assistance in the form of part-time graduate research assistantships. Through this program a graduate student is allowed to work one-half or one-third time with a member of the faculty on a major problem of faculty interest. We have found this method a realistic vehicle for providing intensive research experience for the qualified student.

During the year, the School of Industrial Management was admitted to membership in the American Association of Collegiate Schools of Business. Although our program is in some ways unique in content or emphasis as compared with those of other business schools, membership in this Association testifies to the recognition of quality of staff and curriculum; the School thus takes its place among the recognized schools of administration and business in the country. Accreditation also indicates the recognized emphasis on management in all the programs of the School.

EXECUTIVE DEVELOPMENT PROGRAMS

The undergraduate and graduate programs of the School are designed to produce men with special qualifications to enter the world of management at the lower levels. Although the new graduate's first assignment is likely to be in one of the many functional divisions of the typical industrial company, he has not been educated as a specialist in any field. The aim of these programs has been to give to such men an understanding of the components of industry as such and as a whole.

The important Executive Development Programs of the School are devoted to men who already have demonstrated managerial ability and who show great promise of further executive potential in their companies.

The Alfred P. Sloan Fellowship Program is our principal effort in this important area of advanced education. The Program, made possible by the continuing support and vision of the Alfred P. Sloan Foundation, Inc., awarded Fellowships for a full year's intensive graduate study in management to thirty-four men during 1956–57. These men had a median age of 33.8 years and had approximately ten years of industrial experience in the case of veterans and some fifteen years of industrial experience for nonveterans. This year all thirty-four elected to work for the master's degree and were awarded this degree in June, 1957.

Nineteen of the Sloan Fellows came from companies which had previously sent us men, while ten companies, sending fifteen Fellows, participated for the first time. We like the confirmation of the success of the Program which is accorded us when a company once having had a Sloan Fellow wishes to enter another. At the same time, companies sending a man for the first time enlarge the base from which we draw our candidates.

The first ten-week Program for Senior Executives, described in my report of last year, was followed by two such programs in the past year, one of ten weeks in the fall and the second in the spring, comprising seventeen and twenty men, respectively. Members of these groups are senior in position to the Sloan Fellows and have an age range of between forty and fifty. M.I.T. Endicott House, where the men live, is an essential element to helping these Senior Executives get the most out of a very rigorous and demanding course of study.

The most effective utilization of the superb accommodations of Endicott House, together with what we believe to be the optimum class size for this type of group, limits the size of each future group to twenty men. The comments on the results of the programs, coming from executives of companies sponsoring men, from those who attended, and from the faculty, convince us that this Program for Senior Executives fills a vital need and that our somewhat unique approach meets with favor. As increases in staff are made possible, I am sure additional ten-week sessions would meet with a ready response from industry and at the same time strengthen our whole School program.

A major new development affecting the School is the establishment of the Society of Sloan Fellows of M.I.T. This Society, comprised of former Sloan Fellows, now has an approved Constitution and a Board of Governors. There seems little doubt that the 270 former Sloan Fellows have at their command great potential for the further support and encouragement of the Program at the School.

In the public mind the popular word "refresher" is applied to all courses designed for men who leave their active careers and come back to school for a period of study. If an executive had need for modern inventory procedure or market research techniques, for example, a course reviewing earlier and partially forgotten principles and bringing one's thinking up-to-date might be called a "refresher." But the word hardly applies to the courses arranged for either the Sloan Fellows or the Senior Executives. For, in both cases, the men are exposed to new knowledge and new thinking and acquire new vision and new understanding.

SPECIAL PROGRAMS

As the School develops, we find increasing opportunities for serving the business community by offering short programs in specific fields, varying in length from one day to several weeks. These provide an opportunity for managers in various phases of industry to learn of new developments relevant to management practice which are the outcome of the studies made by our own staff as well as by others conducting research in the field. The questions raised by those attending and their practical experience, in turn, bring to us vital feedback of great value.

During the summer Professor Robert B. Fetter, in conjunction with the M.I.T. Operations Research Project, conducted a two-week program on the use of concepts of probability and statistics in making decisions in production and inventory problems.

Professor Albert H. Rubenstein, in collaboration with Professor Herbert A. Shepard of the Department of Economics and Social Studies, conducted a two-week program in the summer on "Organization for Research and Development." Requests for admission to this program far exceeded our ability to handle the number applying, and the course was limited to thirty-six.

Professors Robert H. Gregory and Richard B. Maffei held a one-week program in "Data Processing and Management Information." Here again the numbers applying exceeded our capacity.

A third in a series on "Human Relations in Laboratory Management" was conducted by Professors Rubenstein and Shepard.

The School participated in M.I.T.'s Industrial Liaison Program by conducting two one-day symposia. The first was under the chairmanship of Professor Howard W. Johnson and entitled "Executive Development: An Appraisal of Current Approaches." The second, under the chairmanship of Professor Sidney A. Alexander, was entitled "Forecasting Economic Trends." Those attending these Industrial Liaison Program symposia are confined to representatives of the industrial companies participating in this program.

STAFF ACTIVITIES

As is to be expected, the members of the staff of the School are called upon for many activities beyond the classroom and their own research interests. They are asked to serve on committees of professional societies, to deliver lectures at other institutions, and to make countless speeches. These activities are time-consuming but contribute to the professional development of the staff member and result from the recognition the men have gained in their respective fields. I can mention here only some of the noteworthy examples of this recognition.

Professor Shapiro made a hurried trip to Paris in the spring to set up plans for a three-week course on management education which he is giving this summer at the Loughborough

Technical College in Loughborough, England, for twenty-five European professors. The course is under the sponsorship of the European Productivity Agency.

Professor Edward H. Bowman conducted a two-week seminar on "Operations Analysis" for the Air Force Institute of Technology at Wright-Patterson Air Force Base. He was also granted a leave of absence for three months to serve as a consultant to the Logistics Department of the Rand Corporation, working on manufacturing problems in the airframe industry.

Professors Leo B. Moore and Herbert F. Goodwin again participated in the Work Simplification Programs at Lake Placid and Sea Island. Professor Moore was a member of the staff and participated in the Annual Creative Problem-Solving Institute at the University of Buffalo. Professor Goodwin was in charge of seminars on work simplification sponsored by the National Metal Trades Association, the New England Shoe and Leather Association, and the Society for the Advancement of Management.

In the latter half of the spring term, Professor Erwin H. Schell (Emeritus) visited Australia as the guest of Walter D. Scott and Company, management consultants, and the Australian Institute of Management. During his two-month stay in Australia, Professor Schell made sixty addresses to students of business administration and to groups of industrial executives in six of the principal cities of Australia. On his return trip he presented a paper at the Eleventh International Management Congress in Paris. Professor Schell has been Chairman of the Program Committee for the United States for these Congresses, held in Stockholm, Brussels, Sao Paulo, and Paris.

Professor McGregor served on the staff of the National Training Laboratory's "Executive Workshop" at Arden House. He also served as Chairman of the Problems and Policies Committee of the Social Science Research Council.

The Dean suffered under the customary occupational hazard of making speeches. He participated in the programs of the two M.I.T. Regional Alumni Conferences, one at Tulsa, Oklahoma, and one at Chicago, Illinois.

Professor Thomson M. Whitin continues on leave of absence as the Chief Economist in the Operations Analysis Section of the Atomic Energy Commission.

Professor Elting E. Morison was on leave of absence during the spring term to continue his work on the Stimson Papers. He has been elected an honorary member of the Harvard Chapter of Phi Beta Kappa.

Professor Gerald B. Tallman was on a leave of absence during the spring term to serve as professor in charge of marketing instruction at the Istituto Post-Universitario per Lo Studio Dell'Organizzazione Aziendale in Turin, Italy.

Professors Thomas M. Hill and Myron J. Gordon have continued on the Hospital Operation Study at the Peter Bent Brigham Hospital, sponsored by the U. S. Department of Health, Education, and Welfare. As a result of this study, major changes in administrative organization and practices have been effected. This research has attracted considerable interest in the field of public health.

Professor Hill again this year served on the American Accounting Association's Committee on Concepts and Standards, completing a two-year project of revising the Association's statement of the theoretical principles underlying corporate financial statements.

Professor Douglass V. Brown continues to serve as a member of the Research Advisory Board of the Committee for Economic Development.

Professor Rubenstein served as a University Seminar Associate at the Columbia University Seminar on the Theory of Organization and Management.

In addition to the activities reported above, many of the School's faculty served as consultants to companies together representing most categories of industry and business. These experiences, typically involving planning and operations as well as management training and education at top levels of the organization, were obviously of benefit to both the companies and to our staff members. Where such consultation fits the M.I.T. policy framework, faculty members are encouraged to participate in these kinds of consulting relationships.

RESEARCH AND PUBLICATIONS

Although a complete listing of all publications of the members of the staff of the School is included elsewhere in the President's Report, it is fitting that I should mention here, under this appropriate dual heading, certain developments of the year.

Professors Bowman and Fetter's book, *Analysis of Production Management*, published by Richard D. Irwin, Inc., appeared in February and has received wide acceptance and favorable comment.

Professor Billy E. Goetz' *Management Planning and Control* has been adopted by McGraw-Hill as the July selection for the Business Book Club.

Professor Rubenstein has begun a study for the Federal Reserve Bank of Boston on "Problems of Financing and Managing New Research — Based on Enterprises in New England."

Professor David Durand's manuscript, "Bank Stock Prices and the Bank Capital Problem," has been published by the National Bureau of Economic Research.

Professor Gregory C. Chow's book, *Demand for Automobiles in the United States: A Study in Consumer Durables*, was published by the North-Holland Publishing Company, Amsterdam, Holland, as a volume in the series of "Contribution to Economic Analysis," edited by Jan Timbergen.

Professors Hill and Gordon are revising their basic accounting text, *Accounting: A Management Approach*, specifically for first-year graduate students and for the Sloan Fellowship Program.

Professor Edwin Kuh's book written with John Meyer, *The Investment Decision: An Empirical Study*, has been published by the Harvard University Press.

Professor Shapiro, in addition to his teaching, research, and administrative duties, found time to prepare and have published several papers resulting from his research and studies, all of which are listed elsewhere.

The spirit of research leading to discovery, to innovation, and to new thinking, which characterizes this M.I.T. environment, now has its well-established counterpart in the School. I shall not attempt here to list all the work now proceeding but choose examples indicating the wide interests of our staff.

Professor McGregor's project, originally undertaken in collaboration with Professor Alex Bavelas, is proceeding after a delayed start; results of significance can now be predicted. The purpose of this study is to gain a deeper understanding of the significant variables involved in the successful career development of industrial executives. This is a project undertaken under a special grant from the Sloan Foundation.

Professor Ross M. Cunningham's work on brand loyalty has continued to attract the attention of schools and industrial firms and is being actively pursued.

Professor Gordon Shillinglaw is continuing his research on the purposes and methods of internal profit measurement.

Professor Gordon's work on his common stock value project is reaching its final stages with promise of making a substantial contribution to our knowledge of certain questions of corporate financial policy.

Professor Edgar H. Schein is continuing his research begun with the military on the development of organization within small problem-solving groups. He is also supervising a follow-up study of 150 American prisoners of war of the Chinese Communists during the Korean War. This study is an attempt to discover the kind of adjustments these men have made since their return to civilian life in the United States.

Under a two-year National Science Foundation grant, Professor Marvin E. Shaw is studying the relationships between leadership style, group structure, and communication patterns in small problem-solving groups.

Under the leadership of Professor Forrester, who joined our staff as Professor of Industrial Management last September, a program of research has been initiated in the field of industrial dynamics. This may well develop into a new breakthrough in the application of techniques of high-speed computing to some of the vexing problems in managerial decision making. The School applied for a grant from the Ford Foundation for pursuit of studies and research in this area, and $275,000 has been granted to cover a five-year period.

Another major research project in this broad field is under way for the Sprague Electric Company, under the leadership of Professor Forrester and certain members of the staff. The results of this three-year study hopefully will be of practical value to the Company, while providing our staff with excellent opportunities for research in certain organizational and operational fields.

The School is in a most favored position in having a fund granted to it by the Sloan Foundation, the income of which may be used by the administration of the School in supporting individual pieces of research which require funds which are often quite nominal. In some cases, an initial grant

from this fund makes possible a preliminary study to disclose the likelihood of a worthwhile project which can later be supported by a further grant or from other sources. This pump-priming, as it were, can be of considerable significance in obtaining funds to support research, and we expect to see this happen frequently as our research programs become better established.

STAFF CHANGES

Chadwick J. Haberstroh comes to the School as an Assistant Professor from Carnegie Institute of Technology, where he was a Research Fellow in Industrial Administration.

Dr. Joseph V. Yance, who has spent the past year on Dr. Forrester's research on dynamic models, has been appointed an Assistant Professor. He is working with Dr. Forrester in putting together the first subject of instruction growing out of their studies.

Dr. George F. Hadley, who began his career in industry after receiving his Ph.D. degree in physics, came to the School of Industrial Management for his master's degree and now is appointed an Assistant Professor.

Two Research Associates have been appointed for the coming year: Theodore M. Alfred will work with Professor McGregor on his research, and Jack A. Arnow will assist Professor Forrester.

Thomas M. O'Farrell has been appointed Assistant to the Director of the Executive Development Programs.

Professor Floyd B. Gillis resigned to go to Purdue University.

Dr. Warren Torgerson resigned to accept a research position in the Lincoln Laboratory.

When Professor Shapiro agreed to become Associate Dean of the School following the death of Professor Robnett in 1954, he stipulated the period he would so serve. That period now having expired, Professor Shapiro has relinquished the office to devote full time to his teaching and research. For the current year he will be on leave of absence, having been awarded one of the highly prized Ford Foundation Fellowships for research in his field of finance.

The period during which Eli Shapiro has been my associate in the administration of the School has covered its formative years. During this time our staff was being assembled

and programs shaped. In all of this, and particularly in establishing our standards of scholarship and our goals of excellence, Professor Shapiro played a major part. His contributions will leave an indelible stamp on the School and on education for management.

For the current year, Professor Douglass V. Brown will be the Acting Associate Dean.

In the Fall of 1956, Professor William Van Alan Clark, Jr. was appointed Assistant Dean.

Thousands of graduates of Course XV will be saddened to learn that Miss Olive Barnard died suddenly in September, three months after her retirement under the Institute's retirement plan. In her thirty-eight years of service, Miss Barnard contributed much to the success of Course XV and to the establishment of the School of Industrial Management. She was respected and held in deep affection by literally thousands of M.I.T. graduates, most of whom she could call by name. At the recent Alumni Day exercises at M.I.T., Miss Barnard was made an Honorary Member of the M.I.T. Alumni Association, an action received with obvious approval by the large audience present.

VISITORS TO THE SCHOOL

As the School has grown in stature and reputation, it has increasingly been called upon to report on its activities to visitors from abroad. We were hosts to nearly a dozen major groups of industrialists or scholars from a number of countries, including Spain, Japan, Denmark, Austria, Norway, Germany, and England. Professor P. L. Henderson of the University of Melbourne spent the fall semester with us as a Visiting Fellow. We were also visited by over twenty-five individual scholars from abroad for shorter periods of time.

In addition, several schools of business and administration in this country have sent representatives to visit us and consult on matters of curriculum and methodology.

STUDENT LIFE AND ACTIVITIES

It is natural that young men motivated toward management should possess leadership qualities that lead them into many positions of responsibility in undergraduate and graduate life at the Institute. In the fraternities and in many student activities our men are more than well represented in positions

of leadership. There could be no better management laboratory than successfully administering these enterprises, which often require unusual qualities of judgment, organizing ability, and character.

The M.I.T. Management Association — the undergraduate society — and the more recently formed Graduate Management Society perform valuable services to the members and are an important link in student-faculty relations. For the past three years the graduate society has created a very intelligent indoctrination program for incoming graduate students. It assists the married students, who comprise a full third of our graduate student body, with their housing problems; and through a series of social affairs it develops a fine morale in the graduate student body. For its accomplishments, the Graduate Management Society received the coveted Compton Award for "promoting high standards of performance and good citizenship within the Institute community." A check for $500 accompanied the certificate.

The amenities are of immense importance to young men entering on a career in management, and we seek to encourage their development in all ways open to us. In this connection the Erwin H. Schell Room and the Robnett Graduate Lounge, both gifts of alumni of Course XV, are of great usefulness. One of our important needs is for funds to suitably furnish the lobby of our Sloan Building as a gathering place for students when not in class and to provide other facilities of a similar nature, which would greatly further the students' getting together with each other and with members of the faculty.

PLACEMENT OF GRADUATES

There is ample evidence that industry is in as short supply of men with the training offered by this School as it is for men trained to be engineers or scientists. Over 40 per cent of the companies sending representatives to M.I.T. to interview students asked especially for graduates from this School at either the bachelor's or master's level. It is a fair estimate that our students averaged nine interviews per man. This situation puts every man in a difficult position when deciding on his first job. Salaries offered are high, but money is not the first consideration in most cases. On the whole, graduates base their choices on where they think their best opportunity lies, and they exercise good judgment in doing so.

ADVISORY COUNCIL

Our Advisory Council, comprised of distinguished men of industry, serves the School well by providing us with a vital management sounding board as well as with continuing industrial contacts for the Dean and other members of the staff. In October, in what has come to be the annual meeting of the Council, a full day's meeting at the School was devoted to reviewing the School's programs, and the discussions which took place brought out much of value to those of us whose noses are close to the grindstone. We are deeply indebted to Mr. Sloan and the others who attended for their great interest in the School and for their helpful suggestions and comments.

ALWAYS THE LOOK AHEAD

Five years is a short time in the life of an educational institution such as this, and the first five years can only indicate the shape of things to come. We are well established as a going institution. We are becoming recognized as a school of high standards and rigorous programs and for an imaginative approach to education for management. We hope to turn out men at all levels of instruction with an understanding ready for a life of action guided by a respect for thought.

Growth in numbers as well as influence is inevitable. The demand for students trained as ours are and coming from the environment of science, engineering, and research which characterizes M.I.T. is large indeed and seems to be growing. But our success must always rest on quality rather than size of student body or numbers of programs. Financial resources now existing are already limiting the development of our certain potential. In the final analysis, the support accorded us by individuals, foundations, and American industry itself will be the measure placed by them on the success of our aims. I believe this support will be forthcoming.

E. P. Brooks

THE SCHOOL OF SCIENCE

As the School of Science approaches the beginning of its second quarter century, it is developing into an entity with great organic strength and *esprit de corps*. Interesting and lengthy discussions among its faculty members and administrative officers have resulted in the formation of a body of educational opinion which is gradually making itself felt most constructively. Formal policies designed to improve further the professional training of scientists are now being considered by the Science Council.

A development that has become increasingly important during recent years is the growing concern of both scientists and engineers for educational policies, particularly in regard to undergraduate education. The inclusion of increasing amounts of science in the general education of all M.I.T. students raises a whole range of difficult problems which are gradually being overcome. Most of the engineering disciplines require continually more advanced physics instruction, thus necessitating the creation of new subjects and the assignment of new staff members. Faculty members whose time has been fully occupied with their regular teaching duties and their research projects are eagerly making room in their schedules to handle these many new educational challenges.

An example of this spirit is afforded by the Physical Science Study Project initiated by Professor Zacharias, assisted by Professor Francis Friedman. This enterprise, which has won the financial support of the National Science Foundation, is an effort to create a distinct change in the science curriculum of American secondary schools by setting up a new senior course in physics, together with all the supplementary material needed by high school teachers. The group has already demonstrated that such a major challenge can be made to

enlist the support and collaboration of distinguished scientists from all over the country, and a large number of members of our Physics Department also have willingly and effectively participated in the initial phases of this ambitious project. Teaching techniques and aids which may well be as important to the solution of our own problems as to the high school science program are being discovered and assimilated. It will be most interesting to observe the evolution which this challenging program will undergo in the process of adoption by the high schools.

The teaching programs of the science departments are being modified in various degrees throughout the School, as will be seen from the reports of the department heads given below. The earth and life sciences have added elementary electives to the curricula required of those intending to continue in these disciplines. The Mathematics Department is finding ways of coping with the greatly increased demand for mathematics subjects throughout the undergraduate curriculum. The chemistry undergraduate curriculum has been greatly changed to provide a better approach to a new concept of chemical education, described in greater detail below.

The Physics Department also has been vigorously studying ways of meeting the challenges of an increased load and of revised Course content. With limited manpower, limited space, and limited time, the conduct of teaching operations involving very large groups makes necessary more intensive study of educative processes for their own sake. Problems relating to the use of laboratories for large groups are particularly acute here and are receiving careful attention. Considerable success has been achieved in the more effective use of existing facilities, but some expansion is needed to meet our educational challenge fully. Such problems require devoted attention over many years.

The recent abandonment of the undergraduate curriculum in meteorology, far from being a retrenchment on the part of M.I.T. in this field, is a reorientation of our educational philosophy. Meteorology is rapidly becoming a quantitative science, and meteorologists need much more preparation in the physical sciences and mathematics than was formerly required. So much professional work must be deferred to the graduate years that it is now no longer realistic to pretend that professional competence can be acquired in an

undergraduate curriculum. Because we wish to give the prospective meteorologist a broad training in the earth sciences, it is also desirable that he receive at least an introduction to the other major fields of earth science during his undergraduate years.

The new undergraduate curriculum of the Department of Geology and Geophysics is well designed to provide the type of undergraduate education now considered best for the student who wishes to specialize in meteorology at the graduate level. It will permit him to acquire the necessary basic background in science and mathematics, to gain some acquaintance with geology and oceanography, and to take enough meteorology so that he may enter graduate work without difficulty. We believe that this represents a definite advance in the undergraduate education of a meteorologist, and we hope that many students will follow this path.

PERSONNEL CHANGES

Professor Francis Bitter of the Physics Department was appointed Associate Dean of the School on October 25, 1956. The School is especially fortunate in obtaining as its Associate Dean a person of Professor Bitter's talents and experience in the improvement of undergraduate education, as well as in the proper balancing of undergraduate education with graduate education and with research. He has in the past made signal contributions to the teaching of freshman and sophomore physics at the Institute. With the science department heads and others who are working continually on the improvement of educational methods, Dean Bitter can be expected to make further outstanding contributions.

On January 1, 1957, Dr. Irwin W. Sizer, former Acting Head of the Department of Biology, was made Head of that Department, and Dr. Patrick Wall was made Executive Officer. Professor Sizer and his colleagues have been putting into effect the policies adopted as a result of the intensive study of biology and its long-range objectives at M.I.T. made by a group of distinguished biologists from other institutions, invited to meet as advisers. Out of their recommendations has come the decision not to attempt to cover too broad a spectrum in biology here but to specialize in those areas for which we are especially well equipped. A concentration on molecular biology approached through the avenues of biochemistry, biophysics, and physiology seems to constitute an ideal central theme for our

Department. In addition, the Biology Department should serve as the focus of all research in the life sciences and should establish joint seminars and conferences to encourage biological research here.

Early in September the MathematicsDepartment suffered a tragic loss in the fatal accident of Professor Witold Hurewicz. Professor Hurewicz, a member of the Department since 1945, had attended the International Symposium on Algebraic Topology at the National University of Mexico. He met his death as a consequence of a fall from a pyramid in Uxmal, Yucatan. Professor Hurewicz is sadly missed both as a person and as a colleague.

MAJOR RESEARCH ACTIVITIES

An outstanding event of the year was the completion of the Karl Taylor Compton Laboratories, dedicated on June 10, 1957. While it is not expected that new fields of investigation can be attacked because of this new facility, there is a cogent reason for believing that the Compton Laboratories mark a milestone in the evolution of scientific research at M.I.T. Many of the outstanding groups of research workers in contiguous fields have, during the past decade, been widely separated on the campus. This physical separation, foreign to the principal M.I.T. tradition, has reduced the very desirable opportunities for spontaneous discussion by key people. Not only will the Laboratories provide common working space for scientists working in related areas, but they will also create a greatly improved atmosphere for the breeding of ideas.

In addition to housing the new Computation Center and many activities of the Research Laboratory of Electronics, the Laboratories will provide space for about one-third of the activities of the Laboratory for Nuclear Science. The new quarters will contain the cosmic ray group offices and campus laboratories, parts of the theoretical groups, the bubble chamber and nuclear emulsion scanning rooms and laboratories, the high-energy counter and electronics laboratories, the synchrotron staff offices, and the Laboratory's headquarters, including its purchasing facilities, drafting room, electronics shops, electronic stockroom, and instrument pool.

INTERDEPARTMENTAL LABORATORIES

After educational problems are considered, the point of greatest interest concerning the School is its relationship to the body

of science itself. This involves particularly the long-range research programs of the various departments and the effectiveness of the School in fostering the most significant aspects of the research programs of its staff members.

Of outstanding importance is the role of the interdepartmental laboratory. We are fortunate in having a variety of such laboratories which have been functioning for some time with outstanding success under the wise administration of able scientists. These laboratories greatly further programs which involve collaboration among groups of workers in different departments. Their contribution is not, however, confined to team research involving large groups. The work of many smaller groups on important projects requiring only a few specialists is greatly advanced by the many services which the interdepartmental laboratory can provide. This feature of organization and administration appears to be with us to stay, because of the effectiveness with which it supplements our departmental structure in handling research activities. Ideas are continually being generated by the heterogenous groups brought together frequently and informally. New solutions to many problems of government and industry are being discovered. Large funds on a continuing basis are successfully solicited and effectively spent in organizations especially created for this purpose. And finally, because of the above factors, the interdepartmental laboratories have proven most effective in attracting outstanding faculty members.

During the past ten years noteworthy progress in research has been made in the Laboratory for Nuclear Science, under the directorship of Professor Jerrold R. Zacharias of the Department of Physics. Pressure of other duties led to Professor Zacharias' resignation as Director during the past school year, but he accepted temporary Chairmanship of a new Directing Committee of the Laboratory. After serving for several months on an interim basis, Professor Zacharias was succeeded by Professor Martin Deutsch as Chairman of the Committee, whose members now include Professor Zacharias, Professor Victor F. Weisskopf, and as *ex-officio* members, Professor Nathaniel H. Frank, Chairman of the Department of Physics, and Dr. Peter T. Demos, Associate Director of the Laboratory.

The growing importance of the several earth sciences and the need for expanding and integrating them in the M.I.T.

community were recognized by the appointment of an *ad hoc* committee consisting of three representatives each from the Departments of Meteorology and of Geology and Geophysics to make recommendations for the future development of these sciences at M.I.T. The committee recommended the development of a course of instruction in which the fundamentals of science are presented against a background of the most challenging problems concerning the nature, dynamics, origin, and history of the earth system — the solid earth, the atmosphere, and the oceans; the development of a diversified program of research in which the observational, experimental, and theoretical aspects of the several earth sciences would be equally emphasized; and the raising of funds needed to obtain adequate space and facilities to fill existing gaps and further strengthen the current effort. These recommendations were approved by the visiting committees of the two Departments concerned and by the administration, and steps have been taken during the year to get this program underway.

A new interdepartmental Laboratory of Earth Sciences, designed to foster the development of interdisciplinary research in the earth sciences, has now been established as a joint enterprise of the Departments of Meteorology and of Geology and Geophysics, with Professor Henry Houghton as Director. Many of the major problems of our physical environment demand such an integrated attack if solutions are to be achieved. A number of the current research projects of the two departments will come under the organization of the new Laboratory.

The two departments concerned will jointly offer a series of five subjects at the fourth-year and graduate level in the principal areas of classical physics polarized around the earth sciences. These subjects will be thermodynamics, hydrodynamics, geodynamics, electrodynamics, and theoretical elasticity and plasticity. The first three will be offered during 1957–58. The desired subject matter in electrodynamics is now partially available in other departments, and the subject in elasticity and plasticity is under consideration.

The Departments of Geology and Geophysics and of Meteorology deal with the solid earth and the atmosphere, respectively. The third important area of the earth sciences is oceanography. Cooperation with the Woods Hole Oceanographic Institution has been sought and enthusiastically

accepted. Three of the Institution's staff members gave a two-term sequence in oceanography for our students during the current year. This arrangement will be continued and strengthened next year, when certain key Woods Hole staff members will hold M.I.T. appointments. It is also contemplated that some graduate students will do research at Woods Hole. Other joint research and seminar activities will also be fostered.

The various researches now being carried on by the School staff are described in the reports of the departments which are given below. (See also the reports of the Laboratory for Nuclear Science, the Research Laboratory of Electronics, and the Spectroscopy Laboratory, which appear in the section on interdepartmental laboratories.

GEORGE R. HARRISON

DEPARTMENT OF BIOLOGY

The number of undergraduates registered in Course VII remains constant, at about thirty-six. About two-thirds of these are preparing for medicine, another fifth are going on to graduate school in biochemistry and biophysics, and the remainder are planning to do industrial research.

However, students taking the undergraduate and graduate subjects of the Department are by no means limited to those in Course VII. Out-of-Course students come mainly from the Departments of Chemistry and Food Technology and the Course in Humanities and Science. Students not majoring in biology have, during the last few years, increased to 41 per cent of the total attendance. It is expected that this percentage of nonbiology majors will increase with the growth of the programs in biophysics, biochemistry, and microbiology.

The subject Perspectives in Life Sciences, which emphasizes the quantitative aspects of biology and the application of the physical sciences and engineering to the solution of biological problems, was taught by Professor Patrick Wall during the spring term. Cytology and Genetics has been extensively revised by Professor Herman Lewis and now includes consideration of biochemical and viral genetics in contrast to the classical Mendelian genetics, thus fitting in well with the advanced work of the Department in biochemistry and microbiology. Under the supervision of Professor Richard S. Bear,

Introduction to Biophysics was taught as a new subject, being given as a cooperative assignment in which a large number of biophysicists at M.I.T. participated. Although it required a considerable background in mathematics, physics, and chemistry, the amount of biology required was minimal, so that many nonbiology majors in science and engineering could take it.

The number of graduate students in the Department, still slowly increasing, now stands at thirty-five. Most of these students are candidates for the Ph.D. degree in physiology, biochemistry, or biophysics. Of the graduate courses, the biology seminar was taught by Visiting Professor Paul Weiss of the Rockefeller Institute. This unique advanced subject in growth and development was designed to be of special interest to research workers in the field of molecular biology; one session was taught at the Rockefeller Institute with the cooperation of Dr. Detlev Bronk and his staff. Intermediary Metabolism was taught during the spring term by Professor John Buchanan and Mr. Lewis Lukens as an advanced graduate subject for both chemists and biochemists. Particular emphasis was laid on the use of isotopic tracers in the study of various problems of biosynthesis and the interconversion of organic compounds inside the living cell.

There has been a steady growth in the postdoctoral training program of the Department. Many persons with Ph.D. and M.D. degrees come to M.I.T. to take advanced graduate subjects and to participate in the research programs of the Department. Most of these students are supported by national postdoctoral fellowships. The postdoctoral program for medical men is well supported at the present time by the Commonwealth Fund, but further support for the Ph.D. postdoctoral program is now being sought.

RECENT EVENTS

Professor Francis O. Schmitt's contributions to research in biology were recognized during the year when he was presented with the Lasker Award for his studies on connective tissue and was awarded an honorary degree from the University of Chicago. He and his collaborators have recently developed new views on the relation of nerve fibers to the cells immediately surrounding them and are working on the consequences of this intimate relation to nerve impulse conduction.

Professor Howard P. Jenerick and his associates have obtained most interesting results on the relation between muscle membrane potentials and their discharge characteristics. They are also working on the dynamics of muscle contraction and relaxation.

Among the biochemists, Professor Gene M. Brown has pursued his investigation of the metabolism of pantothemic acid, and Professor Buchanan has continued his intensive research on the biosynthesis of purines which play an essential role in the genesis and metabolism of cells.

Professor David F. Waugh has worked out a mechanism for the formation of fibrils from protein molecules and has isolated Kappa-casein, the key protein in the clotting of milk by rennin. Professor Cecil E. Hall has developed an improved method for the observation of macromolecules with a considerable increase of resolution. Members of Professor Bear's group, especially Drs. Carolyn Cohen and Richard Morgan, have examined the structure of large molecules by X-ray diffraction and have had particular success in comparing natural and synthetic molecules. Professor Bernard S. Gould has carried out both tissue culture and in vivo experiments on the synthesis of collagen in skin. It will be seen that there has been a multiple approach to the problems of the origin and nature of large biological molecules.

PERSONNEL

Dr. Bear leaves M.I.T. July 1, 1957, to become Dean of Science at Iowa State College. Dr. Eugene Bell has joined the Department as Assistant Professor of Biology to teach the new subject of Developmental Biology and to carry on research on the use of ultrasound in studying embryos and tissues. Dr. Patrick D. Wall has joined the Department as Associate Professor to take over the teaching of the freshman subject in Life Sciences and to carry on research on the biophysics of the central nervous system, in collaboration with the Research Laboratory of Electronics. Dr. Cyrus Levinthal joins the Department as Professor of Biophysics. He will assume major responsibility for teaching the biophysics subjects of the Department and in addition will set up a research program on the genetics and biophysics of viruses. Professor Rollin Hotchkiss, member of the Rockefeller Institute, will join the

Department in February as Visiting Professor of Biology. He will teach a graduate subject on the genetics of microorganisms and will also participate in research.

IRWIN W. SIZER

DEPARTMENT OF CHEMISTRY

So great are the recent changes in teaching methods and in the nature of chemistry itself, that a re-evaluation of the chemistry curriculum in the light of present needs has seemed desirable. Accordingly, a special departmental committee was charged with the responsibility of making such an evaluation and of recommending how best to make use of the time available for teaching undergraduate chemistry majors. The plan that follows was developed by a committee of the Department of Chemistry composed of Professors Herbert O. House, David N. Hume, John W. Irvine and Walter H. Stockmayer (Chairman), with Professors Arthur C. Cope and Leicester F. Hamilton (*ex officio*). It was adopted by unanimous vote of the Chemistry Department faculty, approved by the M.I.T. Faculty in the spring of 1957, and will go into effect in the 1957–58 academic year.

The first year remains substantially as before, with a subject in general chemistry to meet the needs of both chemistry majors and terminal students as well as possible. The second year is devoted to organic chemistry, taught essentially as it was before in the junior year, except that the laboratory is somewhat abbreviated by elimination of experiments on qualitative organic analysis. This subject is reserved for the first semester of the third year, when it can be treated more adequately and the students have had sufficient German to be able to use Beilstein's Tables. We believe that the change in the second year to material strikingly different from that in the first will stimulate interest and attract students to chemistry as a major subject.

In the first term of the junior year, concurrent with the laboratory subject in qualitative organic chemistry, chemistry majors have an intermediate inorganic lecture subject (with an elective laboratory available) and a first-semester subject in physical chemistry, as at present. Analytical instruction as

such is begun only in the second semester of the junior year. At this time the students have a one-semester subject in quantitative analysis, with approximately equal emphasis on inorganic methods and organic functional group analysis. The second semester of analytical chemistry, which is also open to graduate students, falls in the first semester of the senior year and involves instrumental methods of analysis.

The advantages of such a curriculum appear to be considerable. Organic chemistry is introduced early in the sequence, allowing the teaching of inorganic, analytical, and physical chemistry to be based on a background of at least two years of college mathematics and physics. The prior study of organic and some physical chemistry allows instruction to be given in modern analytical chemistry as it is actually practiced today, with full understanding of the principles involved and the breadth of its applicability. Inorganic chemistry as a distinct specialization apart from general chemistry emerges in the student's mind a year earlier than is possible with the usual system of advanced inorganic courses in the senior year and yet comes late enough to utilize two years' experience in mathematics and physics.

As at present, the new program includes an experimental thesis and elective subjects in advanced chemical topics during the senior year. Students are urged to obtain a broader and deeper perspective of all fields of chemistry through the elective program; they may, if their interests are already well defined, start specialization in one of these fields.

PERSONNEL

The enrollment of graduate students in chemistry, practically all candidates for the doctoral degree, reached a new high of 214 in September, 1956. The number of doctoral degrees in chemistry granted during the academic year ending June 30, 1957, also was a record number of 42.

Professor John S. Waugh assumed charge of the second semester of the freshman subject in General Chemistry, sharing responsibility for the year's work with Professor Clark C. Stephenson.

Professor Lars Gunnar Sillen served as the fifth Arthur D. Little Visiting Professor of Chemistry during the spring term of 1957 and delivered a series of twenty lectures on the subject of "Chemical Equilibria." Professor Sillen's lectures

were attended by advanced students in chemistry, members of the faculty, and guests from other institutions in the Boston area.

Professor John C. Sheehan was elected to the National Academy of Sciences in the spring of 1957, becoming the fifth active member of the faculty of the Chemistry Department to receive that honor.

Professor George E. Kimball, formerly a member of the faculty of Columbia University and currently active in the field of operational analysis with Arthur D. Little, Inc., was appointed Visiting Professor of Chemistry during the past academic year.

There wer four retirements among members of the Chemistry Department faculty at the end of the 1956–57 academic year: Professors Avery A. Ashdown, Arthur R. Davis, George Scatchard, and Charles M. Wareham. The first three of these men will hold M.I.T. appointments during the next academic year and continue to participate in either teaching or research. Dr. Roy A. Whiteker resigned as Instructor in Chemistry at the end of the academic year to accept a teaching appointment elsewhere.

Three men have accepted appointments as Instructors in the Department of Chemistry and begin their work shortly after July 1, 1957. They are Dr. Klaus Biemann, in analytical chemistry; Dr. James W. Ross, Jr., in analytical chemistry; and Dr. Dietmar Seyforth, in inorganic chemistry.

RESEARCH

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

Professor Isadore Amdur has been investigating the scattering of atomic beams by atoms and molecules to obtain information about interaction potentials. Information obtained in these experiments is being used in the calculation of properties of gases and gas mixtures at very elevated temperatures.

Professor George H. Büchi has been studying structures of naturally occurring substances. The active principles of the common sneezeweed were isolated and their constitutions established. Studies on the molecular structure of maaliol led

to the discovery of a peculiar non-Markownikoff ring cleavage of a cyclopropane. Biogenetic speculations suggested a hypothetical structure of muscopyridine, the basic constituent of musk, which has now been confirmed by total synthesis. Manool, an important but rare starting material for the preparation of perfumes, has become readily available by partial synthesis from sclareol. A careful analysis of data already available in the chemical literature has revealed the structures of ambrosin and damsin which occur in Ambrosia maritima.

Professor Arthur C. Cope has reported in joint publications studies of "transannular reactions" in six-, seven-, and eight-membered rings. These reactions have been observed to lead to products unexpected in the light of classical theory because of the activation of a hydrogen atom located on the opposite side of the ring from a functional group. The hydrogen atoms in question are activated by spatial proximity. Another series of joint papers has reported studies of amine oxides; these studies constitute a method for converting amines into olefins that is similar to but sterically different from the long-known thermal decomposition of quaternary ammonium bases.

Professor Charles D. Coryell has been investigating the fission of natural uranium by deuterons and has shown that over 80 per cent of the fission follows capture of the whole deuteron. In addition, seven new isotopes of palladium and silver found in the nuclear fission reaction have been identified. Very interesting patterns of nuclear isomerism are demonstrated among these.

Professor Frank A. Cotton is studying the detailed nature of chemical bonding in complex ions, in particular by modern methods of X-ray absorption, magnetic susceptibility, and nuclear magnetic resonance.

Professor Frederick D. Greene has published a study of one of the large number of organic reactions that proceed by means of odd-electron carbon intermediates (free radicals) in paired, chain-propagating steps. A study of bromination of bibenzyl by N-bromosuccinimide as a model system of that kind has shown that such reactions may occur with a high degree of specificity. This is one of the first examples of a stereospecific radical reaction in an acyclic system.

Professor Herbert O. House has investigated reactions of derivatives of ethylene oxide with acids. These studies have

shown that the stability of a carbonium ion intermediate is diminished very little if at all by the presence of an adjacent carbonyl group, contrary to previously accepted views on this subject.

Professor David N. Hume has extended the study of stepwise formation of complex ions in aqueous solutions to mixed ligand anion complexes. Investigation of the behavior of bismuth ions in media containing both chloride and bromide revealed that all the theoretically possible mononuclear complex ions containing both chloride and bromide were present. Further studies suggest that this is a very general phenomenon, and the actual composition of solutions of complex-forming metal ions with more than one type of anion is much more complicated than hitherto suspected.

Professor John W. Irvine, Jr. and Professor Coryell have been exploring methods of evaluating complex-formation constants for tracers in concentrated aqueous solutions, using uptake by organic solvents and by anion exchange resins.

Professor George Scatchard has applied ion-exchanger membrane "electrodes" to the determination of the binding of anions to proteins. These membranes are particularly useful for ions which do not react reversibly at true electrodes. This application has necessitated studies on diffusion through such membranes and on the effect of such diffusion on electromotive force, which have led to increased knowledge of both ion-exchanges and proteins.

Professor John C. Sheehan has reported the culmination of nine years of research on the synthesis of the natural penicillins by the successful synthesis of Penicillin V. This synthesis was accomplished by use of a carbodiimide to effect closure of the sensitive and reactive beta-lactam ring present in all of the penicillins. By other synthetic methods, he and his collaborators have accomplished the synthesis of penicillins not found in nature, which differ from the natural products only in the acylamino fragment attached to the beta-lactam ring. A number of these new products have pronounced biological activity resembling the penicillins and are being examined to determine whether they may have effectiveness against organisms not affected by the natural penicillins.

Professor C. Gardner Swain has reported recently a study of the exchange of hydrogen between the nitrogen of ammonium salts and the oxygen of alcohols using deuterium

(stable heavy hydrogen) or tritium (radioactive hydrogen) as a tracer. The mechanism is surprisingly complex. A mechanism which is consistent with the kinetic data involves an ammonia-alcohol complex as an intermediate. The exchange of hydrogen between two different alcohols is also being studied as a model for the completely unknown mechanism of the most common chemical reaction, the exchange of hydrogen between water molecules.

Professor John S. Waugh has been engaged in fundamental studies involving determinations of nuclear magnetic resonance spectra. His results on a number of hydrocarbons have given experimental support to the classical free electron model which had been proposed to account for the chemical shifts in the nuclear magnetic resonance spectra of protons attached to aromatic ring hydrocarbons.

ARTHUR C. COPE

DEPARTMENT OF FOOD TECHNOLOGY

This year marked the Department's installation of a new General Electric Electron Accelerator, which should materially aid in our radiation preservation program. Sterilization by radiation was pioneered by this Department and has now become national in scope and of great importance in the foods industries.

One of the significant research findings in the Department during the past year has had to do with the successful radiation preservation of fluid milk products on a small scale. This appears to be one of the first real "break-throughs" in overcoming the greatest single problem preventing the commercial radiation preservation of foods — namely, the production of undesirable side reactions such as off-flavor. A new technique, known as the concurrent radiation-distillation technique, has been devised in the Department to solve this problem. During the year very significant progress has been made in research in the chemistry of flavor of milk and other foods. In the course of studies on the chemistry of irradiated milk, evidence has been uncovered of the presence of three fatty acids never before isolated from milk.

Members of the Department faculty and staff have participated in a number of important symposia and professional meetings. Professor Bernard E. Proctor was one of the featured speakers at the Association of Food and Drug Chemists meeting in New York; this meeting celebrated the fiftieth anniversary of the Pure Food Law Act, which founded the Food and Drug Administration. He also served as Chairman of the American Chemical Society symposium celebrating the centennial of William Perkins' discovery of the coal-tar dyes.

In July of last year the Department, in cooperation with the Super Market Institute, Inc., conducted a symposium on frozen foods and food marketing in the Kresge Auditorium, attended by 150 representatives of the food supermarket chains in this country.

Professor Proctor served during the past year on the Food Protection Committee of the National Research Council and as a representative on the Council's Food and Nutrition Board. The Food Protection Committee is charged with studying chemical additives in foods, one of the most important problems in the food field today.

During the past year a very successful series of industrial food seminars was held. Leaders in the food and fermentation industries and in universities participated. These seminars have been an inspiration to students and offer an opportunity for students and staff members to meet leaders in food science and technology throughout the world.

Professor Samuel A. Goldblith joined Professor Proctor in presenting invited papers on the implications of radiation preservation on public health methods at the American Public Health Association meeting and also at the Inter-American Symposium on Atomic Energy sponsored by the State Department at Brookhaven National Laboratory, where Professor Goldblith was a United States delegate.

One of the outstanding sophomore students in the Department was a recipient of one of the Gerber Product Scholarships awarded by the Institute of Food Technologists on a national competitive basis.

During the past year Professor John T. R. Nickerson was honored by his election as Chairman of the New England Fisheries Technologists. He is also serving as a member of the Executive Committee of the Northeast Section of the Institute of Food Technologists.

Professor Goldblith served as Chairman of the Northeast Section of the Institute of Food Technologists and also was elected a member of the Council of the national organization.

BERNARD E. PROCTOR

DEPARTMENT OF GEOLOGY AND GEOPHYSICS

The curricula of Courses XII (four years) and XII-A (five years), Geology and Geophysics, were revised this year to provide the subjects recommended by the *ad hoc* committee to study future development of the earth sciences. Undergraduate students interested in a career in geology, geophysics, or geochemistry, in meteorology, or in oceanography can now obtain the needed foundation in Course XII and then proceed into advanced graduate work in their fields of special interest by remaining in Course XII, by entering Course XIX (Meteorology), or by working at M.I.T. or the Woods Hole Oceanographic Institution under an interdepartmental committee.

To stimulate undergraduate interest in the earth sciences and to expand and diversify instruction in these sciences, several new subjects were added to those previously offered. Freshmen now have a choice of subjects in astronomy, earth science — geology, geophysics, geochemistry — and elementary meteorology; sophomores and juniors may take the beginning subjects in geology, geophysics, geochemistry, meteorology, and oceanography; while seniors and fifth-year students have a wide choice of subjects in all of these sciences of the earth. By using the large number of elective hours provided in the Course XII curriculum, the advanced student may sample a broad area of the earth sciences or concentrate his effort in some restricted field, thus preparing himself for a professional position or for further graduate work.

DEPARTMENTAL ACTIVITIES

The ninth Summer School of Geology was held at the Nova Scotia Centre for the Geological Sciences, with Professor Walter L. Whitehead as Director, Professor Roland D. Parks as Assistant Director in charge of geological surveying, and Dr. Nathaniel McL. Sage as Lecturer in charge of field camps.

Twenty-seven M.I.T. undergraduates, as well as one from DePauw University (Indiana) and one from St. Francis Xavier University (Nova Scotia), received basic field instruction. In addition, one undergraduate each from Yale, the

University of Michigan, and the University of Kansas carried on thesis work. Special field work was also conducted by three M.I.T. graduate students and one from Harvard. The school was increased from eight to ten weeks in length and greatly improved by the change.

Three junior geophysicists, along with seventeen other students from fifteen other colleges, participated in the Student Cooperative Plan of Geophysical Service, Inc., working as field assistants in the southwestern United States. An outstanding feature of this carefully planned program is a series of forty short lectures delivered to the student group by professional geologists and geophysicists during the orientation week at Dallas before the students go to their field assignments.

A two-term sequence of lectures in physical oceanography was offered by Drs. William von Arx, Joanne Malkus, and John B. Hersey, all scientists on the staff of the Woods Hole Oceanographic Institution. A similar series of lectures, probably by other Woods Hole staff members, will be offered again next year. The bi-weekly earth sciences colloquium was held throughout the year, with many nationally and internationally known speakers from outside M.I.T.; it was so successful that it will be repeated next year, again as a cooperative enterprise between M.I.T.'s Departments of Geology and Geophysics and of Meteorology and the Woods Hole Oceanographic Institution. These activities, as well as several other less formal seminars, colloquia, and discussion groups, attest to the growing and widespread interest in the earth sciences in the Cambridge academic community.

The first of the Vannevar Bush Fellows in earth sciences started his thesis research at the Geophysical Laboratory of the Carnegie Institute of Washington under the terms of the Fellowship.

RESEARCH

The many current projects in the Departments of Geology and Geophysics and of Meteorology constitute a major over-all research effort in the earth sciences and form a large and important part of the future program of the newly established interdepartmental Laboratory of Earth Sciences. We hope, however, that new programs of research may be started by both Departments — whenever appropriate in cooperation with the Woods Hole Oceanographic Institution — because

it will only be by such integrated efforts that many of the major problems of our physical environment will be effectively attacked and solved.

Graduate enrollment was the same as last year, with forty-eight degree registrants, but is expected to increase about 10 per cent in 1957–58. The staff that will be available next year can effectively handle this modest increase if we make a few much needed space changes. Geologists, geophysicists, and geochemists with advanced degrees are in constant demand, and our own graduates have had no difficulty in securing excellent positions.

Considerable use was made of the Whirlwind digital computer in studies of the relations between observed statistics and the physical interpretation of ground motions in seismic exploration, headed by Professor Stephen M. Simpson, Jr. Whirlwind facilities were also used by Professor Martin J. Buerger in further solutions in the X-ray analysis of crystal structures.

In the Cabot Spectrographic Laboratory, under the direction of Professor William H. Dennen, principal efforts were devoted to a major study of the distribution of minor elements in sediments and sedimentary rocks, by Professors Dennen and Ely Mencher. Dr. Geoffrey Nicholls, Reader in Mineralogy at the University of Manchester, was a guest of the Laboratory and conducted personal research.

In the Mass Spectrometry Laboratory, research on the natural variations in isotopic abundances led to direct measurement of the age of certain sedimentary rocks and confirmation of the validity of age measurements on certain minerals of igneous rocks. Graphic and precise age measurement is now established, and a program of global correlations in the earth's early history has been started. These studies were carried on by Professors Patrick M. Hurley, Harold W. Fairbairn, and William H. Pinson, Jr.

The Subcommittee on Nuclear Geophysics of the National Research Council, under the chairmanship of Professor Hurley, held a conference on Cosmological and Geological Implications of Isotope Ratio Variations, at Endicott House in June, 1957. Professors Hurley, Pinson, and John W. Winchester represented M.I.T. Thirty visiting scientists from twenty-six national and foreign institutions participated in the conference.

Theoretical studies of mineral stabilities at extreme pressures were investigated further by Professor Gordon J. F. MacDonald, with special reference to the constitution of the earth's interior; investigations of the stability of minerals under nonhydrostatic stress were carried out and the results applied to the problem of the origin of metamorphic rocks.

Theodore R. Madden conducted further studies of methods developed in our geophysical laboratory for locating conductive mineral deposits, utilizing frequency-dependent effects that result from localized polarization. New investigations of remanent magnetism in rocks were started by Professor Richard R. Doell.

Studies of indentation hardness as an indicator of plastic behavior of single crystals were carried on by Professor William F. Brace, utilizing laboratory equipment in the Department of Metallurgy. Equipment is now being designed for further work at elevated temperatures and pressures.

Professor Winchester and his geochemical group initiated a diversified program of investigations, as follows: water vapor pressure measurements of hydrated minerals by infrared spectroscopy, using the facilities of the M.I.T. Spectroscopy Laboratory; determination of potassium in common rocks and minerals by neutron activation, using the Brookhaven reactor and M.I.T. cyclotron; study of the ion-exchange properties of micas, in cooperation with the Department of Metallurgy; and a search for the long-lived nuclide K^{88}.

STAFF ACTIVITIES AND CHANGES

Dr. Richard R. Doell joined the staff as Assistant Professor of Geophysics. Dr. John Winchester came as Assistant Professor of Geochemistry after spending a year in the Netherlands on a postdoctoral Fulbright Award. Dr. Nathaniel McL. Sage, Jr., Chairman of the Department of Geology at the University of New Hampshire, was appointed Lecturer for the summer and participated in our Summer School of Geology at Crystal Cliffs, Nova Scotia. Drs. John B. Hersey and William von Arx, both physical oceanographers on the staff of the Woods Hole Oceanographic Institution, were appointed Associate Professors of Oceanography and will be available henceforth for lectures and graduate thesis supervision in oceanography. Both gave a series of lectures on physical oceanography during the year.

Professor Walter L. Whitehead, who joined the departmental staff in the fall of 1928, retired as Associate Professor Emeritus in June, 1957, but will continue to direct the M.I.T. Summer School in Nova Scotia for the tenth year. Professor Whitehead is known to three decades of Course XII undergraduates as thesis adviser, Registration Officer, Camp Director, field trip leader, kind and sympathetic counselor, and champion of their rights and privileges. He envisioned and helped to bring into existence the Nova Scotia Centre for the Geological Sciences, where the Department has conducted the M.I.T. Summer School of Geology under his direction since 1948. He has done much to foster good international relations with Canada and especially with the Maritimes, and his retirement as Director of the School will be celebrated at the closing exercises on August 30, the day after St. Francis Xavier University awards him an Honorary Doctor's degree.

Dr. Arthur J. Boucot, formerly geologist with the United States Geological Survey and this year a Guggenheim Fellow in Europe, will join the staff in the fall as Assistant Professor of Geology; he will assume directorship of the Summer School and offer work in sedimentology and paleontology.

Dr. Herbert E. Hawkes, since 1954 Lecturer in Geology, resigned to accept a professorship in the Division of Mineral Technology at the University of California (Berkeley). Dr. Hawkes was for many years head of the Geochemistry Prospecting Section of the United States Geological Survey before coming to M.I.T. He is widely known for developing new methods in ore finding and did much to stimulate student and staff interest at M.I.T. in this area of geology.

ROBERT R. SHROCK

DEPARTMENT OF MATHEMATICS

During the year, on the basis of its own professional needs and the needs of other departments of the Institute, the Department of Mathematics reviewed its programs in elasticity, hydrodynamics, and probability. The Department has arranged to give a one-semester undergraduate subject in each of these areas as part of its regular schedule and, in each case, to follow this with a graduate subject of one year's duration.

The programs will enable undergraduate students to take introductory subjects in the various areas and at the same time will permit graduate subjects to start at a more advanced level and to go further. In the field of analysis, the regular junior subject will continue to be given annually, as will a year's subject in Functions of a Real Variable.

During the year, the Department conducted an experimental program in second-year calculus and differential equations for physics sophomores. Next year the program will continue, this time for sophomore physics majors, sophomore mathematics majors, and for sophomores in the new Course in Electrical Science and Engineering (VI-B). The program will be extended to the first semester of the junior year for those physics students who have participated in the program this year. Under this three-semester integrated program these students, all of whom are now required to take at least three semesters of mathematics beyond the freshman year, will obtain a coordinated program with several topics covered more comprehensively than previously.

Enrollment in mathematics subjects during the year again reached a new high. During the fall semester a total of 3,562 students enrolled in mathematics subjects in 127 sections. These figures compare with 3,293 students in 117 sections for the fall semester of the preceding year and 2,663 students in 89 sections during the fall of 1952. Thus since 1952 the enrollment in mathematics subjects has increased by 33.8 per cent. During the same period the total M.I.T. enrollment increased 18.2 per cent, from 5,074 to 6,000. The increase in enrollment in mathematics subjects in recent years has been mainly in the upper division and graduate subjects. The number of mathematics majors, both undergraduate and graduate, also showed an increase.

During the year Professors John F. Nash and George B. Thomas, Jr. were on leave; Professor Nash had a Sloan Grant at the Institute for Advanced Study, and Professor Thomas was a visiting member of the faculty at Stanford University. Professor Francis B. Hildebrand served as principal lecturer in a study conference on applied mathematics at the University of Buffalo during the early part of June.

The Department had three visiting members on the faculty throughout the year — Professor Joaquin B. Diaz of

the University of Maryland; Dr. Stanislaw M. Ulam, Senior Scientist at the Los Alamos Laboratory; and Assistant Professor Robert A. Clark of the Case Institute of Technology. We also had three visiting lecturers — Dr. Michel A. Kervaire, formerly of the University of Berne, Switzerland; Dr. Klaus F. Roth of the University of London; and Dr. John T. Stuart of the National Physical Laboratory of Teddington, England. Dr. Marcel Berger of the University of Strasbourg spent the year in the Department as a Research Associate on research sponsored by the National Science Foundation. Associate Professor Richard V. Kadison of Columbia University spent the year on partial leave from Columbia University.

Assistant Professor Isadore M. Singer joined our faculty at the beginning of the academic year. Dr. Claude E. Shannon of the Bell Telephone Laboratories, who had been spending the calendar year of 1956 as Visiting Professor in the Electrical Engineering Department, accepted a joint appointment as Professor of Communication Sciences in the Electrical Engineering Department and Professor of Mathematics in our Department beginning January 1, 1957. Professor Shannon's appointment will help to strengthen the close relationship which exists between the scientific interests of the two departments.

Mathematical research by members of the Department is being carried out in the fields of algebra, algebraic geometry, analysis, cybernetics, differential equations, differential geometry, elasticity, functional analysis, hydrodynamics, mathematical logic, number theory, numerical analysis, partial differential equations, probability and statistics, topological algebra, and topology.

The Mathematics Colloquia of Harvard and M.I.T., which had been meeting as separate colloquia, merged at the beginning of the year. The new joint colloquium held regular meetings alternating between Harvard and M.I.T. The departments at both institutions feel that the joint arrangement has proved beneficial, and the arrangements will be continued. Members of the Department spoke at colloquia, seminars, and various scientific meetings in this area and in other parts of the United States.

WILLIAM T. MARTIN

DEPARTMENT OF METEOROLOGY

The Department of Meteorology has enjoyed a successful year in both its teaching and research programs. The graduate enrollment increased by nearly 40 per cent over that of the previous year. The present staff could effectively handle more students, but because of space limitations no significant increase is possible. The demand for meteorologists with advanced degrees continues to exceed the supply, and none of our graduates has had difficulty in finding a satisfactory position.

The research program of the Department is largely supported by agencies of the federal government. The largest area of effort is in the field of theoretical meteorology, reflecting the interests of a majority of the faculty and a conviction that this is the most fruitful approach to the major unsolved problems of the atmosphere.

A substantial research effort must be devoted to the experimental area of synoptic meteorology. Work is also being devoted to the development and utilization of new methods and instruments of observation.

Professor Hurd C. Willett and his group have developed new methods for studying the changes in the global circulations over periods ranging from days to several years. Professor Willett is also seeking more definite clues to the effects of variable solar emissions on the atmospheric circulation.

Professor Jule G. Charney and Dr. Norman A. Phillips have had considerable success in developing new theoretical models of the atmosphere with greater generality than earlier ones. Some of these models include the effects of solar and long-wave radiation. These models are awaiting testing on the I.B.M. 704 Computer in the new Computation Center.

Professor Victor P. Starr and his group have continued to advance our understanding of the mechanics and energetics of large-scale atmospheric circulations. Over the past several years, on the basis of these important findings, Dr. Hsiao-lan Kuo has developed a theoretical model of the atmosphere for a spherical earth, including both the heat input by radiation and the frictional dissipation. Except for delays due to computer breakdowns, this model would already have received its first tests.

Professor James M. Austin has succeeded in developing relationships between atmospheric inversions and the associated surface climate. This is an important step in the direction of relating climate to the larger-scale weather patterns and the surface topography. It will permit climatic information to be deduced from the generally available weather maps rather than only from micrometeorological observations on the site. Professor Austin also brought to a successful conclusion a long study of the mechanism of atmospheric pressure change. This work has led to a detailed and quantitative understanding of the processes that occur during the life cycle of migratory cyclones.

Professor Edward N. Lorenz and his collaborators have succeeded in developing new types of empirical orthogonal polynomials for the representation of atmospheric pressure patterns. These have the advantage of nonredundancy, and thus they are the minimum number of parameters needed to represent a given pattern. This novel step should greatly strengthen the time-series approach to the study of atmospheric circulation changes.

Professor Delbar P. Keily and his group have completed the development of a new electronic probe for determining drop size in natural clouds, and the instrument is now awaiting flight tests. Professor Keily has also been developing new instrumentation for the measurement of rain drop size and for the detection of ice crystals in a cloud.

The Weather Radar Research Group, under the general supervision of Professor Henry G. Houghton, has obtained rather complete information on the shape of precipitation particles with the aid of a radar of variable polarization. A new contouring circuit has been developed to make it possible to study more quantitatively the distribution of precipitation in a storm. Major emphasis has been placed on the integration of the radar data with the more conventional observations, to gain a more thorough understanding of such atmospheric phenomena as coastal storms, cold fronts, squall lines, and thunderstorms.

Under the general supervision of Professor Houghton, a group at the Round Hill Field Station, consisting of Dr. Harrison E. Cramer, Dr. Frank A. Record, and Harry C.

Vaughan, has made important contributions to our understanding of the diffusion of gaseous substances in the lower atmosphere. It has been found that the inverse of the standard deviation of the azimuth wind direction correlates surprisingly well with the behaviour of a gas plume from a continuous point source.

Professor Morton G. Wurtele has been studying with considerable success the challenging problem of developing a numerical model of the tropical hurricane. Professors Charney, Starr, and Lorenz have also contributed to this work.

Professor Frederick Sanders has been devoting his efforts to the very important task of bridging the gap between the most recent theoretical developments and their application to the day-to-day behavior of the weather as observed on the weather map. This is of obvious importance to the weather forecaster, but it is perhaps even more important that the theoretical meteorologist have his product subjected to the acid test of the real atmosphere.

Members of the Department have devoted considerable time to outside activities during the year. For the second successive year, staff members shared the weekly "Weather for You" program on WGBH-TV. Almost every member of the faculty served on governmental and society committees and undertook some private consultation work. As noted elsewhere, Professor Austin was appointed Director of the Summer Session, thus reducing the time he can devote to meteorology.

HENRY G. HOUGHTON

DEPARTMENT OF PHYSICS

As anticipated, the Physics Department during the past year has felt the impact of the growing number of students majoring in physics and the increased tempo and activities in the research front. In September, 1956, almost one out of four freshmen entering the Institute indicated physics as his intended major field; and even with the expected attrition this will lead to a significant increase in the number of Course VIII students in the upper undergraduate years. The total number of physics majors at all levels last fall was approximately seven hundred. This, plus the growing service load of the Department, has called for increased teaching effort on the part of the physics staff.

TEACHING PROGRAMS

In first-year physics, Professor William L. Kraushaar tried a new educational experiment in the teaching of the repeat group in freshman mechanics (8.01) with considerable success; he and Professor K. Uno Ingard are planning to introduce this innovation into the first-year teaching this fall. Briefly, the objective of this new approach is to teach first-year physics essentially inductively, as is done in the subsequent stages of our physics instruction, rather than as a pure analytical subject, which is the usual pattern. There has been increased interest and activity in the first-year laboratory work, both on the part of staff and teaching assistants. The stimulus provided by Dr. Edwin H. Land in his Arthur D. Little lecture has generated much discussion, not only with regard to freshmen, of the pattern of all our teaching.

In the second-year physics, Professor Bruno B. Rossi has published a book on optics as an outgrowth of his lectures in sophomore physics (8.031 and 8.041). This book is a significant addition to the literature of physics. Professor Francis Bitter's book, *Currents, Fields, and Particles*, has appeared, and there is great activity in connection with the teaching of this sophomore subject. When Professor Bitter became Associate Dean of Science he was lost to active teaching; however, his interest and guidance in this area continues unabated. A sizable experimental program investigating how to attain more effective teaching in this subject is being planned. This includes a preliminary study program during the summer of 1957 and a relatively large-scale effort during the next academic year.

In the third year the efforts of Professors Francis L. Friedman and Victor F. Weisskopf to strengthen our teaching in the third-year physics subjects (8.05 and 8.06) continue unabated. The junior laboratory is bursting at the seams, so to speak; not only is it difficult to handle the day-by-day student load in this laboratory, but space limitations are also causing some slowing down in our program of overhauling and strengthening this effort. However, both Professor Malcom W. P. Strandberg and Professor Kraushaar report that good progress is being made. The modern physics for nonphysics majors, taught by Professor William W. Buechner in collaboration with Dr. Peter T. Demos, has gained popularity and significance in the undergraduate program of the Institute as a whole.

In the fourth year a new approach to our senior laboratory and Thesis has been successfully initiated by Professor David H. Frisch. The laboratory work and thesis now may be combined if a student so wishes; of sixty-six seniors last fall, fifty-eight took advantage of this opportunity and worked in the research laboratories on current research projects. This procedure has added considerable strength to the educational opportunity in this area. The temporary space relief so gained will evaporate as the senior class grows in size; and even this year this relief was bought at the cost of crowding research laboratories, such as the Laboratory for Nuclear Science, the Research Laboratory of Electronics, and the Spectroscopy Laboratory.

At graduate level there has been no systematic review of our subjects of instruction since the war, and there is need for reassessment and recasting of our graduate program. A committee under the leadership of Professor Herman Feshbach will undertake a very thorough study of this problem during the coming year; it has already become evident that this study will react strongly on our undergraduate program, especially with regard to undergraduate elective subjects. In addition, the graduate subjects which are offered for nonphysics majors, such as Professor Robley D. Evans' Nuclear Physics for Engineers, continue to grow.

RESEARCH

The major part of the research work of the Physics Department is carried out in the Laboratory for Nuclear Science and the Research Laboratory of Electronics. These laboratories have functioned most satisfactorily in the support of the research programs of many individual members of the Department as well as in joint interdepartmental programs. A review of these projects is contained in the reports of the two laboratories.

In the Radioactivity Center, Professor Evans, with Drs. Robert A. Dudley and Norman C. Rasmussen, has studied decay schemes of various nuclei and has made marked progress in understanding the biological effects of radiation. This activity has become one of the most significant of its kind in the country.

In solid state theory, Professors John C. Slater and George F. Koster and their collaborators have continued their studies, especially of molecular wave functions and energy levels. Professor Koster has given a graduate subject in group theory and has done research in the application of group theoretical methods to energy band problems. This research group is running at full strength.

The X-ray Diffraction Group, under Professor Bertram E. Warren, continues its work in order-disorder, temperature diffuse scattering and dislocations, and imperfections of crystals. During the spring semester Professor Warren was a Visiting Fulbright Professor at the College de France in Paris, working with Professor Laval.

In the Spectroscopy Laboratory Professors George R. Harrison and Lee C. Bradley III and Dr. Sumner P. Davis have continued to make progress in high-resolution spectroscopy and are working closely with Professor Bitter on the hyperfine structure work being supported by the Research Laboratory of Electronics. The Spectroscopy Laboratory has become most attractive to our seniors and could not accommodate as many as wished to work there.

In acoustics, Professor Ingard continues to lead a strong program in the investigation of sound generation by turbulence, the propagation of sound in the atmosphere (with emphasis on the interaction of sound with turbulence), and nonlinear effects in sound fields.

Professor Laszlo Tisza has received support for his theoretical research in irreversible thermodynamics, which will stimulate increased activity in this important field.

OTHER ACTIVITIES

The completion of the Karl Taylor Compton Laboratories, into which much of the activity of the Research Laboratory of Electronics and the Laboratory for Nuclear Science will move this summer, marks a welcome and long-needed addition to our facilities. The Computation Center, with its I.B.M. 704 Computer, is already under way under the direction of Professor Morse and promises to be a thriving activity. Progress toward the completion of the reactor and toward the building of the Cambridge Electron Accelerator is satisfactory.

In addition to numerous seminars in special fields, the Physics Department has been host to a large number of invited guest speakers at its regular colloquia. Professor

Wayne B. Nottingham's annual Conference on Physical Electronics was again held, and an International Conference on Crystal Physics under the leadership of Professor Slater is planned for July, 1957. Professor Nathaniel H. Frank served as Chairman of the Physics Division of the American Society for Engineering Education.

Professors Albert G. Hill and Clark Goodman continued on leave in their capacities as Vice President — Director of Research of the Institute for Defense Analyses, and Assistant Director of the Reactor Development Division of the Atomic Energy Commission, respectively. Professor George E. Valley, Jr., returned to the Department as Professor of Physics from the Lincoln Laboratory, and Professor Francis W. Sears has resigned to accept a faculty position at Dartmouth College. Professor Charles Manneback of the University of Louvain, Belgium, a guest of the Institute, has participated in the Department's activities.

The Department has received added stimulus by the presence of Professors Francis E. Low and Walter Thirring as Visiting Professors in Theoretical Physics, of Dr. G. Lueders of Germany as a guest of the Department, and of Professor I. I. Rabi as Visiting Institute Professor during the fall semester. Professor Low has accepted a professorship in this Department. Professor Clifford G. Shull established residence at M.I.T. in the spring term and has been contributing to the freshman teaching and the preparation of neutron diffraction equipment to be used with the new reactor. He is also planning for next year a new graduate subject in the theory of neutron diffraction, as part of the effort necessary to launch an effective neutron diffraction research program.

NATHANIEL H. FRANK

SOLAR ENERGY PROGRAM

Although formally under the School of Science, the activities of the Godfrey L. Cabot Solar Energy Program are in fact in the Schools of Engineering, Science, and Architecture. The solar-energy heated house, nearing completion in Lexington, will be tested during the coming heating season. Research on light-catalyzed organic syntheses and photochemical decomposition of water continues in the Chemistry Department.

In the Department of Chemical Engineering, selective black surfaces are being studied — surfaces which exhibit a high absorptivity for sunlight but a low radiating power, with consequently exciting possibilities for improved performance of flat-plate solar heat collectors. Research on the mechanism of crystal growth is being initiated — a program representative of those which combine advancement of our fundamental knowledge with improved prospects of more effective use of solar energy.

HOYT C. HOTTEL

SUMMER SESSION

In addition to a variety of regular subjects given for credit, five Special Summer Programs were offered in the School of Science: Horizons in Food Technology, Techniques of Infrared Spectroscopy, Applications of Infrared Spectroscopy, New Developments in Instrumental Analysis (Chemistry), and the High School Science Teachers' Program.

The last was made possible by a grant from the Westinghouse Educational Foundation. Twenty-four outstanding teachers from throughout the country were each awarded $800 to spend two months participating in the work of a laboratory of their choice. Almost all of the departments in the School of Science had a share in this stimulating enterprise.

FRANCIS BITTER

INTERDEPARTMENTAL LABORATORIES

LABORATORY FOR NUCLEAR SCIENCE

The research program of the Laboratory for Nuclear Science continues along the same lines as last year. Laboratory activities include: nuclear inorganic chemistry (Professors C. D. Coryell, J. W. Irvine, Jr., and G. Scatchard); nuclear organic chemistry (Professors C. G. Swain and F. D. Greene, II); chemistry of the fission elements (Professors D. N. Hume and L. B. Rogers); cosmic ray research (Professors B. B. Rossi, R. W. Williams, D. O. Caldwell, G. W. Clark, W. L. Kraushaar, J. B. Linsley, S. Olbert and Dr. H. S. Bridge); photomeson and photonuclear research using M.I.T.'s synchrotron and linear accelerator (Professors B. T. Feld, D. H. Frisch, R. Weinstein and Drs. L. S. Osborne, D. M. Ritson, A. Wettenberg, P. T. Demos, D. Luckey, and C. P. Sargent); theoretical nuclear physics (Professors V. F. Weisskopf, H. Feshbach, F. Low, M. H. Friedman, U. Haber-Schaim, A. K. Kerman, W. Thirring and Dr. D. M. Brink); nuclear energy level studies, using the M.I.T.-O.N.R. Van de Graaff generator (Professors W. W. Buechner and H. A. Enge, Drs. F. J. Eppling and C. Paris and Messrs. M. Mazari and A. Sperduto); gamma ray angular correlation studies and neutron time-of-flight research, using the Rockefeller Van de Graaff generator (Drs. L. E. Beghian, B. G. Goldring, and R. P. Scharenberg); elastic scattering of alpha particles, protons, and deuterons from nuclei, using M.I.T.'s Markle cyclotron (Professor M. Deutsch and Dr. N. S. Wall); radioactivity research and positronium studies (Professors R. D. Evans, M. Deutsch, and C. J. Maletskos); high-energy nuclear emulsion studies (Drs. D. M. Ritson, L. S. Osborne, and R. A. Schluter); and bubble chamber studies (Professor R. W. Williams and Dr. I. A. Pless).

A total of 291 persons participated in the work of the Laboratory during the past year, not including visitors. These included 46 academic staff members of the Departments of Chemistry and Physics, 31 D.S.R. staff members, 39 graduate students from the Department of Physics, 83 full-time nonstaff employees, and 28 part-time nonstaff employees. Visiting scientists from this country and abroad who were active in the researches of the Laboratory numbered 25. The past year also saw a marked increase in the activity of physics undergraduate students within the framework of the Laboratory.

Most notable during the past year has been the impetus given to the Laboratory's high-energy program by a purposeful increase of effort in that general area. Additional funds for this purpose were received from the joint program of the Office of Naval Research and the Atomic Energy Commission. Besides a continuation of already established research with the synchrotron and the nuclear emulsions activity, the extended program provides for work using counter techniques at the Brookhaven Cosmotron; for the development of synchrotron beam-analyzing magnets; for the construction of a pulsed magnet (200–300 kilogauss) to be used in the identification of negative hyperon beams; and for the implementation of a bubble chamber program.

Installation of a Van de Graaff beam injector for the synchrotron has been completed with a resulting improvement in beam intensity, thus far, by a factor of approximately twenty. Synchrotron research has included the measurement of nucleon momenta using photoproton and photoneutron coincidences; the development of apparatus for the study of one-quantum positron annihilation; studies of photomeson production from complex nuclei and from deuterium; the energy distribution of neutrons emitted from μ-meson capture; the scattering of gamma rays, particularly from hydrogen and deuterium; the design of a novel differential Cerenkov counter making use of a Schmidt lens system; the development of a large sodium iodide crystal gamma ray spectrometer; and the construction of a magnetic lens for the deflection of mesons into the synchrotron target room.

Photographic emulsion research has continued on the dynamics of K^+ scattering and on a search for the "Pais-Piccioni" effect. Objects of study included the energy dependence of the K^+ scattering cross section; the sign of the K^+

scattering potential; the spin of the tau$^+$ meson; isotopic spin selection rules and the Kπ_2 decay; and the angular distribution of the K$^+$ meson decay products. High-energy counter research has included a search for $\pi^0 \rightarrow 3\gamma$ decays, using the Harvard cyclotron; and preparations for measuring total cross section for K$^+$ meson attenuation in liquid hydrogen, using the Brookhaven Cosmotron.

Three hydrocarbon bubble chambers have been put into operation, the largest 9 inches in diameter. A significant step forward was achieved through the addition of heavy elements (notably methyl-iodide) to the bubble chamber fluid, resulting in a fifteen-fold decrease of radiation length. A program has been initiated for using a high-speed computer in data analysis. An experiment has been performed, using the 9-inch chamber and μ^+ mesons from the Chicago cyclotron, to examine the asymmetry of the μ-e decay process. Data from the experiment are still in the process of analysis, including scrutiny for the reality of a possible π-μ-decay asymmetry observed during a rough preliminary examination. It is planned to use the chamber in the near future with the Cornell 1-Bev synchrotron to study π and μ pairs and the strange particles, and with the Brookhaven Cosmotron to examine the θ^0 decay process. A propane chamber 15 inches in diameter by 10 inches deep, suitable for methyl-iodide loading has been initiated. The design of a similar liquid hydrogen chamber is progressing.

The Cosmic Ray Group has continued its concern with two major fields of investigation. The first includes high-energy interactions and the properties of particles produced in such interactions. This research has been done mainly at the Brookhaven Cosmotron, using incident beams of high-energy protons and π^- mesons, although cosmic rays have been used also as a source of very high-energy particles. The second principal area of research concerns air showers and some related problems of the origin of cosmic rays. It is notable here that the large air shower experiment has shown the primary cosmic ray spectrum to extend without a noticeable break to energies above 10^{18} ev. The largest shower observed had an energy which was probably above 10^{19} ev. Results to date indicate that further experiments are crucial, particularly as regards the arrival direction of the highest energy particles and the shape of the spectrum beyond energies of

10^{18} ev. A "giant" air shower experiment, with a possible diameter of two miles, is currently under serious consideration and will probably be implemented within the year. It should be noted that partial support for the current large air shower experiment is provided by the National Science Foundation and that the giant air shower experiment, if carried through, will also be supported by that agency.

Besides observations stemming directly from the large air shower experiment, studies have been conducted to examine the velocity spectrum of cosmic-ray μ mesons at sea level; the incidence of air showers and their direction of arrival at sites in Bolivia (Chacaltaya) and India (Kodaikanal); short period fluctuations in cosmic-ray intensity as detected by a 1000-count-per-minute meson telescope; the μ-meson component of large air showers; polarization of cosmic-ray μ mesons; and other related measurements. Calculations of cosmic-ray cascades have been continued, using the analytical methods developed and reported earlier.

In the low-energy field, additional support was provided by the Air Force Office of Scientific Research for improving facilities used in studying nuclear energy levels and for developing analog-to-digital converters and memory circuitry for taking experimental data. The former of these will provide, among other things, a new magnetic spectrograph, now under construction at the O.N.R. Van de Graaff generator. With respect to nuclear data-taking equipment, a 256-channel magnetic core memory unit has been purchased for use with the Rockefeller Van de Graaff generator, with a view to examining methods for generalizing — or at least broadening — its applicability.

Work with the Rockefeller generator during the past year has been concerned with the measurement of g-factors of low-lying states of nuclei excited by the coulomb process and with adaptation of the generator to pulsed operation. Precision measurements (from which g-factors are now being determined) have been made for samarium and neodymium. When adapted to pulsed operation, short bursts ($\sim 10^{-9}$ seconds) of protons and deuterons will be available for the study of neutron inelastic scattering processes, (d,n) reactions on light and medium nuclei, and short-lived isomeric states induced by the incident beam.

Research with the M.I.T. cyclotron has involved a continuation of the angular distribution studies of elastically scattered 7.5-Mev protons; the measurement of polarization of such elastically scattered protons; 30-Mev alpha particle scattering; alpha particle and deuteron induced reactions; and the development of apparatus for time-of-flight neutron energy measurements.

The work of the Laboratory's radioactivity group has included further positronium studies, confirming earlier work on the quenching effect of nitric oxide and chlorine; studies of radioactive decay schemes; and experiments with polarized positrons to determine, in particular, the longitudinal polarization of β-rays by means of the circular polarization of the annihilation radiation. The immediate purpose of the last work is to examine the Fermi term in beta-decay interaction by observing the polarization of positrons from a 0-0 transition.

Nuclear energy level studies using the O.N.R. generator have been concentrated largely on the nuclei between mass numbers 40 and 70. Efforts have been directed toward determining level order and, where possible, the spins and parities of states. A number of angular distribution studies for deuterium stripping reactions have also been carried out. The importance of angular distribution studies has led to the design of a new high-resolution spectrograph for this work. The new apparatus will allow data to be taken simultaneously at a large number of angles, with a resulting simplification and shortening of the experimental process and independence of the data from deterioration of the bombarded target.

The work of the Linear Accelerator Group has centered about a study of gamma-ray-induced neutron spectra by time-of-flight measurements of the energies of the emitted neutrons. Apparatus was developed to produce a short (2.5 by 10^{-9} second) pulsed beam from the linear accelerator and for the measurement of neutron flight times over a seven-meter flight path. Spectra of bismuth, lead, silver, and tantalum have thus far been measured. It is proposed to undertake a systematic study of the neutron spectra from light elements.

The work of the Theoretical Group in the last year again covered almost all fields of nuclear and meson physics and field theory. The group was fortunate this year to have had

with it Professors Francis E. Low and Walter Thirring, the former a leading expert in meson physics and the latter in field theory, both of whom have helped greatly in deepening the understanding of these fields. Professor Thirring has worked out during his time here an exact solution of a one-dimensional field theoretical problem which may be very instructive for the understanding of field theoretical divergences. He also delivered a subject on the foundations of field theory. Professor Low stimulated a number of new researches in meson theory as well as giving a series of lectures on meson physics. Notable in the field of meson physics have been works on multiple meson production, on charge-dependent effects in pion scattering, on μ-meson decay, and on the production of pions. The new discoveries on parity received considerable attention. In this connection we were fortunate to have as a guest Dr. G. Lueders from Germany, who lectured on the Schwinger-Lueders-Pauli theorem, which is of great importance in this field.

The theory of nuclear reactions has received a great deal of attention. Refinements and further applications of the optical model were undertaken. These concerned mainly the exact shape of the potential well on one hand and the theory of proton reactions on the other. The problems of the interaction of elementary particles have been considered in many ways: for example, through the connection between the magnetic moment of the deuteron and the newly discovered spin-orbit forces, the influence of the vacuum polarization upon the proton-proton interaction, and the saturation of nuclear matter.

Work has been carried out on the theory of nuclear spectroscopy. Some progress was made in the understanding of the nuclear photoeffect, especially in respect to the relation between the collective model and the individual particle model. The theory of deformed nuclei was also taken up, with some interesting consequences in the spectroscopy of lighter nuclei.

Collaboration among members of the Laboratory and Harvard University physicists has continued in all phases of planning relative to the proposed 6-Bev Cambridge Electron Accelerator. Much of the research planning of both the Harvard and M.I.T. groups has resulted from joint considerations regarding future work with the accelerator, and the

present high-energy program of this Laboratory is distinctly concerned with preparations for the machine's use when it is put into operation.

PETER T. DEMOS[1]

RESEARCH LABORATORY OF ELECTRONICS

During the past year, the Research Laboratory of Electronics provided research facilities for 50 professors, 10 instructors, 8 research associates and 118 students, including 65 research assistants and 4 teaching assistants. In addition to the staff members, the Laboratory supported the research of 34 graduate students, 16 seniors working on theses, 11 visitors, and 7 industrial fellows.

Participating faculty and students were drawn largely from the Physics and Electrical Engineering Departments, but five other departments were represented — Modern Languages, Economics, Chemistry, Mathematics, and Biology.

The total staff of the Laboratory, including monthly non-staff and hourly employees, numbered 309.

The operating budget for the period totaled $1,500,000, 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. This year the Laboratory received support from the Atomic Energy Commission to permit continuance 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, and the Hughes Electronic Corporation. During the past year, seven full-time graduate students were supported by the Program.

[1] For the Directing Committee of the Laboratory for Nuclear Science.

Sixteen students working in the Laboratory received Bachelor of Science degrees, twenty-one received Master of Science degrees, and nine received Doctor's degrees during the past year. Members of the staff published twenty-four technical and progress reports and fifty-six journal articles and presented papers at thirteen technical meetings. The Laboratory had visitors from fourteen foreign countries as well as from all parts of the United States.

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; 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; Prof. George G. Harvey's soft–X-ray and energy bands in metals research; and Dr. William M. Whitney's work in the Low Temperature Laboratory on second sound in helium.

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 of 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 of Dr. Manuel V. Cerrillo; the information theory and communication systems research of Professors Robert M. Fano,

Peter Elias, and Claude E. Shannon; the switching circuit investigations of Professors Samuel H. Caldwell and David A. Huffman; the statistical communication theory research of Professor Yuk-Wing Lee and his students; the solid-state devices research of Professors Richard B. Adler and Robert M. Fano; the propagation and noise studies of Professor Jerome B. Wiesner and his students; and the electroneurophysiology investigations of 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.

JEROME B. WIESNER

SPECTROSCOPY LABORATORY

The research programs of the Spectroscopy Laboratory in physics and chemistry were unusually productive during the past year, as measured by undergraduate and graduate theses and scientific publications.

The ruling-engine program, under Professor George R. Harrison, has resulted in the production of improved diffraction gratings having weaker Rowland ghosts than any previously obtainable. New techniques for the ruling of echelles have been developed, and improved high-resolution spectrographs are now made possible.

Senior physics students working under the direction of Dr. Sumner P. Davis have investigated conditions for obtaining good emission spectra of rare-earth atoms in high magnetic fields. Both arcs and electrodeless discharge tubes, the latter operated at microwave frequencies, have been used as sources; and Zeeman spectra of terbium, dysprosium, and holmium have been obtained and partially analyzed.

Work went forward on the problem of detecting coincidences between optical photons. A study was initiated of the polarization of atoms by electron bombardment, with the expectation that this technique would prove valuable in the study of hyperfine structure.

In the field of infrared spectroscopy, the Laboratory extended its studies at moderately high resolution with small grating spectrometers to wave lengths of two hundred microns. Despite the small size of the gratings used, the achieved resolution was very good. One molecular band resolved — that due to the parallel vibration in benzene at fifteen microns — represents the largest symmetrical top hitherto resolved in the infrared. Papers presenting these results as well as spectroscopic studies of methyl amine, cycloöctratriene, ethylene oxide, cyclopropane, and isotopic derivatives of these substances appeared in print during the year.

Other investigations in chemical spectroscopy were directed by Professors George Scatchard (spectroscopic measurement of vapor pressures of alloys) and Carl Garland (infrared spectra of adsorbed substances).

The Special Summer Programs in Infrared Spectroscopy were again presented to about 130 persons. The visiting lecturers were Dr. F. A. Miller of the Mellon Institute, Professor E. R. Lippincott of the University of Maryland, Dr. R. Norman Jones of the Canadian National Research Council, Dr. W. J. Potts of the Dow Chemical Company, and Dr. E. J. Rosenbaum of the Sun Oil Company.

Other research workers from American and foreign institutions in the Laboratory during the past year were Dr. Ryumyo Onaka of the University of Tokyo, Professor Yoshio Tanaka of Tokyo University of Education, Yohiko Yamada of Osaka University, Dr. P. C. Von Planta of the University of Basel, and Dr. Rene Zurcher of the Swiss Institute of Technology, Zurich.

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

RICHARD C. LORD

REPORT OF THE TREASURER

The major trends and developments in Institute financial affairs for the fiscal year 1956–57 are summarized in the following exhibit.

	1956–57	*1955–56*	*Change*
Academic operations	$19,489,000	$17,099,000	+$2,390,000
Division of Sponsored Research	49,118,000	43,092,000	+ 6,026,000
Total funds	87,471,000	82,679,000	+ 4,792,000
Plant assets	41,309,000	37,980,000	+ 3,329,000
Gifts and grants	8,498,000	10,387,000	− 1,889,000
Investments — market value	128,086,000	123,683,000	+ 4,403,000
Investments — book value	85,314,000	79,390,000	+ 5,924,000

OPERATIONS

The operations of the Institute in 1956–57 are set out in the following exhibit.

	1956–57	1955–56
Revenues and funds		
Tuition and other income	$ 6,458,000	$ 4,964,000
Investment income	1,793,000	1,890,000
Gifts and other receipts	4,215,000	3,859,000
Contract allowances for indirect expenses	5,230,000	4,580,000
Auxiliary activities	1,793,000	1,806,000
Total	**$19,489,000**	**$17,099,000**
Expenses		
Academic	$ 8,116,000	$ 6,901,000
General and administration	6,272,000	5,237,000
Plant operations	3,136,000	3,014,000
Auxiliary activities	1,965,000	1,947,000
Total	**$19,489,000**	**$17,099,000**

For three successive years prior to 1955–56, academic expenses were in the six-million dollar range. In 1955–56 academic expenses approached the seven-million-dollar mark and for the fiscal year 1956–57 exceeded eight million dollars. This uptrend reflects the program in recent years to increase faculty salaries and the compensation of Institute employees. The expense of faculty and employee benefits has doubled in the last two years. The expense of benefits for all M.I.T. employees, including the Division of Sponsored Research, is in general and administration expenses. Faculty salary expenses in 1956–57 were further increased by additional compensation provided for summer session teaching occasioned by the change for the faculty from ten and one-half months' to nine months' teaching duties, with no reduction in basic annual salary.

The increase in academic expenses over the past two years has been met largely from the increased tuition income from the $1,100 tuition rate in effect for the first time in 1956–57 and from gifts and other receipts. Higher academic expenses

in 1955–56 were met in part from a special distribution of investment income in anticipation of the greater tuition revenue in 1956–57. Contract allowances for indirect expenses were increased as general and administration expenses grew and as a greater proportion of plant operating expenses was financed from contract allowances than in the preceding year. In 1956–57 sponsored research volume increased 15 per cent over the preceding year.

GIFTS

The gifts for 1956–57 are compared to 1955–56 in this table.

	1956–57	*1955–56*
Gifts for endowment	$ 2,381,000	$ 2,404,000
Gifts for buildings	731,000	1,134,000
Gifts for current use — invested	1,330,000	2,176,000
Industrial Liaison support	1,293,000	1,195,000
Other funds for current use	2,763,000	3,568,000
Total gifts	$ 8,498,000	$10,387,000

Substantial additions to endowment in 1956–57 included bequests from Mary C. Emery, Arthur E. Fowle, Glenn L. Martin, and Henry D. Warren. The second part of the grant from the Ford Foundation for faculty salaries was received during the year. Receipts from the National Science Foundation and the Kresge Foundation made up the greater part of the gifts and grants received for buildings and equipment during the year. Gifts directly to the Alumni Fund of $356,179 are included in gifts for current use — invested and make up a part of the total of $641,371 credited by the Alumni Fund office. Contributions for the Faculty Salary Adjustment Fund are included in gifts for current use — invested in the amount of $518,000. Funds for staff compensation were also increased by a gift from the Alfred P. Sloan Foundation, Inc., included in other funds for current use.

FUNDS

Endowment and other funds increased by $4,792,000 during 1956–57.

	1956–57	*1955–56*
Endowment for general purposes	$34,902,000	$33,994,000
Endowment for designated purposes	19,882,000	17,090,000
Total endowment funds	**$54,784,000**	**$51,084,000**
Other funds	32,687,000	31,595,000
Total funds	**$87,471,000**	**$82,679,000**

Total endowment resources of $54,784,000 on June 30, 1957, compare with endowment funds of $41,248,000 five years ago and $34,287,000 ten years ago. New endowment resources were added during the year for faculty salaries, for the support of academic departments, for undergraduate scholarships, and for plant operations.

Increases were recorded in funds for the Faculty Salary Adjustment Program, for academic department purposes, in funds for the funding of faculty tenure salaries and related expenses now met with other resources, in net realized gains on investment transactions, and in the reserve of unallocated investment income. These increases were offset in part by decreases in building funds and unrestricted funds during the year. In recognition of the investment real estate properties of the Institute that may be transferred or converted to educational plant assets, the reserve for academic plant was increased by drawing on other Institute funds. The reserve to finance new appointments to the faculty was further increased during the year by adding unrestricted funds.

With retirement funds included, the total book value of funds on June 30, 1957, was $96,378,000.

PLANT FACILITIES

The Karl Taylor Compton Laboratories, including the Computation Center, and the nuclear reactor accounted for most of the $3,339,000 payments for construction added to educational plant in 1956–57. Since the close of the fiscal year, the National Guard Armory on Massachusetts Avenue and Vassar Street was purchased by the Institute from the Com-

monwealth of Massachusetts, subject to an occupancy agreement of limited duration. The building funds on hand at the close of the year were fully committed but with gifts receivable were sufficient to meet all construction in progress and the cost of the Armory building. Construction of the David Flett du Pont Athletic Center adjoining the Armory will be undertaken during 1957–58, and this structure will constitute the principal addition to academic plant in 1957–58.

Total plant operating expenses increased from $3,014,000 in 1955–56 to $3,136,000 in 1956–57, with most of the change due to regular operating expenses of new building facilities and to the higher costs of building maintenance and operations.

The book value of the educational plant of the Institute was $41,309,000 on June 30, 1957, compared to $37,980,000 on June 30, 1956.

INVESTMENTS

The investment position of the Institute on June 30, 1957, and June 30, 1956, 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, 1957		*June 30, 1956*	
	Book Value	*Market Value*	*Book Value*	*Market Value*
General Investments				
Bonds	$42,550,000	$ 39,957,000	$38,704,000	$ 38,183,000
Stocks	22,122,000	64,049,000	22,457,000	63,649,000
Real estate	11,863,000	11,863,000	10,503,000	10,503,000
Commercial paper	2,208,000	2,208,000	1,477,000	1,477,000
Total	**$78,743,000**	**$118,077,000**	**$73,141,000**	**$113,812,000**
Special investments	4,791,000	8,229,000	4,765,000	8,387,000
Student notes receivable	1,780,000	1,780,000	1,484,000	1,484,000
Total	**$85,314,000**	**$128,086,000**	**$79,390,000**	**$123,683,000**

Funds sharing in the income from the general investments earned 6.14 per cent on the average book value compared to 6.29 per cent last year. This year 5 per cent plus a special distribution of ½ of 1 per cent was allocated to the funds,

which compares with 5 per cent and 1 per cent, respectively, last year. These special distributions have been made from the reserve of unallocated investment income. The total income on the general and special investments in 1956–57 was $4,263,000, compared to $4,070,000 in 1955–56. Of the total investment income of the year, $1,793,000 was used for current expenses, $448,000 was added to principal of endowment funds, and $412,000 was added to unallocated investment income. The remainder was added to funds for current use. Total unallocated investment income was $3,628,000 on June 30, 1957. The general investment gain-and-loss account was $6,324,000 on June 30, 1957, compared to $5,401,000 on June 30, 1956.

The proportion of the general investments in bonds at market value was 33.8 per cent on June 30, 1957, and 33.5 per cent on June 30, 1956; but the proportion of investment income from bonds increased from 25.1 per cent to 30.1 per cent. At market values the proportion of the general investments in stocks decreased from 55.5 per cent on June 30, 1956, to 53.7 per cent on June 30, 1957; and the proportion of investment income represented by common-stock dividends declined from 62.2 per cent to 57.0 per cent.

Real estate investments are carried at identical figures for both book and market values, but actual market values probably exceed book values. The greater part of the commercial real estate owned by the Institute is subject to long-term leases. The income on the investment of Institute funds in dormitories is at the rate of 3 per cent on book value, and this income as a part of total investment income is used for the academic operations of the Institute.

The investments of the M.I.T. Pension Association and the Supplementary Retirement Fund on June 30, 1957, and June 30, 1956, are presented in the following exhibit.

	June 30, 1957		*June 30, 1956*	
	Book Value	*Market Value*	*Book Value*	*Market Value*
Pension Association	$7,260,000	$ 9,800,000	$6,259,000	$8,694,000
Supplementary Retirement Fund..	1,545,000	1,606,000	661,000	725,000
Total.....	**$8,805,000**	**$11,406,000**	**$6,920,000**	**$9,419,000**

ACCOUNTING AND REPORTING PROCEDURES

As in former years, investment income, gifts, and other receipts and contract allowances for indirect expenses were used as required to meet current expenses. Under new regulations the government contract allowances for indirect expenses are subject to adjustment after the close of the fiscal period. The working capital accounts for academic operations and for the Division of Sponsored Research are consolidated in the balance sheet of June 30, 1957; whereas on June 30, 1956, the current assets and liabilities of the Division of Defense Laboratories, as it was then constituted, were segregated and so presented on the balance sheet for that date.

GENERAL

During the year the trustees of the staff retirement plan were notified that the M.I.T. Pension Association and the Supplementary Retirement Trust are tax exempt under the provisions of the Internal Revenue Code of 1954. A report of the consulting actuaries confirmed that the unfunded obligations of the Institute under the retirement program for the staff will be funded in eleven and one-half years from July 1, 1957, at the Institute's current annual rate of contributions to the Pension Association and the Supplementary Retirement Plan. The unfunded accrued liability will be amortized by level annual payments of approximately $400,000.

The increase in the funds of the Institute of $4,792,000 in 1956–57 contrasts with the increase of $8,846,000 in 1955–56. This reduced rate of growth was due in part to the receipt in 1954–55 and 1955–56 of funds for construction and other purposes to be expended in 1956–57 and in succeeding years. Construction payments were $3,339,000 in 1956–57 and $1,847,000 in 1955–56. The growth in endowment funds in 1956–57 was maintained at the level of the preceding year.

Respectfully submitted,

JOSEPH J. SNYDER
Vice-President and Treasurer

September 9, 1957

BALANCE SHEET June 30, 1957

Schedule A

INVESTMENTS

General investments:		
U. S. Government bonds	$14,344,549	
Other bonds	28,206,145	
Preferred stocks	676,751	
Common stocks	21,445,011	
Real estate (including $5,313,680 devoted to Institute use) and mortgages	11,862,584	
Commercial paper	2,208,128	
(A-1)		$ 78,743,168
Investments of funds separately invested (A-2)		4,791,222
Students' notes receivable (A-13)		1,779,972
Total investments		85,314,362
Less temporary investment of general-purpose cash		1,153,231
		$ 84,161,131

CURRENT AND DEFERRED ASSETS

Cash:		
General purposes	$ 2,330,437	
Restricted to certain research contracts	1,981,363	
Students' safe-keeping deposits	73,844	$ 4,385,644
Temporary investment of general-purpose cash		1,153,231
Accounts receivable:		
U. S. Government (A-14)	$ 2,605,135	
Other (A-14)	519,420	3,124,555
Contracts in progress, principally U. S. Government (A-15)		7,303,442
Inventories, deferred charges, and other assets (A-16)		1,406,541
		$ 17,373,413

EDUCATIONAL PLANT

Land, buildings and equipment (A-20)	$ 41,308,735
	$142,843,279

BALANCE SHEET June 30, 1957

Schedule A

INVESTED FUNDS

Endowment funds:			
Income for general purposes	(A-3)	$34,902,034	
Income for designated purposes	(A-4)	19,881,866	$ 54,783,900
Student loan funds	(A-5)		3,195,043
Building funds	(A-6)		1,666,559
Other expendable funds:			
General purposes	(A-7)	$ 481,712	
Designated purposes	(A-8)	11,646,460	12,128,172
Unexpended endowment income for designated purposes	(A-4)		1,239,886
Agency and annuity funds	(A-9 & A-10)		1,195,388
General investments—gain and loss account	(A-11)		6,323,823
Unallocated investment income	(A-12)		3,628,360
			$ 84,161,131

CURRENT LIABILITIES AND FUNDS

Accounts payable and accrued wages		$ 2,558,088	
Students' advance fees and deposits	(A-17)	444,129	
Students' safe-keeping deposits		73,844	
Withholdings, deposits, and other credits	(A-18)	1,280,529	
Advances by the U. S. Government for certain research contracts		9,707,046	
Total current liabilities			$ 14,063,636
Gifts and other receipts for current expenses	(A-19)		3,309,777
			$ 17,373,413

EDUCATIONAL PLANT CAPITAL

Endowment for educational plant	(A-21)	$ 41,308,735
		$142,843,279

SOURCES OF REVENUES AND FUNDS USED TO MEET EXPENSES OF CURRENT OPERATION for the year ended June 30, 1957

Schedule B

EDUCATIONAL AND GENERAL

Sources of revenues and funds used

Tuition and other income	(B-1)	$ 6,458,434
Investment income	(B-2)	1,793,119
Gifts and other receipts	(B-2)	4,215,311
Contract allowances for administration and plant operation (see below)	(B-3)	5,229,457
Dining and student housing	(B-7)	1,792,453
		$19,488,774

Expenses of current operation

Academic departments	(B-4)	$ 8,115,726
General and administration	(B-5)	6,272,284
Plant operation	(B-6)	3,135,499
Dining and student housing	(B-7)	1,965,265
		$19,488,774

RESEARCH CONTRACTS

Revenues

Government (except Lincoln Laboratory)		$22,764,795
Lincoln Laboratory		30,655,026
Industrial and other sponsors		1,908,324
	(B-3)	**$55,328,145**

Expenses

Direct costs and expenses	(B-3)	$49,118,044
Allowance for use of facilities and other reserves	(B-3)	980,643
Allowances for administration and plant operation	(B-3)	5,229,458
		$55,328,145

STATEMENT OF FUNDS for the year ended June 30, 1957

Schedule C

		Balance June 30, 1956	*Gifts and Other Receipts*	*Investment Income*	*Transfers In — (Out)*	*Expenses*	*Other Charges*	*Balance June 30, 1957*
Endowment funds:								
Income for general purposes	(A-3)	$33,993,733	$ 545,710	$1,879,947	$(191,049)	$1,326,307	.....	$34,902,034
Income for designated purposes	(A-4)	17,089,980	1,951,997	*	839,889	.....	.....	19,881,866
Student loan funds	(A-5)	3,083,339	14,946	96,275	2,424	.....	$ 1,941	3,195,043
Building funds	(A-6)	3,478,670	731,350	155,320	610,369	36,055	3,273,095	1,666,559
Other expendable funds:								
General purposes	(A-7)	606,068	196,359	37,851	(318,127)	23,703	16,736	481,712
Designated purposes	(A-8)	10,109,508	2,685,768	588,075	(808,570)	322,441	605,880	11,646,460
Unexpended endowment income for designated purposes	(A-4)	1,254,009	1,774	1,031,016	(260,389)	466,812	319,712	1,239,886
Agency and annuity funds	(A-9 & A-10)	1,059,234	130,878	62,754	.....	420	57,058	1,195,388
General investments — gain and loss account	(A-11)	5,401,472	922,351	.....	.....	.....	.....	6,323,823
Unallocated investment income	(A-12)	3,216,259	.....	412,101	.....	.....	.....	3,628,360
Total invested funds		$79,292,272	$ 7,181,133	$4,263,339	$(125,453)	$2,175,738	$4,274,422	$84,161,131
Gifts and other receipts for current expenses	(A-19)	3,387,367	4,671,063	.....	125,453	3,832,692	1,041,414	3,309,777
		$82,679,639	$11,852,196	$4,263,339	$.....	$6,008,430	$5,315,836	$87,470,908

Gifts received during year	$ 8,498,000	
Appropriations from research contract allowances	977,348	
Net realized gain on investments	1,220,435	
Reserved from operating revenues of service activities	766,330	
Other	390,083	
Investment income used to meet expenses of current operation		$1,793,119
Gifts and other receipts used to meet expenses of current operation		4,215,311
Expenditures for buildings added to educational plant		$3,339,264
Scholarship and fellowship awards		880,039
Direct research costs charged against gifts designated therefor		304,888
Other charges to funds not representing operating expenses		791,645

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

AUDITORS' CERTIFICATE

TO THE AUDITING COMMITTEE OF THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY:

We have examined the financial statements of Massachusetts Institute of Technology:

Schedule A — Balance Sheet as of June 30, 1957.

Schedule B — Sources of Revenues and Funds Used to Meet Expenses of Current Operation for the Year ended June 30, 1957.

Schedule C — Statement of Funds for the Year ended June 30, 1957.

Our examination was made in accordance with generally accepted auditing standards, and accordingly included such tests of the accounting records and such other auditing procedures as we considered necessary in the circumstances. It was not possible to confirm certain receivables from the United States Government, but we satisfied ourselves as to such receivables by means of other auditing procedures.

In our opinion, said statements present fairly the financial position of Massachusetts Institute of Technology at June 30, 1957, and the results of its operations for the year then ended.

LYBRAND, ROSS BROS. & MONTGOMERY

Boston, Massachusetts, September 12, 1957

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, 1957, and their certificate is submitted herewith.

Respectfully,

WILLIAM A. COOLIDGE
RALPH LOWELL
HAROLD B. RICHMOND, *Chairman*

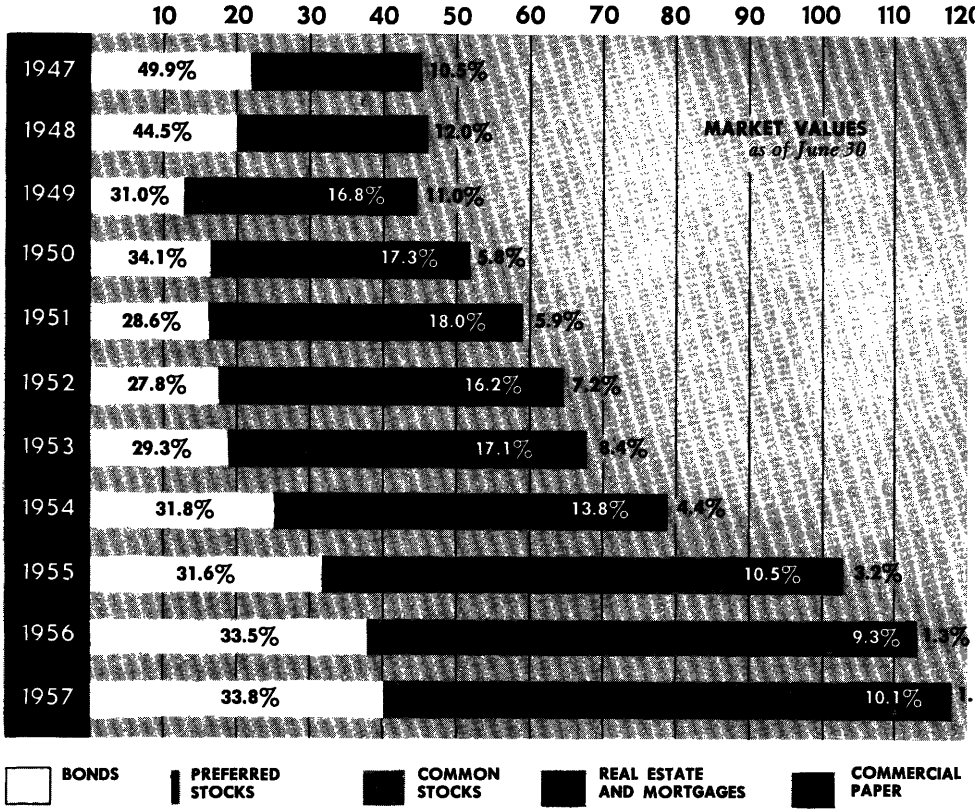
SUMMARY OF INVESTMENTS — JUNE 30, 1957

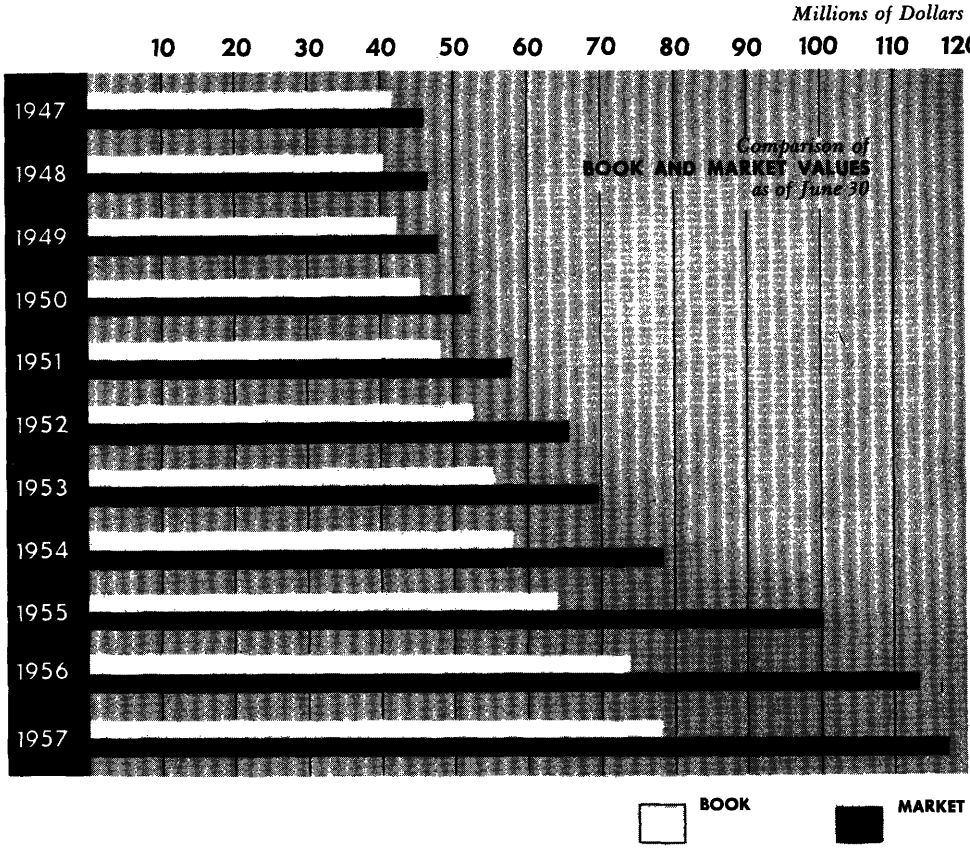
	Book Value	Market Value Amount	Market Value Per Cent	Net Income Amount	Net Income Per Cent
GENERAL INVESTMENTS					
Bonds					
U. S. Government	$14,344,549	$ 13,619,865	11.5	$ 327,944	8.3
Canadian	2,120,093	2,145,345	1.8	83,889	2.1
Industrial	4,200,499	3,980,110	3.4	123,157	3.1
Public utility	5,228,680	4,734,715	4.0	133,048	3.4
Common carrier	3,152,786	3,033,399	2.6	76,783	1.9
Financial	13,501,988	12,443,271	10.5	448,903	11.3
Other	2,100	.....	....	2	....
Total	**$42,550,695**	**$ 39,956,705**	**33.8**	**$1,193,726**	**30.1**
Preferred Stocks	**$ 676,751**	**$ 667,790**	**0.5**	**$ 28,506**	**0.7**
Common Stocks					
Industrial	$14,658,634	$ 51,593,816	43.7	$1,762,148	44.5
Public utility	3,461,079	5,287,926	4.5	232,511	5.9
Railroad	262,392	609,848	0.5	41,415	1.0
Bank	1,552,714	2,095,956	1.8	100,890	2.5
Insurance	788,121	2,460,924	2.1	73,450	1.9
Other	722,071	1,333,707	1.1	47,140	1.2
Total	**$21,445,011**	**$ 63,382,177**	**53.7**	**$2,257,554**	**57.0**
Mortgage Notes	**$ 84,357**	**$ 84,357**	**0.1**	**$ 3,117**	**0.1**
Real Estate					
For Institute use	$ 5,313,680	$ 5,313,680[1]	4.5	$ 167,119	4.2
Other property	6,464,547	6,464,547[1]	5.5	248,267	6.3
Total	**$11,778,227**	**$ 11,778,227**	**10.0**	**$ 415,386**	**10.5**
Commercial paper	**$ 2,208,127**	**$ 2,208,127**	**1.9**	**$ 63,675**	**1.6**
Total general investments	**$78,743,168**	**$118,077,383**	**100.0**	**$3,961,964**	**100.0**
OTHER INVESTMENTS					
Separately invested funds	$ 4,791,222	$ 8,228,509		$ 301,375	
Students' notes receivable	1,779,972	1,779,972		†	
Total investments	**$85,314,362**	**$128,085,864**		**$4,263,339**	
Less: Temporary investment of general purpose cash	1,153,231				
Investments (Schedule A)	**$84,161,131**				

[1] Book value used in lieu of market appraisal. †Interest credited directly to student loan funds.

GENERAL INVESTMENTS 1947-1957

Millions of Dollars





INCOME ON THE GENERAL INVESTMENTS, 1947-1957

	Income	Per cent yield on market value[1]	Per cent yield on book value[1]
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	3,732,597	3.49	5.38
1957	3,961,964	3.42	5.22

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

GENERAL INVESTMENTS
Schedule A-1

Par Value		*Book Value*	*Net Income*
	U. S. GOVERNMENT BONDS		
	Treasury Bills		
$ 75,000	2.95% 7-18-57	$ 74,870.94	.....
500,000	3.17% 8-22-57	497,578.47	.....
500,000	3.16% 8-29-57	497,191.11	.....
500,000	3.35% 9-5-57	495,765.97	.....
500,000	3.20% 9-23-57	496,044.44	.....
1,000,000	3.21% 9-26-57	991,975.00	.....
	Treasury Notes		
1,000,000	2⅞%, Series A, 6-15-58	1,000,000.0.	$28,750.00
	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	33,000.00
3,018,000	2½%, 11-15-61	3,018,000.00	75,450.00
2,040,000	2½%, 8-15-63	2,040,000.00	51,000.00
1,500,000	2½%, 12-15-68/63	1,469,218.75	37,500.00
1,500,000	2½%, 6-15-69/64	1,456,667.00	37,500.00
10,000	3¼%, 6-15-83/78	10,000.00	325.00
	Savings Bonds Series G		
100,000	2½%, 7-1-57	99,200.00	.....
	Small Holdings	7,398.72	102.60
	Income from bonds sold or matured	.....	40,566.67
	Total U. S. Gov't bonds	**$14,344,548.82**	**$ 327,944.27**
	CANADIAN BONDS		
	Industrial		
$ 168,000	Aluminum Co. of Can., Ltd., Deb., 3⅞%, 5-1-70	$ 168,000.00	$ 6,510.00
192,000	Aluminum Co. of Can., Ltd., Deb., 4½%, 3-1-73	192,000.00	8,904.60
200,000	Aluminum Co. of Can. Deb., 4½%, 4-1-80	200,000.00	(4,573.77)
	Public Utility		
200,000	Bell Tel. of Canada, 1st J, 4½%, 12-15-67	200,000.00	9,407.82
200,000	Interprov. Pipe Line, 1st A, 3½%, 1-1-70	197,375.00	7,212.19
500[1]	Trans-Canada Pipe Lines, Ltd., Sub. Deb., 5.60%, 1-1-87	47,717.67	(433.48)
1,000[1]	Westcoast Trans. Co., Ltd., Sub. Deb. A, 5½%, 4-1-88	115,000.00	5,484.72

[1] Units.

GENERAL INVESTMENTS *Schedule A-1 — continued*

Par Value		*Book Value*	*Net Income*
	CANADIAN BONDS — *continued*		
	Financial		
$ 500,000	Canadian Acceptance Corp., Ltd., 4½%, 11-1-68.....	$ 500,000.00	$ 23,342.66
500,000	G.M.A.C. of Canada Deb., 4¾%, 12-15-69.....	500,000.00	24,826.18
	Income from bonds called..	.....	3,208.34
	Total Canadian bonds.....	**$ 2,120,092.67**	**$ 83,889.26**
	INDUSTRIAL BONDS		
$ 100,000	Champion Paper & Fibre Co. Deb., 3¾%, 7-15-81.	$ 100,000.00	$ 1,697.92
250,000	Commonwealth Oil Refining Co. Deb., 6%, 12-31-66..	250,000.00	15,000.00
40,000	Dresser Industries, Inc. Conv. Sub. Deb., 4⅛%, 3-1-77	40,000.00	(94.19)
300,000	General Electric Company Deb., 3½%, 5-1-76.....	300,000.00	10,500.00
1,000,000	General Motors Corp. Deb., 3¼%, 1-1-79.....	1,000,000.00	32,500.00
237,000	Kaiser Aluminum & Chemical Corp., 1st Mtg., 4¼%, 4-1-81	237,000.00	2,437.25
150,000	Kaiser Steel Corp. 1st Mtg., 4¾%, 5-1-76.....	150,000.00	2,265.53
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	20,313.51
300,000	Minneapolis-Honeywell Reg. Co. Deb., 3¾%, 8-1-76..	298,500.00	4,708.32
208,000	Phillips Petroleum Co. Conv. Sub. Deb., 4¼%, 2-15-87	208,000.00	(12,098.46)
500,000	Pittston Company Sub. Deb., 6¼%, 10-1-76.....	500,000.00	8,767.36
77,000	Shamrock Oil & Gas Corp. Deb., 3½%, 4-1-67.....	77,000.00	2,695.00
300,000	Superior Oil Company Deb., 3¾%, 7-1-81.....	300,000.00	4,846.36
250,000	Union Tank Car Co. Deb., 3¾%, 10-15-75.....	250,000.00	9,375.00
140,000	U. S. Steel Corp. Deb., 2.05–2.65%, 8-1-57-64...	140,000.00	3,262.50
	Income from bonds sold...	.....	5,981.00
	Total industrial bonds.....	**$ 4,200,499.00**	**$ 123,157.10**

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

Par Value		*Book Value*	*Net Income*
	PUBLIC UTILITY BONDS		
	Electric and Other		
$ 200,000	American & Foreign Power Co. Deb., 5%, 3-1-2030..	$ 197,182.41	$ 10,000.00
500,000	American Tel. & Tel. Co. Deb., 4⅜%, 4-1-85.....	500,000.00	(6,240.72)
1,000,000	American Tel. & Tel. Co. Deb., 3⅞%, 7-1-90.....	1,000,000.00	(10,054.06)
200,000	Consolidated Edison Co. of N. Y. 1st, 3⅝%, 5-1-86..	200,000.00	7,250.00
200,000	Duke Power Company 1st, 3⅝%, 5-1-86.....	200,000.00	7,250.00
300,000	Florida Power & Light Co. 1st, 3⅝%, 4-1-86.....	300,000.00	10,875.00
200,000	Niagara Mohawk Power Corp., 3⅝%, 5-1-86....	200,000.00	7,250.00
300,000	So. California Edison 1st G, 3⅝%, 4-15-81.....	297,318.00	10,875.00
200,000	Wisconsin Electric Power Co. 1st, 3⅞%, 4-15-86.....	200,000.00	7,750.00
200,000	Bell Telephone Co. of Pa. 1st Ref. C, 5%, 10-1-60..	200,000.00	(2,000.00)
	Gas Transmission		
200,000	Columbia Gas System, Inc., Deb. D, 3½%, 7-1-79...	200,000.00	7,000.00
200,000	Columbia Gas System, Inc., Deb. E, 3⅝%, 9-1-80...	200,000.00	7,250.00
200,000	Columbia Gas System, Inc., Deb. F, 3⅞%, 4-1-81...	200,000.00	7,750.00
105,000	Northern Natural Gas Co., Deb., 3⅝%, 11-1-73....	105,000.00	3,806.25
200,000	Northern Natural Gas Co., Deb., 3¼%, 11-1-74....	200,000.00	6,500.00
250,000	Oklahoma Natural Gas Co., 1st, 3½%, 5-1-81.....	250,000.00	8,750.00
82,000	Southern Natural Gas Co. 1st, 4%, 5-1-73.....	81,180.00	3,280.00
198,000	Tennessee Gas Trans. Co. Deb., 4%, 4-1-75.....	198,000.00	7,920.00
500,000	Tennessee Gas Trans. Co. 1st, 3⅞%, 2-1-76.....	500,000.00	19,375.00
	Income on bonds sold.....	.....	18,461.27
	Total public utility bonds..	**$ 5,228,680.41**	**$ 133,047.74**

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

Par Value		*Book Value*	*Net Income*
	COMMON CARRIER BONDS		
$1,000,000	Blackships, Inc. Series A thru G, 5%, 4-1-73/75...	$ 1,000,000.00	$ 13,055.56
557,000	Great Lakes Pipe Line Co. Deb., 4%, 2-1-74.....	557,000.00	22,280.00
500,000	Great Lakes Pipe Line Co. Deb., 4¾%, 4-1-82.....	500,000.00	739.60
250,000	New York Central R.R. Eq. Tr., 2¾%, 11-15-57.....	248,560.66	6,875.00
500,000	Shell Pipe Line Corp. Note, 3.30%, 12-15-58/67.....	491,143.38	13,704.10
158,000	Southern Pacific Company, 4½%, 5-1-81.....	156,081.75	7,110.00
200,000	Transcont. Gas Pipe Line Corp. 1st P.L., 5%, 4-1-77	200,000.00	(2,079.46)
	Income on bonds sold.....	.....	15,098.33
	Total common carrier bonds	**$ 3,152,785.79**	**$ 76,783.13**
	FINANCIAL BONDS		
$2,000,000	Associates Invest. Co. Note, 3%, 12-1-64.....	$ 2,000,000.00	$ 60,000.00
500,000	Associates Invest. Co. Note, 4¾%, 1-15-67.....	500,000.00	.....
500,000	Associates Invest. Co. Sub. B Note, 4¾%, 10-1-68..	500,000.00	20,715.28
500,000	Associates Invest. Co. Note, 3¼%, 2-15-70.....	500,000.00	16,250.00
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	16,250.00
500,000	C.I.T. Financial Corp. Note, 3%, 2-15-64.....	500,000.00	15,000.00
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	67,890.00
1,195,000	G.M.A.C. Deb., 2¾%, 7-15-64.....	1,183,112.53	32,862.50

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

Par Value		*Book Value*	*Net Income*
	FINANCIAL BONDS — *continued*		
$ 235,000	G.M.A.C. Deb., 3%, 7-15-69	$ 235,000.00	$ 7,050.00
300,000	G.M.A.C. Deb., 3½%, 3-15-72	300,000.00	10,500.00
500,000	G.M.A.C. Jr. Sub. Note, 3¾%, 4-1-73	500,000.00	18,750.00
500,000	G.M.A.C. Deb., 3⅝%, 9-1-75	491,250.00	18,125.00
300,000	Int'l Bank for Recon. & Dev., 3%, 3-1-76	300,000.00	9,000.00
	Income from bonds matured	.....	19,010.42
	Total financial bonds	**$13,501,987.53**	**$ 448,903.20**
	Small holdings	**$ 2,100.00**	**$ 2.50**
Shares			
	PREFERRED STOCKS		
1,000	Anderson Pritchard Oil Corp. 4¼% Cum. Conv.	$ 51,657.52	$ 1,965.65
100	Armstrong-Ohio Corp. B, 5% Cum.	10,000.00	500.00
655	Kaiser Aluminum & Chemical Corp. 4⅛%, Cum.Cv.	65,500.00	2,878.73
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., 2nd Pfd.	64,373.97	2,408.00
2,000	Tennessee Gas Trans. Co. 5% Cum. Conv. 2nd Pfd.	200,000.00	5,140.00
1,800	Tropical Gas Co., Inc. $5.24 Cum.	180,000.00	9,432.00
	Small holdings	1,000.00	70.00
	Income from preferred stocks sold	.....	142.50
	Total preferred stocks	$ 676,751.49	$ 28,505.68
	INDUSTRIAL COMMON STOCKS		
	Agricultural Equipment		
3,000	International Harvester Co.	$ 39,956.12	$ 6,000.00
	Automobile		
5,540	Ford Motor Company	357,330.00	13,296.00
161,024	General Motors Corporation	2,758,456.78	322,048.00

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

Shares		*Book Value*	*Net Income*
	INDUSTRIAL COMMON STOCKS — *continued*		
	Building Supplies		
15,708	Johns-Manville Corporation	$ 325,123.61	$ 34,629.00
12,857	National Lead Company...	118,326.76	41,341.75
7,350	Pittsburgh Plate Glass Co...	138,604.46	20,212.50
	Chemical and Drugs		
4,434	Allied Chemical & Dye Corporation	181,087.03	13,107.00
360	Christiana Securities Corp..	1,825,474.35	174,600.00
545	Diamond Alkali Company..	21,761.72	926.93
4,470	Dow Chemical Company...	84,073.65	5,311.20
2,196	E. I. du Pont de Nemours & Company	323,808.95	13,014.00
21,000	Hercules Powder Company.	344,959.94	23,100.00
19,540	Merck & Company, Inc....	139,688.72	21,494.00
13,024	Monsanto Chemical Co....	103,627.72	12,896.00
14,396	Union Carbide Corporation	329,847.11	49,653.75
	Containers		
15,000	American Can Company...	415,738.38	30,000.00
10,061	Owens-Illinois Glass Co....	290,970.64	25,152.52
	Electrical Equipment		
29,172	General Electric Company.	328,018.98	57,436.00
6,440	General Radio Co., Conv...	74,830.00	.....
7,000	McGraw-Edison Co.....	74,697.64	9,800.00
575	Sprague Electric Company.	33,000.00	690.00
8,053	Westinghouse Electric Corp.	225,462.65	16,106.00
	Food and Beverages		
3,150	Liquid Carbonic Corp.....	53,551.11	6,300.00
6,020	United Fruit Company....	105,434.52	18,060.00
	Machinery		
8,653	Caterpillar Tractor Co.....	92,204.43	19,469.25
6,167	Draper Corporation.....	100,327.98	9,867.20
	Non-Ferrous Metal		
4,000	International Nickel Co. of Canada.....	134,488.60	15,000.00
4,036	Kennecott Copper Corp....	257,638.67	34,306.00
	Office Equipment		
4,644	International Business Machines Corporation.....	247,577.19	8,495.20
11,034	National Cash Register Co..	92,107.98	12,400.36

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

Shares		*Book Value*	*Net Income*
	INDUSTRIAL COMMON STOCKS — *continued*		
	Oil		
18,750	Commonwealth Oil Refining Company, Inc.....	$ 4,500.00	.....
706	Continental Oil Company.	24,998.31	$ 1,111.95
9,148	Gulf Oil Corporation.....	228,851.01	22,321.25
5,000	LaGloria Oil & Gas Co....	1.00	.....
10,970	Ohio Oil Company.....	221,282.75	17,552.00
21,574	Phillips Petroleum Co.....	482,292.92	36,675.80
22,465	Socony Mobil Oil Company, Inc.....	396,279.16	52,076.50
25,030	Standard Oil Co. of Calif...	343,870.15	45,054.00
14,538	Standard Oil Co. (Indiana)	300,553.70	33,526.24
103,028	Standard Oil Co. (N. J.)...	979,534.96	225,466.65
10,686	Texas Company.....	187,880.30	26,168.20
26,100	Tropical Gas Company, Inc.	6,475.00	.....
	Paper		
12,558	International Paper Co.....	186,368.71	37,249.72
	Retail Trade		
5,125	J. C. Penney Company....	165,618.55	21,781.25
23,325	Sears, Roebuck & Company	219,212.80	22,647.00
	Rubber		
300	B. F. Goodrich Company..	14,325.00	660.00
513	Goodyear Tire & Rubber Company.....	37,861.74	807.60
	Soap		
15,304	Procter & Gamble Co.....	274,196.10	28,312.40
	Steel		
6,000	Inland Steel Company.....	198,474.49	25,500.00
6,600	National Steel Corporation.	149,488.34	26,400.00
	Miscellaneous		
33,468	Eastman Kodak Company.	388,889.78	85,422.50
185	Halliburton Oil Well Cementing Company.....	10,059.38	444.00
733	Minneapolis-Honeywell Regulator Company.....	42,963.56	1,187.75
10,608	Minnesota Mining & Manufacturing Company.....	151,558.00	11,668.80
2,000	Texas Instruments, Inc.....	24,922.57	.....
	Income on stocks sold.....	.....	25,401.80
	Total industrial stocks.....	**$14,658,633.97**	**$1,762,148.07**

GENERAL INVESTMENTS *Schedule A-1 — continued*

Shares		*Book Value*	*Net Income*
	PUBLIC UTILITY COMMON STOCKS		
28,113	American Gas & Electric Company	$ 358,533.72	$ 40,482.72
1,332	American Tel. & Tel. Co.	167,517.91	11,576.25
4,240	Boston Edison Company	155,396.99	11,872.00
525	Central Maine Power Co.	13,059.38	735.00
7,000	Commonwealth Edison Co.	172,198.06	14,000.00
4,500	Florida Power & Light Co.	161,613.60	5,670.00
6,953	General Public Utilities Corporation	200,583.54	12,436.50
10,080	Illinois Power Company	202,166.83	14,112.00
10,600	Middle South Utilities, Inc.	293,301.33	16,430.00
5,000	Montana Power Company	169,075.59	9,000.00
5,623	Ohio Edison Company	274,503.56	13,742.50
8,700	Public Service Co. of N. H.	154,649.50	8,550.00
4,000	Southern Calif. Edison Co.	138,089.14	9,600.00
2,450	Southern Company	38,457.50	2,436.88
6,493	Texas Gas Trans. Corp.	102,714.68	6,429.50
1,500	Trans-Canada Pipe Lines, Ltd.	30,282.33	.....
12,750	Transcontinental Gas Pipe Line Corporation	219,934.67	12,075.00
6,000	Utah Power & Light Co.	145,750.00	6,900.00
39,432	Virginia Elec. & Power Co.	463,251.02	36,451.65
	Income on stocks sold	.....	11.23
	Total public utility stocks	**$ 3,461,079.35**	**$ 232,511.23**
	RAILROAD COMMON STOCKS		
21,630	Atchison, Topeka & Santa Fe Railway	$ 211,196.11	$ 35,487.00
2,062	Great Northern Railway Co.	51,195.56	5,928.25
	Total railroad stocks	**$ 262,391.67**	**$ 41,415.25**
	BANK COMMON STOCKS		
3,790	Bankers Trust Co., N. Y.	$ 192,230.30	$ 10,601.50
3,698	Continental Illinois Nat'l Bk. & Trust Co., Chicago	179,977.12	14,612.00
5,549	First Nat'l Bank of Boston	307,790.41	16,924.45
7,189	First Nat'l City Bank of N.Y.	295,919.04	19,410.30
7,275	Guaranty Trust Co., N. Y.	343,284.37	25,218.40
6,853	Hanover Bank, New York	233,512.54	13,135.00
	Income on stocks sold	.....	988.10
	Total bank stocks	**$ 1,552,713.78**	**$ 100,889.75**

GENERAL INVESTMENTS Schedule A-1 — *continued*

Shares		*Book Value*	*Net Income*
	INSURANCE COMMON STOCKS		
8,334	Boston Insurance Company	$ 197,914.51	$ 15,001.20
4,250	Continental Insurance Co. of New York	68,383.05	8,500.00
8,652	Fireman's Fund of Calif.	209,379.20	15,573.60
3,821	Hartford Fire Ins. Co.	142,746.44	11,264.25
9,302	Ins. Co. of North America	169,698.05	23,093.75
	Income from stocks sold	.....	17.25
	Total insurance stocks	**$ 788,121.25**	**$ 73,450.05**
	OTHER COMMON STOCKS		
10,640	Bond Investment Trust of America	$ 193,002.60	$ 9,720.80
13,024	Century Shares Trust	192,458.46	7,033.86
1,080	Cochran Foil Company	6,680.00	612.00
61,478	Colonial Fund, Inc.	201,320.97	23,893.20
1,000	National Research Corp.	30,000.00	.....
781	Photon, Inc.	12,276.28	.....
520	Rockwell Mfg. Company	10,000.00	1,122.00
735	J. P. Stevens & Co., Inc.	25,325.00	1,102.52
1,015	Stone & Webster, Inc.	30,087.85	2,257.50
	Small holdings	20,919.55	1,073.60
	Income from stocks sold	.....	323.96
	Total other common stocks	**$ 722,070.71**	**$ 47,139.44**
	MORTGAGE NOTES		
	Dover	$ 30,500.00	.....
	Bay State Road, Boston	1,000.00	$ 118.75
	Collincote Street, Stoneham	500.00	20.00
	Maude Terrace, Watertown	1,165.55	67.69
	Summer Street, Watertown	3,682.37	203.53
	Beta Theta Pi	11,000.00	612.50
	Delta Kappa Epsilon	4,500.00	178.64
	Kappa Sigma	6,600.00	332.50
	Lambda Chi Alpha	6,234.64	552.41
	Phi Kappa	8,675.00	474.38
	450 Beacon Street, Inc.	7,000.00	87.50
	Sigma Chi	3,500.00	131.25
	Income on paid up mortgages	.....	337.98
	Total mortgage notes	**$ 84,357.56**	**$ 3,117.13**

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

	Book Value	*Net Income*
REAL ESTATE DEVOTED TO INSTITUTE USE		
Dormitories and Housing		
120 Bay State Road, Boston.	$ 26,000.00	$ 780.00
Graduate House	647,951.94	19,440.00
Baker House	2,064,180.53	61,926.00
Burton House	1,453,380.37	43,602.00
Burton House (mtg.)	195,400.00	1,886.27
Westgate veterans' housing.	459,492.60	13,784.78
Total dormitories and housing	**$ 4,846,405.44**	**$ 141,419.05**
Research		
565 Memorial Drive, Camb.	$ 200,560.50	$ 11,030.83
209 Mass. Ave., Cambridge.	100,000.00	5,500.00
Wood Street, Lexington.	66,714.04	3,669.27
68-92 Albany Street, Camb.	100,000.00	5,500.00
Total for research	**$ 467,274.54**	**$ 25,700.10**
OTHER REAL ESTATE		
180–194 Main St., Camb.	$ 181,467.39	$ 3,175.20
36–44 Memorial Dr., Camb.	970,349.71	45,893.60
80 Memorial Drive, Camb.	837,690.30	41,837.09
100 Memorial Drive, Camb.	153,510.85	6,399.96
333 Memorial Drive, Camb.	40,000.00	.....
500 Memorial Drive, Camb.	38,302.80	2,063.28
540–550 Memorial Drive, Cambridge	351,524.51	14,575.04
628 Memorial Drive, Cambridge (land)	9,211.94	.....
640 Memorial Drive, Camb.	1,080,482.88	11,387.91
76–94 Mass. Ave., Camb.	413,678.74	9,824.04
Bexley Hall, Cambridge	120,280.61	4,567.70
Gloversville, New York	216,819.40	10,880.86
New London, Connecticut.	203,921.80	9,839.27
Plattsburg, New York	135,934.73	6,323.88
Taunton, Massachusetts.	166,704.15	7,620.15
Waltham, Massachusetts.	626,878.96	31,436.04
Willimantic, Connecticut.	137,201.43	6,266.31
Worcester, Massachusetts.	300,538.63	14,680.90
Canadian Petrofina, Ltd., purchase lease back	245,440.03	6,801.24
Royalite Oil Co., Ltd., purchase lease back	234,607.87	9,892.58
Income from real estate sold	.....	4,801.30
Total other real estate	**$ 6,464,546.73**	**$ 248,266.35**

GENERAL INVESTMENTS *Schedule A-1 — continued*

Par Value		*Book Value*	*Net Income*
	COMMERCIAL PAPER		
$ 500,000	Continental Can Company, Inc., 3⅝%, 9-12-57.....	$ 490,736.11	.....
500,000	Continental Can Company, Inc., 3⅝%, 10-30-57....	491,541.67	.....
500,000	Industrial Acceptance Corp., 4%, 7-10-57.....	490,000.00	.....
500,000	Phillip Morris Company, 3⅞%, 12-26-57.....	490,204.86	.....
250,000	R. J. Reynolds Tobacco Co., 3⅝%, 11-27-57.....	245,644.96	.....
	Income from maturities....	.....	$ 63,674.90
	Total commercial paper...	**$ 2,208,127.60**	**$ 63,674.90**
	Total general investments..	**$78,743,168.31** (Schedule A)	**$3,961,964.20**

INVESTMENTS OF FUNDS SEPARATELY INVESTED

Schedule A-2

Par Value or Shares		*Book Value*	*Net Income*
	ANONYMOUS R.S. FUND		
200	Mico Instrument Company 5% Cum. Pfd.	$ 20,000.00	.....
	AVOCA FUND		
7,200	General Radio Company	$ 76,200.00	.....
	BABSON FUND		
	U. S. Government Bonds		
$ 2,000	Treasury, 2¼%, 9-15-59/56	$ 2,000.00	$ 45.00
2,000	Treasury, 2½%, 8-15-63	2,000.00	50.00
1,950	Treasury, 2½%, 9-15-72/67	1,906.13	48.75
1,000	Savings Bonds, 2½%, 7-1-61	1,000.00	25.00
1,000	Savings Bonds, 2½%, 1-1-63	1,000.00	25.00
	Preferred Stocks		
80	United Stores 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	130.00
60	Standard Oil Company (Indiana)	1,413.36	135.60
	Total of the Babson Fund	$ 20,361.51	$ 987.35
	CLASS OF 1919 FUND		
$ 50	U. S. Savings Bonds, 1957	$ 37.00	$ 182.00
	CLASS OF 1920 FUND		
$ 3,000	U. S. Savings Bonds, 1957-58	$ 2,220.00	$ 604.50
	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	30,200.00	1,289.57
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	$ 650.00
180	Standard Oil Company (N. J.).	2,010.78	396.00
	Total of the Draper Fund.....	**$ 101,540.14**	**$ 4,015.57**
	JOSEPH HEWETT FUND		
	U. S. Government Bonds		
$ 15,500	Treasury Bonds, 2¼%, 6-15-59/62	$ 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.....	50,250.00	2,232.62
10,000	Northern Pacific R.R., 4%, 1-1-97	10,000.00	400.00
10,000	Southern Pacific Company, 4½%, 5-1-81.....	10,000.00	450.00
12,000	Texas & New Orleans R.R., 3⅜%, 4-1-90.....	12,000.00	405.00
	Industrial Common Stocks		
440	American Can Company.....	8,570.00	880.00
200	E. I. du Pont de Nemours & Co.	8,271.55	1,300.00
900	General Electric Company.....	8,107.50	1,800.00
630	National Cash Register Company	5,195.75	708.00
400	Standard Oil Company (Indiana)	9,392.40	922.23
1,374	Standard Oil Company (N. J.).	10,399.02	3,016.20
300	Union Carbide Corporation....	6,944.20	1,035.00
300	United Fruit Company.....	7,120.00	900.00
	Bank Common Stocks		
120	Bankers Trust Co., New York...	4,775.00	336.00
132	Guaranty Trust Co., New York.	5,078.70	457.60
	Insurance Common Stock		
200	St. Paul Fire & Marine Insurance Company.....	4,812.50	240.00
	Total of the Hewett Fund.....	**$ 208,272.09**	**$ 16,381.40**

FUNDS SEPARATELY INVESTED *Schedule A-2 — continued*

Par Value or Shares		*Book Value*	*Net Income*
	INDUSTRIAL MANAGEMENT RESEARCH FUND		
	U. S. Government Bonds		
$275,000	Treasury Bills, 3.05%, 7-18-57	$ 272,973.02	.....
	Bonds		
500,000	G.M.A.C., 3%, 11-1-59	491,269.07	$ 15,000.00
200,000	G.M.A.C., 3%, 4-1-60	197,000.00	6,000.00
150,000	G.M.A.C., 2¾%, 7-15-64	145,875.00	4,125.00
	Common Stocks		
40,000	General Motors Corporation	682,539.69	80,000.00
	Income from securities sold	.....	5,423.75
	Total of Industrial Management Research Fund	**$1,789,656.78**	**$110,548.75**
	MUSEUM OF SCIENCE COOPERATIVE FUND		
$ 500	Textron, Inc.	**$ 12,343.75**	**$ 725.00**
	RICHARD LEE RUSSEL FUND		
	Mortgage		
	111 Bay State Road, Boston	$ 2,000.00	$ 100.00
	Common Stocks		
20	General Electric Company	930.00	40.00
50	General Public Utilities Corp.	1,732.75	67.00
30	Standard Oil Company (N. J.)	1,095.00	66.00
	Total of the Russel Fund	**$ 5,757.75**	**$ 273.00**
	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	41,560.26
1,950	General Electric Company	32,468.22	3,900.00
324	Mission Corporation	6,291.00	880.27
	Total of the Solar Energy Fund	**$ 773,459.22**	**$ 48,143.03**
	TECHNOLOGY LOAN FUND		
	U. S. Government Bonds		
$ 96,000	TreasuryBonds,2¼%,6-15-62/59	$ 96,000.00	$ 2,160.00
50,000	Savings Bonds, 2.76%, 7-1-66	50,000.00	1,380.00
100,000	Savings Bonds, 2½%, 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*
	TECHNOLOGY LOAN FUND — *continued*		
	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	3,960.00
2,000	Burroughs Corporation	39,049.69	2,000.00
800	E. I. du Pont de Nemours & Co.	29,304.00	5,200.00
3,000	General Electric Company	25,813.25	6,000.00
1,537	Gulf Oil Corporation	32,770.04	3,750.02
1,561	Monsanto Chemical Company	46,361.02	1,545.50
4,192	National Cash Register Company	36,657.55	4,711.34
1,050	Pittsburgh Plate Glass Company	53,780.85	2,887.50
1,500	Procter & Gamble Company	29,511.45	2,775.00
1,375	Socony-Mobil Oil Company	49,843.96	3,187.50
3,858	Standard Oil Company (N. J.)	24,864.43	8,487.60
1,200	Union Carbide Corporation	27,726.00	4,140.00
	Bank Common Stocks		
1,302	First Nat'l. City Bank of New York	46,228.91	3,515.40
1,062	Guaranty Trust Company, New York	50,333.82	3,681.60
	Insurance Common Stocks		
835	Hartford Fire Insurance Co.	44,879.08	2,505.00
280	St. Paul Fire & Marine Insurance Company	6,737.50	336.00
	Income from bonds matured	.....	2,696.87
	Total of Technology Loan Fund	**$1,041,909.44**	**$ 75,831.83**
	JAMES E. TURNER FUND		
	Bond		
$ 1,250	Meadville Community Hotel, 4% Due 7-1-1986	**$ 1,250.00**	.....
	WAYNE FUND		
	Common Stock		
21	International Paper Company	**$ 2,014.69**	**$ 15.75**
	H. K. WEBSTER COMPANY FUND		
	Preferred Stock		
250	H. K. Webster Co. 5% Pfd.	**$ 25,000.00**	**$ 937.50**

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

Par Value or Shares		*Book Value*	*Net Income*
	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, 2⅞%, 6-15-58..	100,000.00	2,800.00
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
	Other Bonds		
40,000	American Tel. & Tel. Co. Deb., 3¼%, 9-15-84.....	40,700.00	1,200.00
40,000	G.M.A.C. of Canada, 4¾%, 12-15-69.....	40,400.00	1,686.09
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	1,148.00
748	Boston Insurance Company.....	19,145.78	1,346.40
270	First National Bank of Boston....	11,465.90	823.50
468	First Nat'l. City Bank of New York	20,641.73	1,263.60
396	Guaranty Trust Company, N. Y.	18,087.30	1,372.80
	Industrial Common Stocks		
400	E. I. du Pont de Nemours & Co.	15,279.10	2,600.00
1,500	General Electric Company.....	13,188.05	3,000.00
400	Inland Steel Company.....	16,120.12	1,700.00
939	International Paper Company...	14,853.12	2,795.49
1,932	Standard Oil Company (N. J.)..	12,311.87	4,250.40
450	United Fruit Company.....	10,690.25	1,350.00
	Income from stocks sold.....	.....	225.00
	Total of the Whitney Fund.....	**$ 570,225.94**	**$ 33,276.28**
	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	248.26
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	$ 560.00
210	General Electric Company	3,235.75	420.00
285	General Motors Corporation	2,890.86	570.00
200	Minneapolis-Honeywell Regulator Company	5,494.69	350.00
100	Parke, Davis & Company	4,412.50	45.00
110	Shell Oil Company	5,928.54	215.00
138	Socony-Mobil Oil Company, Inc.	6,761.18	319.00
752	Sperry Rand Corporation	3,930.88	601.60
300	Standard Oil Company (N. J.)	2,684.08	660.00
100	Union Carbide Corporation	2,713.10	345.00
	Insurance Common Stocks		
120	St. Paul Fire & Marine Insurance Co.	2,887.50	144.00
	Public Utility Common Stocks		
151	American Gas & Electric Co.	5,492.62	54.36
150	Commonwealth Edison Company	4,388.57	300.00
214	General Public Utilities Corp.	7,398.00	387.00
269	Middle South Utilities Company	3,241.58	416.96
190	Pacific Gas & Electric Company	7,125.34	450.00
300	United Gas Corporation	2,125.01	450.00
	Bank Common Stocks		
65	Bankers Trust Company, N. Y.	3,071.50	182.00
132	Guaranty Trust Company, N. Y.	5,920.20	457.60
	Railroad Common Stocks		
225	Denver & Rio Grande Western Railroad	4,500.00	562.52
	Other Common Stocks		
100	C.I.T. Financial Corporation	3,300.00	240.00
	Mortgage		
	539 South Atlantic Ave., Ormond Beach, Florida	17,208.17	657.27
	Total of the Witmer Fund	**$ 140,974.09**	**$ 9,453.07**
	Total of funds separately invested	**$4,791,222.40** (Schedule A)	**$301,375.03**

RESEARCH CONTRACTS

Schedule B-3

	Lincoln Laboratory	*Other government research*	*Industrial and other sponsors*	*Total*
DIRECT COSTS CHARGED TO RESEARCH CONTRACTS:				
Salaries and wages	$12,923,655	$11,151,024	$ 988,018	$25,062,697
Materials and services	11,618,883	4,866,930	359,031	16,844,844
Subcontracts	2,723,378	1,916,966	969	4,641,313
Travel	673,631	513,562	48,505	1,235,698
	$27,939,547	$18,448,482	$1,396,523	$47,784,552

CONTRACT ADMINISTRATION EXPENSES:		
Salaries and wages	$	638,093
Vacation allowances — hourly employees		333,389
Materials and services		60,789
Occupational medical service		50,957
Depreciation on equipment		49,711
Insurance		48,931
Laboratory indirect expenses		26,030
Special contract expense		23,736
Research severance allowance		23,293
Special meeting expense		22,742
Travel		14,545
Allowance for extended sick leave and industrial accidents		7,886
Other		33,390
	$	1,333,492
Total direct costs and expenses (Schedule B)		**$49,118,044**

ALLOWANCES FOR INDIRECT EXPENSES			
Appropriations added to invested funds (Schedule A-8):			
Reserve for use of facilities	$	660,205	
Industrial fund		94,738	
Investment income for use of funds		25,700	
Research reserve		200,000	$ 980,643
Administration and plant operation			5,229,458
Total contract revenues			**$55,328,145**

(Schedule B)

GIFTS, GRANTS, AND BEQUESTS

Received during the year ended June 30, 1957

GIFTS FOR ENDOWMENT

Income for general purposes

WALTER J. BEADLE '17 Income share of a trust, for general endowment	$	925.00
ESTATE OF MARY C. EMERY Additional for the Fred Parker Emery and Mary C. Emery Fund		334,021.61
ESTATE OF E. H. R. GREEN Additional for H. Sylvia A. H. G. Wilks Fund		48.29
ESTATE OF ARTHUR H. HERSCHEL '99 Additional on residual bequest for general endowment		7,712.65
CHARLES T. MAIN, INC. Additional for the Charles T. and Charles R. Main Memorial Fund		1,000.00
ESTATE OF ALICE METCALF Additional for the Leonard Metcalf ('92) Memorial Fund		4,090.12
ESTATE OF HARRIETTE F. NEVINS Additional for the George Blackburn Memorial Fund		43,931.93
JOHN L. OSTBORG '26 Additional for the Leonard Metcalf ('92) Memorial Fund		300.00
FRANK P. WAKEFIELD TRUST Additional for the Frank P. Wakefield Fund		9,520.95
ESTATE OF HENRY D. WARREN For the Dexter Roby Memorial Fund		126,783.73
H. K. WEBSTER COMPANY For the H. K. Webster Company Fund		15,000.00
ESTATE OF EVERETT WESTCOTT Additional for the Everett Westcott Fund		1,800.00
ESTATE OF MARION WESTCOTT Additional for the Marion Westcott Fund		575.70
	$	**545,709.98**

Income for designated purposes

WILLIAM L. ABRAMOWITZ '35 For the Allan Winter Rowe ('01) Fund	$	500.00
ACF FOUNDATION, INC. For fellowships in nuclear engineering		50,000.00
ASARCO FOUNDATION For thesis expenses in geology		1,000.00
JULIAN M. AVERY '18 Additional for the Julian M. Avery Fund		728.33
EDMUND D. AYRES '22 For the Class of 1922 Scholarship Fund		5.00

ESTATE OF JASON S. BAILEY	
Additional for the Jason S. Bailey Scholarship Fund	4,345.85
SAMUEL BERKE '15	
For the Samuel Berke Fund	5,000.00
GORDON Y. BILLARD '24	
Additional for the Gordon Y. Billard Fund	865.42
CONTRIBUTIONS	
For the Mrs. William H. Carlisle, Sr., Memorial Scholarship Fund	700.00
JACK F. CHAPIN	
For the Allan Winter Rowe ('01) Fund	10.00
THOMAS L. CLARK ('59) MEMORIAL	
Additional contributions	84.00
RANDOLPH P. COMPTON	
For the W. Danforth Compton ('47) Memorial Scholarship Fund	3,222.76
WILLIAM M. FOLBERTH, JR. '41	
For the Allan Winter Rowe ('01) Fund	40.00
FORD FOUNDATION	
Additional endowment for faculty salaries	1,423,500.00
ESTATE OF ARTHUR E. FOWLE '93	
Additional for the Arthur E. Fowle Scholarship Fund	100,000.00
ESTATE OF EVERT W. FREEMAN '20	
For the Evert W. Freeman Scholarship Fund	17,637.12
JURGIS J. GEGUZIS	
For the Jurgis J. Geguzis Scholarship Fund	10,311.68
CONTRIBUTIONS FOR THE GENERAL UNDERGRADUATE SCHOLARSHIP ENDOWMENT FUND	
J. Allan Abbott '23	6,392.25
Allied Research Associates, Inc.	250.00
Bale Pin Company	500.00
Raymond H. Blanchard '17	500.00
Boston Insulated Wire and Cable Company	500.00
Otto Bussenius and Company	300.00
Thomas S. Byrne, Inc.	1,100.00
Lyndall F. Carter	1,100.00
Crosby Chemicals, Inc.	25.00
Leo J. Feuer '43	100.00
In Memory of Commander Thomas H. Frost '31	150.00
The Glastic Corporation	50.00
Henderson Foundation	200.00
Higgins Ink Company	100.00
Honeymead Products Company	200.00
Virginia White Inglis	25.00
A. D. Jones Optical Works	500.00
S. J. and M. N. Katz Foundation	200.00
Phillips Ketchum	1,100.00
Koehler Manufacturing Company	100.00
Robert E. Lamb, Inc.	200.00
Herbert Levine, Inc.	50.00
Lightolier Fund, Inc.	500.00
Maritime Steel Foundries, Limited	570.02
Maxwell Sackheim and Company, Inc.	100.00

Meredith and Grew, Inc.	400.00
Moran, Proctor, Meuser and Rutledge	500.00
National Cylinder Gas Foundation	1,000.00
Peerless Precision Products Company	25.00
Phi Beta Epsilon Conference	75.00
Phi Beta Epsilon Memorial Fund	75.00
Pump Equipment and Engineering Company	100.00
The Rowen–Leahy Company	550.00
Royal Bond, Inc.	1,100.00
Sheraton Foundation, Inc.	200.00
Sterling, Inc.	100.00
Superior Castings Corporation	550.00
N. Conant Webb '22	250.00
Fernand C. Weiss '13	1,100.00
Wyle Laboratories	550.00
Other	25.00
ROBERT W. HANCOCK '27	
For the Allan Winter Rowe ('01) Fund	690.00
THEODORE V. HOUSER	
For the Theodore V. Houser Scholarship Fund	199.88
DUGALD C. JACKSON, JR. '21	
Additional for the Dugald C. Jackson Professorship	65.00
IRVING D. JAKOBSON '21	
For the Allan Winter Rowe ('01) Fund	125.00
MRS. BO KWANG KIM	
For the Bo Kwang Kim Scholarship Fund	5,000.00
PAUL W. LITCHFIELD '96	
Additional for the Paul W. Litchfield Scholarship Fund	27,737.50
ESTATE OF GEORGE E. MARSH '01	
For the Frances E. Marsh Fund for geology	5,000.00
ESTATE OF GLENN L. MARTIN	
For the Jerome C. Hunsaker ('12) Professorship	100,000.00
M.I.T. BOSTON STEIN CLUB	
For the M.I.T. Boston Stein Club Karl T. Compton Prize Fund	
Samuel S. Eisenberg '15	100.00
For the M.I.T. Boston Stein Club New England Freshman Scholarship Fund	
J. Howard Beck '35	10.00
Leo M. Beckwith '35	200.00
George A. '28 and Ruth Bernet	250.00
David W. '31 and Irene Bernstein	500.00
Julius Brody '32	15.00
Joseph Fishman '34	200.00
General Electric Educational and Charitable Foundation	100.00
Morris J. '22 and Anna Gordon	250.00
Richard H. Gould '42	5.00
Groisser and Shlager Iron Works	1,000.00
Oscar H. '22 and Mary C. Horovitz	200.00
Irving Kalikow	100.00
Arthur S. Karol '44	25.00
Sidney L. Kaye '30	40.00
Mac '25 and Anne Levine	200.00

Owen J. McGarrahan Company	1,000.00
George '24 and Betty T. Neitlich	100.00
Maurice H. Role '19	50.00
Robert L. Sandman '48	30.00
George Schnitzler '21	10.00
Saul M. '21 and Rigi Silverstein	100.00
Edward Sisson '11	25.00
Albert H. '21 and Pearl K. Wechsler	500.00
Robert '27 and Ethel P. Wise	200.00
For the M.I.T. Boston Stein Club National Freshman Scholarship Fund	
Julian J. Bussgang '51	20.00
Richard J. '32 and Diana L. Marcus	1,250.00
Robert G. '31 and Natalie Marcus	250.00
Nathan '24 and Freda Schooler	375.00
M.I.T. Club of New York	
Additional for the scholarship fund	45.45
A. L. Smith Iron Company	
For the Class of 1934 Compton Scholarship	100.00
Standard Oil Company of Texas	
For thesis expenses in geology	750.00
Estate of Elizabeth R. Stevens	
For the Albert G. Boyden Scholarship Fund	76.27
Estate of Mary Thacher	
For the Mary Thacher Scholarship Fund	15,000.00
Mrs. Ray Hill White	
For the Ray Hill White ('05) Memorial Scholarship Fund	10,000.00
Mrs. Freda Walker Wilcox	
For the Edward F. ('86) and Mary R. Miller Fund	25.00
John J. Wilson '29	
Additional for the John J. Wilson Scholarship Fund	4,331.25
Additional for the Mary I. Wilson Scholarship Fund	4,331.25
Estate of Abbey W. Young	
For the Conrad Henry Young ('96) Scholarship Fund	15,000.00
	$1,834,944.03

GIFTS FOR STUDENT LOANS

M.I.T. Boston Stein Club	
For the M.I.T. Boston Stein Club Freshman Loan Fund	
George A. '28 and Ruth D. Bernat	$ 250.00

GIFTS FOR BUILDINGS

Anonymous	
For the Karl Taylor Compton Laboratory	$ 3,000.00
Thomas C. Desmond '09	
For the Karl Taylor Compton Laboratory	5,000.00
Godfrey M. Hyams Trust	
For the Reactor Building Fund	50,000.00

THE KRESGE FOUNDATION	
For the Karl Taylor Compton Laboratory	125,000.00
NATIONAL SCIENCE FOUNDATION	
For the Reactor Building Fund	500,000.00
PHELPS DODGE CORPORATION	
For the Karl Taylor Compton Laboratory	5,000.00
RADIO SHACK CORPORATION	
For the Karl Taylor Compton Laboratory	1,000.00
WILLIAM L. STEWART, JR. '23	
For the Karl Taylor Compton Laboratory	1,200.00
TAFT–PIERCE FOUNDATION	
For the Karl Taylor Compton Laboratory	1,000.00
UNITED FRUIT COMPANY	
For the Reactor Building Fund	25,000.00
WESTINGHOUSE EDUCATIONAL FOUNDATION	
For the Reactor Building Fund	15,000.00
J. O. WHITTEN COMPANY, INC.	
For the Karl Taylor Compton Laboratory	150.00
	$ 731,350.00

OTHER GIFTS—PRINCIPAL AVAILABLE

Added to the unexpended endowment income for designated purposes

M.I.T. CLUB OF CHICAGO	
Contributions for a scholarship	$ 1,350.00

For general purposes

ANONYMOUS	
Additional for the Anonymous ST Fund	$ 2,500.00
LOUIS BARNETT '09	
For general purposes	250.00
ESTATE OF STEPHEN L. BARTLETT	
For the Stephen L. Bartlett Fund	90.03
BETHLEHEM STEEL COMPANY	
For general purposes	12,000.00
THE BUDD COMPANY	
For general purposes	1,672.00
ESTATE OF ARTHUR J. CONNER '88	
For general purposes	6,490.96
PAUL J. CULHANE '23	
Additional for the Class of 1923 twenty-five year gift	2,071.70
DEVELOPMENT FUND	
Unrestricted gifts added to the Development Fund	2,535.00
EASTMAN KODAK COMPANY	
For general purposes	4,000.00
BRADFORD M. ENDICOTT '49	
For general purposes	10,910.62
FIRST NATIONAL CITY BANK OF NEW YORK	
For general purposes	1,200.00
ESTATE OF ALBERT C. GILBERT '05	
For general purposes	8,550.00
GRUMMAN AIRCRAFT ENGINEERING CORPORATION	
For general purposes	7,500.00

WILLIAM T. HAEBLER '22	
For general purposes	2,000.00
ESTATE OF JOHN M. HANCOCK	
For general purposes	5,000.00
WILLIAM T. HENRY ('70) TRUST	
For the William T. Henry Fund	26,735.00
KAISER ALUMINUM AND CHEMICAL CORPORATION	
For general purposes	2,000.00
ESTATE OF MARY L. LODGE	
For General purposes	60,887.93
ESTATE OF ALICE G. MARTIN	
Added to the Augustus B. Martin, Jr., Fund	1,181.30
E. MORTIMER NEWLIN ('14) TRUST	
For general purposes	1,430.37
OLIVETTI CORPORATION OF AMERICA	
For general purposes	1,000.00
RICHARD N. PALMER ('28) TRUST	
For general purposes	550.29
ESTATE OF LANGDON PEARSE '01	
For the Langdon Pearse Fund	10,212.77
PURE OIL COMPANY FOUNDATION, INC.	
For general purposes	2,000.00
STANDARD OIL COMPANY OF CALIFORNIA	
For general purposes	7,500.00
	$ 180,267.97

For designated purposes

ALUMNI FUND	
Contributions	$ 356,179.11
ANONYMOUS	
Additional for the Anonymous F Fund	25,000.00
CURTIS UNIVERSAL JOINT COMPANY, INC.	
Additional for the Ralph E. Curtis ('15) Scholarship Fund	2,000.00
E. I. DU PONT DE NEMOURS AND COMPANY, INC.	
For teaching	4,000.00
PRISCILLA MAXWELL ENDICOTT	
For the Priscilla Maxwell Endicott Fund	15,912.00
ESSO EDUCATION FOUNDATION	
For the Esso Education Foundation Fund	25,000.00
GERBER BABY FOODS FUND	
For the Food Technology Research Fund	2,500.00
GOODYEAR FOUNDATION, INC.	
For an industrial fellowship in economics	3,250.00
EARLE A. GRISWOLD '23	
For the Proctor Portrait Fund	100.00
INDUSTRIAL RELATIONS FUND	
Contributions from industrial concerns	14,650.00

INTERNATIONAL BUSINESS MACHINES CORPORATION	
For an industrial fellowship in economics	1,000.00
M.I.T. BOSTON STEIN CLUB	
For the M.I.T. Boston Stein Club Technion Scholarship Fund	
Carl Feldman '28	20.00
Charles Freed '09	40.00
Hyman L. Rosengard '22	25.00
Jacob Ziskind Trust	2,200.00
OSCAR MAYER AND COMPANY	
For the Food Technology Research Fund	10,000.00
ESTATE OF C. LILLIAN MOORE	
Additional for the John A. Grimmons ('21) Fund	6,215.00
PARENTS' GIFTS	19,201.16
THEODORE B. PARKER ('11) MEMORIAL FUND	
Additional for the Theodore B. Parker Memorial Scholarship Fund	555.27
LEWIS J. SEIDENSTICKER '98	
For the Class of 1898	100.00
STANDARD OIL FOUNDATION	
For the Standard Oil Foundation Fund	25,000.00
EDWARD E. WAYNE	
For the Wayne Organ Reserve Fund	2,014.69
WESTINGHOUSE EDUCATIONAL FOUNDATION	
For an industrial economics fellowship	2,500.00
CONTRIBUTIONS FOR THE SALARY ADJUSTMENT FUND	
The Acushnet Foundation	1,000.00
American Airlines, Inc.	1,000.00
American Can Company	2,200.00
American Radiator and Standard Sanitary Corporation	5,000.00
Anonymous	250,000.00
Babcock and Wilcox Company	2,500.00
Walter J. Beadle '17	18,500.00
Buck Printing Company	100.00
Cabot Foundation, Inc.	25,000.00
Mr. and Mrs. Thomas D. Cabot	5,000.00
Donald F. Carpenter '22	3,000.00
CBS Foundation, Inc.	4,000.00
Continental Can Company, Inc.	5,000.00
Delbar Products, Inc.	500.00
Thomas C. Desmond '09	5,000.00
Henry B. du Pont '23	50,520.35
Pierre S. du Pont, III '33	50,000.00
William Emerson	1,655.62
Ford Motor Company	1,000.00
The Green Foundation	3,000.00
Crawford H. Greenewalt '22	15,000.00
Willis F. Harrington '05	49,465.00
The Jonsson Foundation	1,000.00
The Kelek Company	500.00
The Kendall Company	1,000.00
James R. Killian, Jr. '26	250.00
Fred C. Koch ('22) Foundation, Inc.	5,000.00

Robert A. Lovett	500.00
M. E. McCullough	1,000.00
Merrill Lynch, Pierce, Fenner and Beane Foundation, Inc.	2,000.00
Monsanto Chemical Company	5,000.00
The New England Colleges Fund, Inc.	115.80
Horace F. Spencer	171.00
TI-GSI Foundation	3,000.00
	$1,035,440.00

UNINVESTED FUNDS

Industrial Liaison Program

Support of the Program **$1,292,624.38**

A partial list of companies making payments in 1956–57:

Aircraft-Marine Products, Inc.
Aluminium Laboratories Limited
Aluminum Company of America
American Can Company
Armco Steel Corporation
Avco Research and Advanced Development Division
Bell Telephone Laboratories, Inc.
Chance Vought Aircraft, Inc.
Cities Service Research and Development Company
Continental Can Company, Inc.
Continental Oil Company
Crouse-Hinds Company
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
Hercules Powder Company
International Nickel Company
Koppers Company, Inc.
Latrobe Steel Company
Lever Brothers Company
Liberty Mutual Insurance Companies
Glenn L. Martin Company
McDonnell Aircraft Corporation
Merrill Lynch, Pierce, Fenner and Beane
Mine Safety Appliances Company
Minneapolis-Honeywell Regulator Company
Motorola, Inc.
National Cash Register Company
National Research Corporation
North American Aviation, Inc.
Owens-Corning Fiberglas Corporation
Philco Corporation
Pittsburgh Plate Glass Company
Radio Corporation of America

Ramo-Wooldridge Corporation
Republic Aviation Corporation
Schlumberger Well Surveying Corporation
Sears, Roebuck and Company
Simplex Wire and Cable 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
Sylvania Electric Products, Inc.
Texas Company
United Aircraft Corporation
Whirlpool-Seeger Corporation

Gifts for student aid

EZRA BLOUNT		
For the Y. T. Tsai Memorial Scholarship Fund	$	500.00
BOEING AIRPLANE COMPANY		
For a fellowship		2,500.00
CINCINNATI MILLING MACHINE COMPANY		
For undergraduate scholarships		1,800.00
THOMAS C. DESMOND '09		
For undergraduate scholarships		1,200.00
PHILIP B. DOWNING TRUST		
For the Philip B. Downing Scholarship Fund		465.00
EDGERTON, GERMESHAUSEN AND GRIER, INC.		
For undergraduate scholarships		1,346.00
FLUOR FOUNDATION		
For a fellowship		3,000.00
ERNEST A. GRUNSFELD ('18) FUND		
For the Grunsfeld European Fellowship		2,700.00
HOUSTON ENDOWMENT, INC.		
For the William S. Knudsen Fellowship		2,500.00
INTERNATIONAL BUSINESS MACHINES CORPORATION		
For a fellowship		2,600.00
KNAPP FUND		
For undergraduate scholarships		1,500.00
M.I.T. CLUB OF NORTHERN NEW JERSEY		
For undergraduate scholarships		35.00
H. W. MCCURDY ('22) SCHOLARSHIP FUND		
For undergraduate scholarships		1,200.00
JAMES C. MELVIN TRUST		
For the Melvin Trust Scholarship Fund		9,000.00
NATIONAL MERIT SCHOLARSHIP CORPORATION		
For undergraduate scholarships		56,250.00
ALFRED P. SLOAN ('95) FOUNDATION, INC.		
For the Sloan National Scholarships		82,000.00
For travel related to national scholarships		1,200.00
For the Hungarian Relief Fund		4,000.00
TEAGLE FOUNDATION, INC.		
For undergraduate scholarships		26,350.00

WESTINGHOUSE EDUCATIONAL FOUNDATION	
For the Science Teachers' Fellowships	20,000.00
ADDED TO THE UNDERGRADUATE SCHOLARSHIP AWARDS FUND:	
Air Force Aid Society Educational Fund	460.00
American Brake Shoe Company	2,200.00
American Chemical Society	400.00
American Chicle Educational Trust	1,000.00
American Smelting and Refining Company	1,000.00
American Society for Metals Foundation for Education and Research	700.00
William H. Bagley, Jr. '35	700.00
Bath Iron Works Corporation	1,000.00
Bechtel Corporation	1,500.00
The Bell Foundation	3,200.00
Frank S. Bunnell	550.00
Champion Paper Foundation	975.00
Chance Vought Aircraft, Inc.	3,244.00
Chemical Club of New England	300.00
Civil Air Patrols	2,200.00
Clark Foundation	6,400.00
Morgan A. Collins, Jr. '27	200.00
Carle C. Conway	1,300.00
Charles E. Culpepper Foundation	900.00
Dow Corning Corporation	1,100.00
Ethyl Corporation	3,000.00
The Fafnir Bearing Company	1,000.00
First City National Bank of Houston	300.00
Frank Memorial Corporation	1,000.00
Eleanor G. Frasher	1,100.00
The Gardner Foundation	500.00
General Electric Educational and Charitable Fund	1,350.00
General Motors Corporation	54,050.00
The Felix and Cecile Gouled Foundation	1,250.00
Walter T. Hall '19	100.00
Iowa-Illinois Gas and Electric Company	1,200.00
Jakobson Shipyard, Inc.	1,000.00
Stephen R. Johnson	200.00
Jones and Laughlin Steel Corporation	1,622.00
Richard A. Kane '55	1,315.50
Kennecott Copper Corporation	4,000.00
Kuljian Corporation	1,000.00
Lockheed Leadership Fund	12,600.00
The Martin Company Foundation	700.00
M.I.T. Alumni Association	250.00
M.I.T. Club of Rochester	2,500.00
M.I.T. Club of Southern California	1,000.00
McJunkin Corporation	550.00
Dr. and Mrs. Hyman Miller	1,000.00
Henry A. Morss, Jr. '34	750.00
Mrs. Elsa C. Mueser	1,100.00
National Association of Engine and Boat Manufacturers, Inc.	1,200.00
National Association of Secondary School Principals Scholarship Fund	200.00

Olin Mathieson Chemical Corporation	1,500.00
Carl and Lilly Pforzheimer Foundation, Inc.	500.00
Procter and Gamble Company	7,400.00
Rayonier Foundation	1,000.00
Saint Anthony Educational Foundation, Inc.	100.00
Sanborn Company	500.00
Scituate Women's Club	250.00
Wickliffe Shreve and Bert Schryver	1,000.00
Skidmore, Owings and Merrill	1,200.00
Standard Oil Company of Texas	750.00
Standard Oil Company of California	1,500.00
Symington Gould Corporation	1,500.00
Union Carbide Corporation	2,600.00
U. S. Industries, Inc.	950.00
Western Electric Company	2,800.00
Westinghouse Electric Corporation	1,500.00
	$ 370,362.50

Gifts for general purposes, principally to supplement grants for scholarships

Thomas D'A. Brophy '16	$ 1,010.76
Bulova Watch Company Foundation, Inc.	500.00
Convair—Division of General Dynamics Corporation	500.00
Dewey and Almy Chemical Company	250.00
Esso Education Foundation	5,000.00
General Electric Educational and Charitable Foundation	2,050.00
A. B. Gillman	100.00
Inland Steel Foundation, Inc.	2,000.00
International Business Machines Corporation	3,000.00
Johns-Manville Sales Corporation	1,000.00
Ralph Lowell	102.70
New England Colleges Fund, Inc.	15.40
Pitney-Bowes, Inc.	500.00
Radio Corporation of America	750.00
Raytheon Manufacturing Company	2,464.00
Hervey I. Seley '55	1,250.00
William J. Sherry '21	150.00
United Aircraft Corporation	3,000.00
United-Carr Fastener Corporation	1,000.00
Weyerhaeuser Timber Foundation	2,000.00

Gifts for designated purposes

ALLEGHENY LUDLUM STEEL CORPORATION	
For research in metallurgy	$ 8,000.00
ALLIED CHEMICAL AND DYE CORPORATION	
For a fellowship in chemical Engineering	3,000.00
ALLIS-CHALMERS MANUFACTURING COMPANY	
For research in metallurgy	2,500.00
ALLISON DIVISION—GENERAL MOTORS CORPORATION	
For turbo machine research in aeronautical engineering	20,000.00
AMERICAN BRAKE SHOE COMPANY	
For a fellowship in metallurgy	3,500.00
For a professorship in metallurgy	25,000.00

AMERICAN CHEMICAL SOCIETY	
For research in chemistry	6,435.00
AMERICAN CHICLE EDUCATIONAL TRUST	
For a fellowship in food technology	2,600.00
AMERICAN CYANAMID COMPANY	
For a fellowship in chemical engineering	2,900.00
For soil stabilization research in civil engineering	7,916.66
AMERICAN IRON AND STEEL INSTITUTE	
For research in civil engineering	6,000.00
For research in metallurgy	10,000.00
AMERICAN OIL COMPANY (TEXAS)	
For a practice school fellowship in chemical engineering	2,700.00
AMERICAN PHILOSOPHICAL SOCIETY	
For research in humanities	450.00
AMERICAN SOCIETY OF TOOL ENGINEERS	
For research in mechanical engineering	12,800.00
AMERICAN VISCOSE CORPORATION	
For a fellowship in chemical engineering	2,900.00
For research in food technology	10,000.00
ANONYMOUS	
Additional for the Anonymous C Fund	2,000.00
ANONYMOUS	
For research in electrical engineering	2,500.00
ARMA DIVISION OF AMERICAN BOSCH-ARMA CORPORATION	
For a fellowship in aeronautical engineering	6,400.00
ARMCO FOUNDATION	
For a fellowship in metallurgy	3,600.00
ARMOUR AND COMPANY	
For research in food technology	5,000.00
ARMOUR LABORATORIES	
For research in biology	5,000.00
ASIA FOUNDATION	
For the Asia Fund in the Center for International Studies	500.00
BABCOCK AND WILCOX COMPANY	
For research in mechanical engineering	15,000.00
PHILIP K. BATES '24	
For a fellowship in food technology	1,000.00
BECCO CHEMICAL DIVISION OF FOOD MACHINERY AND CHEMICAL CORPORATION	
For soil stabilization research in civil engineering	3,000.00
CHARLES B. BREED '97	
For the Charles B. Breed Fund	100.00
BRISTOL LABORATORIES, INC.	
For research in chemistry	10,650.00
BULLARD COMPANY CHARITY FOUNDATION, INC.	
For electrical engineering	1,100.00
CAMPBELL SOUP COMPANY	
For research in food technology	5,000.00
CARBIDE AND CARBON CHEMICALS COMPANY	
For a fellowship in chemical engineering	8,550.00

THE CARBORUNDUM COMPANY	
For research in mechanical engineering	4,781.00
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
CHORAL SOCIETY	
Contributions for the Society's European trip	1,309.00
COATS AND CLARK, INC.	
For a fellowship in mechanical engineering	4,000.00
THE COFFEE BREWING INSTITUTE, INC.	
For research in food technology	21,250.00
COMMONWEALTH FUND	
For research in biology	40,000.00
CONSUMERS UNION OF UNITED STATES, INC.	
For a fellowship in chemistry	2,000.00
CORNING GLASS WORKS	
For research in metallurgy	2,000.00
CRANE COMPANY	
For a fellowship in metallurgy	5,950.00
CRUCIBLE STEEL COMPANY OF AMERICA	
For research in metallurgy	2,500.00
CURTISS-WRIGHT CORPORATION	
For turbo machine research in aeronautical engineering	20,000.00
DEWEY AND ALMY CHEMICAL COMPANY	
For equipment in chemical engineering	125.00
DONNER FOUNDATION	
For research in civil engineering	6,580.00
DORR-OLIVER, INC.	
For research in mechanical engineering	3,000.00
DOUGLAS AIRCRAFT COMPANY, INC.	
For a fellowship in aeronautical engineering	2,750.00
DUNLOP CANADA, LTD.	
For research in chemistry	1,500.00
E. I. DU PONT DE NEMOURS AND COMPANY, INC.	
For a fellowship in chemical engineering	9,350.00
For an instructor in chemistry	7,285.00
For research in chemistry	15,000.00
For a fellowship in mechanical engineering	3,500.00
For a fellowship in physics	3,560.00
DUVAL SULPHUR AND POTASH COMPANY	
For research in metallurgy	1,500.00
WILLIAM E. EDGERTON ('55) MUSIC FUND	
Contributions	1,095.70
ELECTRO METALLURGICAL COMPANY	
For comminution research in metallurgy	4,200.00
For a fellowship in metallurgy	4,200.00

PRISCILLA MAXWELL ENDICOTT	
For Endicott House special equipment	1,420.29
M. DIETRICH ERNST	
For the Foreign Student Summer Project	272.55
ESSO RESEARCH AND ENGINEERING COMPANY	
For research in chemical engineering	2,600.00
ETHICON SUTURES LABORATORY, INC.	
For research in biology	5,000.00
ETHYL CORPORATION	
For a fellowship in chemistry	3,100.00
For research in chemistry	3,420.00
EXECUTIVE DEVELOPMENT PROGRAM	
Fees from industrial concerns	98,600.00
EXOMET, INC.	
For research in metallurgy	3,000.00
FEDERAL RESERVE BANK OF BOSTON	
For research in city planning	2,000.00
FIRMENICH, INC.	
For research in chemistry	27,000.00
FIRST NATIONAL STORES, INC.	
For research in food technology	2,500.00
FOOD MACHINERY AND CHEMICAL FOUNDATION	
For the Overseas Study Fund	7,500.00
FORD FOUNDATION	
For the Center of International Studies	150,000.00
Grants to four individuals in economics	19,950.00
For research in industrial management	40,000.00
For M.I.T.—Cal. Tech. Conference	4,962.00
FOUNDRY EDUCATIONAL FOUNDATION	
For research in metallurgy	500.00
For a scholarship in metallurgy	4,500.00
GENERAL COMMUNICATION COMPANY	
For the School of Industrial Management	349.60
GENERAL DYNAMICS CORPORATION	
For a fellowship in chemical engineering	4,400.00
For a fellowship in electrical engineering	4,400.00
GENERAL ELECTRIC COMPANY	
For turbo machine research in aeronautical engineering	30,000.00
For heat measurements research in mechanical engineering	768.00
For thermodynamic research in mechanical engineering	9,300.00
GENERAL ELECTRIC EDUCATIONAL AND CHARITABLE FOUNDATION	
For a fellowship in chemical engineering	3,600.00
For a fellowship in chemistry	3,700.00
For a fellowship in economics	1,200.00
For a fellowship in electrical engineering	2,400.00
For a fellowship in the School of Industrial Management	1,200.00
For a fellowship in mechanical engineering	1,200.00
For a fellowship in metallurgy	4,275.00
For a fellowship in physics	2,950.00
For an educational program in electrical engineering	50,000.00

GENERAL ELECTRONICS LABORATORY, INC.		
For the Commons Room in electrical engineering		500.00
GENERAL MOTORS CORPORATION		
For a fellowship in chemical engineering		3,000.00
B. F. GOODRICH CHEMICAL COMPANY		
For a fellowship in textiles in mechanical engineering		500.00
GOODYEAR TIRE AND RUBBER COMPANY		
For a fellowship in aeronautical engineering		2,700.00
ELLIOTT M. GORDON '39		
For the Society of Sloan Fellows		250.00
WILLIAM I. GORFINKLE		
Additional for the William T. Hall ('95) Memorial Fund		100.00
W. R. GRACE AND COMPANY		
For research in chemical engineering		2,375.00
GREEN GIANT COMPANY		
For research in food technology		1,000.00
HERBERT GRUNFELD AND ERNST GRUNFELD TRUST		
For equipment in metallurgy		500.00
GULF RESEARCH AND DEVELOPMENT COMPANY		
For a fellowship in chemical engineering		5,400.00
HOFFMANN-LAROCHE, INC.		
For a fellowship in food technology		1,200.00
H. P. HOOD AND SONS		
For research in food technology		2,000.00
HOPEDALE FOUNDATION		
For research in metallurgy		1,666.66
HORIZONS, INC.		
For a fellowship in metallurgy		3,500.00
AUSTIN Y. HOY '04		
For the Dean's Chapel Fund		1,900.00
HUMBLE OIL AND REFINING COMPANY		
For a fellowship in chemical engineering		5,800.00
PROFESSOR JEROME C. HUNSAKER '12		
For the Department of Aeronautical Engineering		500.00
GODFREY M. HYAMS TRUST		
For research in radiation in electrical engineering		16,000.00
LILLIA BABBITT HYDE FOUNDATION		
For the Lillia Babbitt Hyde Foundation Fund		8,500.00
MRS. JOHN JAY IDE		
For the William H. Donner Prize Fund		26,341.25
ELMER C. INGRAHAM '26		
For the Research Laboratory of Electronics		2,000.00
INTERNATIONAL BUSINESS MACHINES CORPORATION		
For the Computation Center		
For participating colleges	$	5,998.20
For M.I.T. research assistants and associates		28,720.00
For a fellowship in electrical engineering		3,600.00
For a fellowship in physics		2,600.00
INTERNATIONAL NICKEL COMPANY		
For a fellowship in metallurgy		16,941.66
For comminution research in metallurgy		1,000.00
For research in metallurgy		16,000.00

GEORGIA KAOLIN COMPANY	
For research in metallurgy	1,000.00
M. W. KELLOGG COMPANY	
For research in mechanical engineering	10,000.00
KENNECOTT COPPER CORPORATION	
For a fellowship in metallurgy	4,000.00
FREDERICK G. KEYES	
For research in chemistry	600.00
ESTATE OF CHARLES A. KING '96 AND MARJORIE KING	
For research in biology	12,500.00
LA SALLE STEEL FOUNDATION	
For a fellowship in mechanical engineering	2,700.00
LEVER BROTHERS COMPANY	
For research in mathematics	7,500.00
LEVY-KAUDER CONCERTS	
Contributions	1,090.00
LIFE INSURANCE MEDICAL RESEARCH FUND	
For research in biochemistry	500.00
ELI LILLY & COMPANY	
For research in chemistry	4,000.00
LORD MANUFACTURING COMPANY	
For research in civil engineering	12,100.00
LUCIDOL DIVISION OF WALLACE AND TIERNAN COMPANY	
For research in chemistry	5,000.00
THE MACMILLAN COMPANY (NEW YORK)	
For the International Relations Section	2,197.55
MANUFACTURING CHEMISTS ASSOCIATION, INC.	
For research in civil engineering	25,000.00
LOUIS AND GENE MARRON FOUNDATION	
For the Louis Marron Science Fund in biology	2,000.00
MASON-NEILAN DIVISION OF WORTHINGTON CORPORATION	
For research in mechanical engineering	5,000.00
COMMONWEALTH OF MASSACHUSETTS	
For the highway project in civil engineering	30,000.00
MASSACHUSETTS GENERAL HOSPITAL	
For research in biology	500.00
For the Research Laboratory of Electronics	1,500.00
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	271.55
MAYMAR CORPORATION	
Additional for the Samuel A. Marx ('07) Fund for architecture	1,000.00
MCGRAW-HILL PUBLISHING COMPANY, INC.	
For a fellowship in aeronautical engineering	2,700.00
For research in food technology	85.00
EDWARD MCSWEENEY '23	
For the School of Industrial Management	100.00
MEASUREMENTS LABORATORY	
For the Commons Room in electrical engineering	100.00

MELPAR, INC.	
For a fellowship in electrical engineering	7,500.00
MERCK AND COMPANY, INC.	
For research in chemistry	4,800.00
MINNEAPOLIS-HONEYWELL REGULATOR COMPANY	
For a fellowship in electrical engineering	3,900.00
MONSANTO CHEMICAL COMPANY	
For research in architecture	12,000.00
MOOG VALVE COMPANY, INC.	
For research in mechanical engineering	3,000.00
HENRY G. MORGENTHAU, JR.	
For the Morgenthau Fund in humanities	3,500.00
MUSCULAR DYSTROPHY ASSOCIATION OF AMERICA, INC.	
For research in biology	7,702.50
NATIONAL CRANBERRY ASSOCIATION	
For research in food technology	1,000.00
NATIONAL FOUNDATION FOR INFANTILE PARALYSIS	
For research in the Research Laboratory of Electronics	1,250.00
For a fellowship in biochemistry	1,250.00
For a fellowship in biology	1,250.00
NATIONAL GEOGRAPHIC SOCIETY	
For Edgerton film research in electrical engineering	6,445.94
NATIONAL INSTITUTES OF HEALTH	
For research in biology	1,500.00
For a scholarship in biology	1,000.00
For a fellowship in chemistry	625.00
For research in chemistry	500.00
For a scholarship in physics	500.00
For special studies	150,000.00
For a training program in the Medical Department	6,000.00
NATIONAL METALS TRADES ASSOCIATION	
For the School of Industrial Management	1,000.00
NATIONAL STEEL CORPORATION	
For a fellowship in metallurgy	5,000.00
THE NESTLÉ COMPANY, INC.	
For research in food technology	10,000.00
NOVA SCOTIA RESEARCH FOUNDATION	
For research in geology	2,500.00
NUTRITION FOUNDATION, INC.	
For the K. T. Compton Fellowship—Nutrition Foundation in biology	6,400.00
For research in food technology	4,300.00
OWENS-CORNING FIBERGLAS CORPORATION	
For research in civil engineering	12,750.00
PANTEX MANUFACTURING COMPANY	
For research in mechanical engineering	1,000.00
THE PARKER PEN COMPANY	
For the Joseph N. Scanlon Memorial Fund	1,000.00
PEN AND PENCIL WORKERS UNION OF LOCAL 19593	
For the Joseph N. Scanlon Memorial Fund	200.00

PERKINS-GOODWIN COMPANY	
For the School of Industrial Management	100.00
JOHN B. PIERCE ('48) FOUNDATION	
For housing sewage disposal research in civil engineering	6,250.00
For subsoil sewage disposal research in civil engineering	4,500.00
For research in mechanical engineering	11,250.00
PRINCETON UNIVERSITY	
For utilization of human resources	6,875.00
BERNARD E. PROCTOR '23	
For research in food technology	100.00
PROCTER AND GAMBLE COMPANY	
For a fellowship in chemical engineering	5,800.00
For a fellowship in chemistry	3,800.00
For a fellowship in food technology	3,300.00
For a fellowship in mechanical engineering	2,600.00
RAMO-WOOLDRIDGE CORPORATION	
For a fellowship in electrical engineering	5,000.00
For a fellowship in economics	4,100.00
RAYTHEON MANUFACTURING COMPANY	
For research in food technology	6,000.00
REEVES INSTRUMENT CORPORATION	
For a fellowship in aeronautical engineering	2,700.00
REFRIGERATION RESEARCH FOUNDATION	
For research in food technology	2,663.09
RESEARCH CORPORATION	
For research in chemistry	8,950.00
RESOURCES FOR THE FUTURE, INC.	
For research in city planning	1,000.00
For studies in economics	2,500.00
ROCKEFELLER FOUNDATION	
For research in chemistry	12,401.51
For research in city planning	33,208.78
For the Soviet Science Conference	5,000.00
ROHM AND HAAS COMPANY	
For research in chemistry	3,000.00
THE DAMON RUNYON MEMORIAL FUND FOR CANCER RESEARCH, INC.	
For research in biochemistry	8,000.00
SCHLUMBERGER FOUNDATION	
For a fellowship in electrical engineering	3,000.00
FOR THE PROGRAM FOR SENIOR EXECUTIVES (SCHOOL OF INDUSTRIAL MANAGEMENT)	
Participation by 37 industrial concerns	$ 112,500.00
SHAWINIGAN RESINS CORPORATION	
For research in chemical engineering	3,000.00
SHELL FELLOWSHIP COMMITTEE	
For research in metallurgy	7,500.00
For a fellowship in mechanical engineering	3,600.00
For research in mechanical engineering	7,500.00
For research in physics	7,500.00
For a fellowship in physics	3,600.00

ALFRED P. SLOAN ('95) FOUNDATION, INC.	
For the Executive Development Program	117,500.00
For the industrial management convocation	10,000.00
For special awards	250,018.25
For two research grants in chemistry	15,842.00
For two research grants in mathematics	6,313.00
For two research grants in pyhsics	16,375.00
SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS	
For research in naval architecture	18,000.00
SODIUM SILICATE MANUFACTURERS' INSTITUTE	
For research in metallurgy	6,200.00
SPRAGUE ELECTRIC COMPANY	
For research in industrial management	12,000.00
THE SPRINGFIELD FOUNDRY COMPANY	
For the Joseph N. Scanlon Memorial Fund	250.00
STRANAHAN FOUNDATION RESEARCH	
For research in civil engineering	9,000.00
STANDARD OIL COMPANY OF CALIFORNIA	
For a fellowship in geology	3,350.00
STANDARD OIL FOUNDATION, INC.	
For a fellowship in chemical engineering	2,600.00
STATE HIGHWAY DEPARTMENT OF GEORGIA	
For civil engineering	275.00
STEEL FOUNDERS' SOCIETY OF AMERICA	
For research in metallurgy	37,862.00
HENRY E. SULZHAUER	
For the Commons Room in electrical engineering	10.00
TASTY BAKING COMPANY	
For research in food technology	5,000.00
HOWARD F. TAYLOR '36	
For research in metallurgy	1,200.00
TECHNICAL ASSOCIATION OF THE PULP AND PAPER INDUSTRY	
For research in civil engineering	7,049.01
TELEVISION SHARES MANAGEMENT CORPORATION	
For a prize in electrical engineering	2,000.00
TI-GSI FOUNDATION	
For research in geology	1,000.00
TITANIUM ALLOY MANUFACTURING DIVISION	
For research in metallurgy	1,500.00
UNION CARBIDE CORPORATION	
For a fellowship in chemistry	8,400.00
For research in electrical engineering	5,000.00
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	1,000.00
For comminution research in metallurgy	2,000.00
For thickening research in metallurgy	2,500.00
For research in metallurgy	2,500.00

UNITED NATIONS CHILDREN'S FUND	
For research in food technology	4,551.25
UNITED STATES METALS REFINING COMPANY	
For research in metallurgy	1,000.00
UNITED STATES RUBBER COMPANY FOUNDATION	
For a fellowship in chemistry	3,300.00
UNIVERSAL CYCLOPS FOUNDATION	
For a fellowship in metallurgy	5,000.00
VISKING CORPORATION	
For a fellowship in mechanical engineering	2,700.00
VOORHEES, WALKER, SMITH AND SMITH	
For a fellowship in architecture	7,000.00
WESTINGHOUSE EDUCATIONAL FOUNDATION	
For the Westinghouse Professorship in Mechanical Engineering	15,000.00
WESTINGHOUSE ELECTRIC CORPORATION	
For research in aeronautical engineering	20,000.00
HOWARD D. WILLIAMS '11	
For the Howard D. Williams Fund	500.00
JOHN G. WOLBACH	
For the President's Fund	500.00
WORTHINGTON CORPORATION	
For research in mechanical engineering	1,000.00
YALE UNIVERSITY	
For the Stimson Fund in industrial management	5,250.00
	$2,392,501.86

OTHER GIFTS

Added to agency funds held for investment purposes

CONTRIBUTIONS OF CLASS MEMBERS DESIGNATED FOR THEIR CLASS FUNDS:	
Class of 1907	$ 42,195.69
Class of 1915	781.13
Class of 1917	2,897.87
Class of 1918	581.54
Class of 1933	627.66
Class of 1937	678.90
Class of 1944	491.95
Class of 1948	18.89
Class of 1949	540.27
Class of 1950	585.48
Class of 1951	22.80
Class of 1952	152.45
Class of 1954	221.83
Class of 1955	262.55
Class of 1956	51.65
SWIMMING CAPTAIN'S FUND	
Contributions	29.00

JAMES E. TURNER '33		
For the Class' Twenty-Fifth Year Reunion Fund		1,250.00
EDWIN S. WEBSTER FOUNDATION		
For the Everett Moore Baker Foundation		1,000.00
	$	**52,389.66**

Added to annuity funds

ANONYMOUS		
A life income fund	$	12,814.96
ANTHONY BROWN ARNOLD '07		
For the Anthony Brown Arnold Fund		10,213.50
PHILIP L. COLEMAN '23		
For the Philip L. Coleman Fund		10,000.00
GEORGE S. WITMER '09		
Additional for the George S. Witmer Fund		27,710.82
	$	**60,739.28**

SUMMARY OF GIFTS, GRANTS, AND BEQUESTS RECEIVED

	1957	1956	1955	1954	1953	1952	1951	1950	1949	1948
GIFTS FOR ENDOWMENT:										
Real Estate	.....	.....	$ 275,000	.....	.....	.....	.....	.....	$ 175,000	.....
Funds for general purposes	$ 545,710	$ 61,264	111,956	$ 82,558	$ 50,128	$ 7,740	$ 86,586	$1,030,511	193,255	$ 379,560
Funds for designated purposes	1,834,944	2,342,351	499,495	677,230	538,077	340,532	523,599	382,069	106,114	105,919
GIFTS FOR STUDENT LOANS	250	2,200	4,550	9	905	2,973	227,756	10	115	7,360
GIFTS FOR BUILDING FUNDS	731,350	1,133,990	1,530,684	274,400	15,004	40,308	3,797,212	1,268,266	91,666	316,974
OTHER GIFTS:										
Unexpended balances of endowment fund income	1,350	6,450	6,340	7,786	5,800	5,425	5,775	2,525	9,180	13,800
Funds for general purposes — invested	180,268	191,826	765,680	391,881	1,403,533	2,850,889	2,206,364	2,066,934	482,730	101,899
Funds for designated purposes — invested	1,035,440	1,871,291	922,299	293,548	1,108,931	1,537,653	554,665	245,454	316,441	396,770
Funds for designated purposes — not invested	4,055,559	4,673,207	2,765,567	3,356,835	3,046,288	2,093,875	1,657,399	1,463,763	1,106,065	810,494
	$8,384,871	**$10,282,579**	**$6,881,571**	**$5,084,247**	**$6,168,666**	**$6,879,395**	**$9,059,356**	**$6,459,532**	**$2,480,566**	**$2,132,776**
MISCELLANEOUS GIFTS:										
Agency funds	$ 52,390	$ 30,539	$ 137,598	$ 26,171	$ 38,728	$ 45,711	$ 38,751	$ 18,247	$ 22,436	$ 54,747
Annuity funds	60,739	74,169	55,688	6,625	24,500	28,000	47,000	50,310	33,800	4,300
	$ 113,129	$ 104,708	$ 193,286	$ 32,796	$ 63,228	$ 73,711	$ 85,751	$ 68,557	$ 56,236	$ 59,047
Total	**$8,498,000**	**$10,387,287**	**$7,074,857**	**$5,117,043**	**$6,231,894**	**$6,953,106**	**$9,145,107**	**$6,528,089**	**$2,536,802**	**$2,191,823**

DEAN OF STUDENTS

The past year was my first as Dean of Students. It has been a year of observation and evaluation of the operations and the functions of the office. I would therefore like to open this report by outlining the problems facing the Dean of Students and the policies which seem to me to be the wise ones to meet them.

Everything that happens at a university is part of the educational process. Much beyond the acquisition of knowledge should and does occur in the classroom. Outside the classroom a great deal that is truly educational should result from the student's life in the dormitories, in the dining rooms, and in the multitude of social contacts and associations which occur during his day. The most fruitful concept of the function of the Dean of Students is that he is an administrative officer whose chief concern is for the development of all the facets of education which occur outside the classroom. The Dean should feel that he is an active formulator of educational policies throughout the living structure of the institution. He should be actively concerned that each student may obtain the maximum benefit and his best development from all his activities.

I was a member of the M.I.T. faculty for nineteen years before becoming Dean of Students. I was interested in the problems surrounding the office, but my orientation was that of a faculty member directly concerned with the academic accomplishment of students. Though I believe I had some

understanding of the impact of a student's mental attitudes and emotions on his academic performance, I have become acutely aware that there is a far broader and deeper connection than I had imagined. I thus cannot refrain, as a faculty colleague, from stressing the need for a maximum cooperation on the part of the entire faculty in helping promote better techniques and understandings in this most important area.

The Dean of Students is, of course, responsible for carrying out the rules and regulations of the institution in the non-academic area. It is beyond this, however, that his greatest opportunity lies. The atmosphere in which learning occurs, the attitude of the student body towards responsibility, integrity, and good citizenship as well as toward learning are crucial factors in determining the caliber of the graduating students and should therefore be of grave concern to the Dean.

The Institute yearly admits some nine hundred students from an unusually wide variety of backgrounds. The chief characteristic of these students is their demonstrated ability in mathematics and physics. Because of the diversity of their backgrounds and because mathematical ability seems to be a random talent not dependent upon a family background traditionally informed about the world of higher education, many of these young men come to us with very few preconceived notions of university life. Those they have are in general over-romantic and unrealistic. Entering students are, therefore, very eager to adjust uncritically to the mores of the university world they find upon arrival. They come to us to learn not only the classroom material but the outlooks, manners, and viewpoints of the M.I.T. community as represented by the student body. To use an old phrase, the "climate of opinion" of the student body toward learning and the purposes of learning, toward citizenship, toward responsibility, and toward conduct within the university are crucial factors in the equation. This entire area is ultimately the concern of the whole faculty. It is the direct and constant concern of the Dean of Students. If the highly skilled individual's focus of attention becomes completely acquisitive and self-centered, he can be much more dangerous to our society than were he not educated at all.

If the opportunities for education of the student outside the classroom are to be fully developed, it is quite obvious that a great deal of attention must be paid to the structure of

his living. The Institute has its best opportunity to do this for those students who live in the dormitories. The burden of the report of the Committee on Student Housing was to this effect. Certainly the implementation of that report, which has largely to do with the physical structure of the dormitories, will be a major step in the desired direction. However, very much more than we have accomplished can be done in the dormitories as they now exist.

It seems to me, after a year's observation, that the Institute as a growing residential college has as yet not fully developed a dormitory system and a dormitory atmosphere which capitalizes on all the educational possibilities inherent in a group of diverse young men living together. This is largely because of our dedication to an independent student government. In the interests of maintaining such a government, we have taken pride in having our dormitories run completely by the students themselves. The Faculty Resident in each dormitory, for instance, has no official responsibility for life in his dormitory. The number of freshmen and sophomores in the dormitories is far greater than of upperclassmen. No systematic integration of the freshmen with upperclassmen, graduate students, faculty, or foreign students exists. Quite naturally, the focus of attention of the student dormitory committees is on maintaining order and promoting social events and entertainments of various kinds; it is not upon developing a high caliber of intellectual activity in the dormitory, though some efforts are made in that direction.

The university dormitory at its educational best is a community in which the outlooks and attitudes of young men can be broadened by association with mature minds of scholarly, inquisitive, and creative outlook. This can only be achieved by the presence in the dormitory of individuals who are chosen for their capacities and abilities along these lines. Furthermore, a dormitory should have a rich tradition of outlooks and practices which are passed on from year to year by mature individuals who have a longer tenure than the usual student. It seems to me that the Institute can assume, as it should, the responsibilities for such a development under some form of House Master plan which insures high morale, loyalty to the house, and traditions of high order, and still allows student government to maintain its independence in most of the operation of the dormitory. It has been my observation that

many students feel quite acutely the lack of stimulating and intellectual influences in the dormitories and would be very happy to feel that they were achieving a broader outlook on all aspects of life in a house rich in traditions of quality of which they could be proud and which would capture their loyalty.

This entire question of the structure of our dormitories was discussed at great length during the past months by the Dean's Office staff and others interested in it. We must face this problem and develop a plan for using the dormitories as an educational device which will meet the Institute's responsibilities and still be satisfactory to the students.

That the outlook of many of our students toward the Institute and toward their educational goals is not satisfactory was clearly demonstrated by the student disturbance of the night of March 3, 1957. This outbreak was a demonstration against the administration of the Institute for announcing a raise in rents for the coming year. The arrest of thirty-one students by the police was in itself a painful event. The most distressing feature of the affair was, however, the attitudes toward the educational process which it revealed. The dichotomies of buyer and seller, of labor and management, of two opposing parties to a contractual relationship — namely, the purchase of an education — seemed to many students to be the valid view of their relationship toward the Institute. Had there been a strong underlying tradition of the Institute as a community of scholars working together at various stages of their development with clearly recognized responsibilities, respect for the basic good will of all concerned would have precluded any possibility of such an antagonistic demonstration.

The prevalence of such attitudes is not peculiar to the Institute but is a source of concern throughout the country. It should be a major concern of the Dean of Students to take the initiative in improving these outlooks by improving communications and by seeking throughout the residential structure to establish more mature outlooks toward the goals of the community.

COUNSELING

In both secondary and university education, counseling of students has been emphasized increasingly over the last few decades. Counseling asserts the importance of realizing that a

student's successful learning is the result of a great many factors besides his I.Q.

At M.I.T., students have not only the normal problems of transferring from home and high school to university life; they have in addition the task of reaching a realistic understanding of the nature of science and engineering and their place in a rapidly changing culture. This is not made easier by the unrealistic glamorous ideas so often associated with the field of science. Too frequently admission to M.I.T. is thought of as the end of the rainbow, where a pot of gold will solve all future problems.

To meet in part the need of students who find that their aspirations and their performance are uncomfortably out of balance, the Institute provides opportunities for counseling in various ways. The members of the Dean's staff share this responsibility with the faculty. Expert counseling is also always available from members of the psychiatric staff of the Medical Department. I think it right to say that the effectiveness of counseling at the Institute is due both to the skill and perception of a great many people who do not think of themselves as counselors and to the cordial relations of trust and cooperation between all those engaged in this work.

Granted that our knowledge of how learning and creative activity occur is still very inadequate, we do know more, collectively, about how students learn effectively than we know and use individually. It is in this area that there is much that we can and should do, and it is my hope that we shall sometime be able to devise an effective way of bringing together old and new insights into growth and learning, so that university education at M.I.T. may have for fewer students its periods of tedium and for more students its periods of enthusiastic discovery and rewarding growth.

DORMITORY REGULATIONS

In implementation of the recommendations of the Committee on Student Housing, a committee of representatives of the various living groups met with the Dean of Students at various times during the year to formulate the philosophy and policies behind the rules and regulations of the dormitories, particularly with respect to open house hours. The rules under which the dormitories and other living groups operate were documented and subsequently discussed in a meeting with the

Corporation Committee on Student Activity. The purpose here was to explore the attitudes of various portions of the Institute community, alumni, parents of students, and the surrounding community — including women's schools in the neighborhood — toward the parietal rules of the Institute. The study was reviewed by the Executive Committee of the Alumni Association. All of this indicated quite clearly that a problem exists in this area to which the student body and the Dean's Office must give further attention.

On November 17 and 18, 1956, the Dormitory Council held a Leadership Conference at the Osgood House, North Andover, Massachusetts, to which deans and student representatives of women's colleges were invited. The relationships of women students in the area with the M.I.T. dormitory students with regard to visiting hours and other regulations were fruitfully discussed.

FRESHMAN ADVISORY COUNCIL

After five years of continuous operation, the Freshman Advisory Council has proved itself an established organization making its contribution to the M.I.T. community. There are now seventy members, representing all departments of the Institute. In 1956 each freshman was introduced to his faculty adviser during Freshman Weekend at a dinner which has proved to be a most welcome addition to the orientation program.

For the first time, new advisers were appointed before the close of the spring term for the following year (1957–58) and were invited to luncheon at the Faculty Club as guests of the Council. Professor Charles N. Satterfield, Chairman of the Council, presided, and Dr. Julius A. Stratton expressed the Institute's appreciation for the work done by the individual Council members. Dean William Speer presented brief comments about counseling in general and situations in particular in which faculty advisers may be most helpful.

The spirit of cooperation among the faculty advisers and between this office and the Medical Department continues at a high level. Students are referred by advisers to both the Medical Department and the Dean's Office. Advisers frequently call us to ask about individual students, and periods of absence from classes on the part of students are checked by this office to guard against losing contact with any freshman.

The Course orientation program was directed again by Professor Prescott A. Smith and followed much the same outline as in the previous year. An evaluation made by Professor Smith indicated that perhaps too much emphasis has been placed upon Course choice when the freshman first enters the Institute. We need to emphasize early curricular similarities rather than differences. It also suggests plant visits as a Course orientation device.

It was suggested that the first orientation lecture be sponsored jointly by the Freshman Advisory Council, the Undergraduate Association, and the Placement Office and perhaps consist of a panel including people from industry, with an M.I.T. person as the moderator. This session might be followed by a one- or two-week period when informed persons would be available during the day in the Placement Office to answer student questions and to refer students to a specific department if this seemed desirable.

The philosophy of the Council regarding disqualification of freshmen continues to be that of consideration of the individual student, although it is generally agreed that probation in February would be voted only in cases of extenuating circumstances.

The office of the Assistant Dean of Students, Miss Ruth L. Bean, still functions as headquarters for the Council; there is a close working relationship between Miss Bean, Chairman Satterfield, and the Council members.

WOMEN STUDENTS

This year we had our largest number of first-year women enrolled. It is good to report that the academic record of these students has improved. The year began with an arrangement with a private house owner, which we hoped would solve some of the living problems. Unfortunately the plan did not work well, and in November we had to abandon it and find new living quarters for many of the girls. Because this meant complete changes for them, the experience probably affected their work adversely.

Social activities sponsored by the women students were limited this year to the annual open house in December and the Christmas party for underprivileged youngsters, both held in the Margaret Cheney Room. The women continue, however, to be active on various student committees and in extracurricular activities.

A committee of upperclass women handled the women's part of Freshman Weekend. During the weekend the freshmen and the committee lived together at 120 Bay State Road, where special activities had been organized for them. The Women's Advisory Board sponsored a tea for introducing incoming first-year girls to the Board; to Mrs. Margaret Alvord, Resident Head of 120 Bay State Road; and to members of the Dean's Office.

It seems to me that women students are successfully finding a place in the Institute, both in the academic and the social environment. It is of concern to some of us, however, that the young women are not yet able to realize their full potential here. All of them enter as freshmen with records equal and in some cases superior to some of the young men; yet the emotional conflicts which are raised seem to be responsible for the larger percentage that fail to complete their work. There seems to be a dominating spirit of competition with the men rather than a willingness to contribute as women to the whole community.

I am sure the problem of women students has not been solved; but with the opening of one section of Bexley Hall as an apartment-dormitory, begun so successfully as an experiment during the spring term this year, we shall have gone a long way toward a solution. A searching study of the place of women at M.I.T., including a psychological study of those who choose the school and their reasons for the choice, would provide very helpful material. I would urge that the study group contain men and women outside the Institute who can look at the whole picture objectively. There are successful women in other fields who can contribute immeasurably to such a study. It is my strong recommendation that such a study be considered for the coming year.

AUDITORIUM

The Kresge Auditorium has amply justified its existence during the year. The simple statistics speak for themselves. In all, 359 events were scheduled in the large hall, 271 in the little theatre, and 595 additional meetings occurred in the two rehearsal rooms. Already a need for more rehearsal space has developed.

In this brief report of the Auditorium, I want especially to note the increasing use of the building in terms of its dedi-

catory designation as "the meeting house of the Massachusetts Institute of Technology."

RELIGIOUS PROGRAM

The use of the Chapel has exceeded all expectations: 1,180 events were scheduled during the year. These included 572 religious services, 32 weddings, and 5 christenings.

In addition to these formal services of worship, James Murphy reports an increasing use of the Chapel for private meditation by students of all denominations and religious traditions.

The three full-time guest religious counselors, the Reverend J. Edward Nugent, Rabbi Herman Pollack, and the Reverend Robert C. Holtzapple, continuing their association together as a team, are with the Institute for the fifth year. In addition to these men, ten other members of the clergy have had on-campus office hours or have been on call for student counseling purposes. These religious counselors continue a quiet but impressive service to the student body and to the Institute family. All of them report increasing counseling loads. In part, this is the result of having become familiar with and accepted by the student body; but more especially it is because of their recognized stature as men of worth and good will.

In addition to the formal religious services in the Chapel and the counseling, an especially important aspect of the clergy's role has been the teaching function through the medium of seminars and lectures. This latter function has become a major emphasis for the religious groups, due to the increasing interest of students in the intellectual content of the religious traditions.

It should be noted that it is the desire of the clergy that students participate as much as possible in planning and executing the services of worship and the religious seminars, and in this they have been unusually successful.

Dean Speer has continued to assist the three major traditions in negotiations with Mr. Edgar Kaufman concerning the procurement of suitable religious articles for the Chapel. The Jewish articles, purchased by the Boston Stein Club, were received and dedicated at appropriate services this winter. Several Protestant articles are currently on order.

E. Francis Bowditch has been working closely with Dr. Frederick May Eliot, Bishop Emeritus Norman B. Nash, and other Protestant dignitaries in the organization of the Everett Moore Baker Foundation for Protestant Work at M.I.T. A substantial grant from the Danforth Foundation has been approved for the M.I.T. Foundation project. It will be another year, however, before this experiment can be launched.

The relation between science and religion, or between education and religion, is probably no more or less a subject for discussion among students and faculty than any other subject of such importance. But I might venture to suggest that these relations are of less importance on the theoretical level than they are on the level of the individual's search for meaning and purpose. In this search a student at M.I.T. can now feel that there are many persons available to understand and help him.

STUDENT GOVERNMENT

Malcolm Jones '57, retiring President of the Institute Committee, has written a comprehensive report concerning the activities and major emphases of student government during the recent year. Mr. Jones' report deals in part with the place of student government in the undergraduate student's life.

This is the first year of the financial operation of student government from a single grant of money. The amount of $10.00 per undergraduate student was allotted by the administration to the Institute Committee, the Committee to be responsible for the budgeting and expenditure of the total sum. No other requests for money were granted nor will be. Thus the Institute Committee had full responsibility for all expenditures by activities from funds coming from the Institute. The Finance Committee of the Institute Committee did an excellent job in allocating this single grant. Toward the end of the year the amount per student was reviewed and set at $13.00 for the next three years.

In order to aid the students in preparing an acceptable budget every third year, an Activities Development Board was established under the chairmanship of Professor Robert W. Mann. The chief function of this Board is to act in behalf of the student body in setting a new rate. The relationship of this Board to the student body during the year proved to be excellent. Also, an Audit Board under the chairmanship

of Professor Thomas M. Hill was made responsible for seeing that a competent audit of student books is made each year.

STUDENT ACTIVITIES

The Technology Community Association has replaced the former Technology Christian Association. The transition to a wider and more inclusive spiritual base has been achieved smoothly and without loss of effectiveness. The new advisory board of T.C.A. is composed of Professor John Wilbur, Professor Morris Cohen, Mrs. Karl T. Compton, Mrs. Julius A. Stratton, Mr. Bowditch, William H. Carlisle, Jr., and Dean Robert J. Holden. A Catholic layman is to be invited to join this board.

Thomas Lovejoy '58 has given new and resourceful leadership to the Activities Council, which was established by the 1952–53 Institute Committee reorganization.

In general, the eighty-five activities at the Institute of a nonathletic nature have continued to provide programs of participation and involvement designed to enhance student life and learning.

In its first year of operation, the Commuters' Association has had the benefit of the newly furnished facilities on the second floor of Walker Memorial, which were completed in February. This Association was formed in response to commuting student requests and as a pilot operation designed to give information concerning how best to provide first-class noncurricular education for commuting students. It is still too early to draw any decisive conclusions from the Association's six months of experience in its present quarters. There is, however, genuine appreciation for the administration's contribution in making the facilities available.

During the year it has been possible to arrange with the Department of Building and Power and with the Director of General Services for a mutually agreeable division of role and function within the building and to organize a better program for maintenance and supervision.

Last fall the Dean's Office established a Student Center Committee composed of faculty members and students to represent the students' interests at all stages in the planning of a proposed Student Center Building. There remains foremost in the minds of the Committee the strong necessity for this building and the hope of its not-too-distant construction.

PERSONNEL CHANGES

At the beginning of the year, Associate Dean Frederick G. Fassett, Jr., was made Dean of Residence, his direct concern to be with student living conditions at the Institute. In addition to being in charge of the dormitory system, he is responsible for the Institute's relations with the fraternities and the apartments and rooming houses in which students live. To consolidate his office, the Housing Bureau, formerly operated by T.C.A., was moved to his office. Dean and Mrs. Fassett took up residence in the Moore House, where they have been the social focus of student campus contact with the faculty and administration.

Associate Dean Speer was made Associate Dean for Counseling. He is the chief counselor for the Dean's Office and is its liaison officer with the Registration Officers and the Medical Department.

Mr. Holden, General Secretary of T.C.A., was made Associate Dean of Students. He is responsible for aiding student activities on the campus and is in charge of student use of Institute facilities such as the Auditorium and the Chapel.

Mr. Robert K. Weatherall was added to the Dean's Office staff to assist the Dean of Students and in particular Dean Fassett in the many responsibilities of the office.

JOHN T. RULE

DIRECTOR OF ATHLETICS

With an increase in the number of professionally trained men serving as staff members during 1956–57, the Department was able to maintain and improve the quality of its present athletic program. During the course of the year, student interest and cooperation also reached a new high. Under the dual leadership of Daniel Holland '58, President of the Athletic Association, and Glenn Strehle '58, Varsity Vice President, we had the opportunity to work as a team for the best interests of students and staff.

The first year of operation under the new organization plan of the Athletic Association has seen substantial savings. Credit for good management goes to Mr. Strehle, in his administration of the intercollegiate budget, and to John

Murphy, equipment manager. Both have conscientiously administered their respective accounts with unusual acumen.

Arne Arneson has resigned to accept the track coaching responsibilities of the Air Force Academy in Colorado; this is the only staff change for 1957–58.

INTERCOLLEGIATE PARTICIPATION

Approximately 750 students took part in intercollegiate sports this year. During the fall, 56 men received letters in soccer and 23 in cross-country. Winter activities saw 36 participants in basketball, 42 in hockey, 55 in swimming, 26 in wrestling, 28 in fencing, 77 in track (including outdoor spring participation), 25 in rifle, 11 in pistol, 31 in squash, 23 in skiing, and 17 in weightlifting.

In the spring, 28 students competed in golf, 19 in sailing, 40 in tennis, 56 in baseball, 59 in lacrosse, and 101 in crew.

No new records were established, nor was the year particularly outstanding in contests won or lost. Basketball, under the direction of John Burke and Robert Whitelaw, provided the greatest interest as a competitive sport. Swimming, under the direction of Gordon Smith and Charles Batterman, re-established itself. Much credit is due Harry Duane '57 for the outstanding contribution he made as swimming team captain. His leadership was displayed both in the intercollegiate program and intramurals.

L. Peter Hohorst '57 received the Clifford Award for his contribution to basketball, baseball, and lacrosse during his undergraduate career. His leadership, team spirit, and general sense of humility made him the unanimous choice of the selection committee.

INTRAMURAL PARTICIPATION

Intramural interest in thirteen sports provided opportunity for 2,400 participants. Well over one hundred men took part in intramural golf, track, swimming, table tennis, badminton, bowling, sailing, volleyball, and tennis. More than three hundred were engaged in intramural contests in hockey, touch football, softball, and basketball.

Limitations imposed by a lack of field space are still the major concern of the Department and of the student Association. When facilities are expanded into the Westgate area, we will be able to grant a greater number of intramural teams the privilege of participation in softball and touch football.

PHYSICAL EDUCATION PROGRAM

The growing trend to strengthen physical education programs in the curriculum of educational institutions clearly points out the significance of the established M.I.T. program. Robert Whitelaw, Director of Physical Education, reports that close to 85 per cent of the M.I.T. underclassmen are exposed to physical education classes during the course of each year. The selection of activities is voluntary; and with twenty-one classes offered, each student has a wide range of choice. Physical activities that may be enjoyed both in college and in later life have gained in popularity.

During the school year, 3,331 students registered in one of the twenty-one physical education classes. The year has seen the addition to the program of bowling, archery, and developmental classes.

In an attempt to determine the basic physical condition of the entering freshman student, the Kraus-Weber Modified Test, a minimum test of physical fitness, was administered to the entering freshman class. The results indicated that further research is necessary before reliable conclusions can be formulated. The introduction of the developmental class and physical fitness testing program motivated a number of students to consult the Medical Department and members of the physical education staff to determine means by which their physical efficiency could be improved.

The Faculty Committee on Fourth Year Records faced the problem of seven seniors who had failed to complete the physical education requirement. The Faculty Committee on Third Year Records had previously extended the completion deadline from June of the junior year to the end of the first semester of the senior year for these men. After deliberation and discussion, the Fourth Year Committee voted to refuse registration, subject to the Dean's Office review and approval of each individual case. Seven seniors were placed on Dean's probation and allowed to register. All completed the requirement during the second semester.

The revised requirement recommended and approved by the Undergraduate Policy Committee in September, 1956, requires "that completion of the physical education class requirements be limited to the first two years." This requirement motivated a larger percentage of the freshman and sophomore class to complete their requirements as compared

with previous years. Basic questions relating to the requirement and the mechanics of enforcement are awaiting study and action by the Undergraduate Policy Committee. Approximately 38 per cent of the Class of 1960 completed requirements during their freshman year.

The completion of the new tennis courts and the du Pont Athletic Center will enhance the efficiency of the teaching program. New locker facilities in the Center will permit a regular program for women students in the near future. It is with eager anticipation that the Department looks forward to carrying out its objectives in service to the students and faculty of M.I.T.

MISCELLANEOUS

During the course of the year several interesting experiments and new procedures have been undertaken.

In cooperation with the Beaver Key, a junior honorary society, each entering freshman was invited to the athletic office for a personal interview. The purpose of the invitation was to provide general information about M.I.T. Of the entering class, approximately five hundred freshmen responded and were interviewed by members of Beaver Key or the athletic staff.

Personal evaluation summaries were submitted to the Director of Athletics at the close of each intercollegiate season for each participant in each sport. These summaries have been passed on to the Dean of Students and the Director of Placement.

The Athletic Board, under the chairmanship of Professor Thomas Jones, met each month during the academic year. Problems of note were those concerned with the new facilities to be built with the David du Pont gift and review of the athletic program at M.I.T. A committee under the chairmanship of Stewart Edgerly, Jr. '46, made a comprehensive study of the history of football at the Institute. This study was the basis of the Board's recommendation that tackle football, in any form, be discontinued at M.I.T.

The Athletic Board spent many hours reviewing the required physical education program. It is proposed that this study be continued in 1957–58.

I wish to express the appreciation of the Athletic Department for the thoughtful cooperation of the thirty faculty

members who have served as team advisers during the year. In addition, the Office of the Dean of Students, the Registrar's Office, and the Medical Department have all given unsparingly of their time in providing help in the mutual problems we have faced.

RICHARD L. BALCH

DIRECTOR OF STUDENT AID

With a tuition increase of $200 — or 22 per cent — becoming effective in July, 1956, there was some apprehension that student aid resources might prove insufficient during 1956–57. It is therefore gratifying to record that financial aid to undergraduates totaled almost $1,400,000, bettering by 40 per cent the amount of assistance furnished during the previous academic year. Briefly, $629,188 was awarded in scholarships, $356,752 was granted in loans, and $407,445 was paid by the Institute to students employed in part-time jobs on the campus.

SCHOLARSHIPS

In the statistics comparing 1956–57 with 1955–56 (next page), it is worth noting that the number of students assisted in 1956–57 showed an increase of 20 per cent, while the total grants were augmented by 80 per cent. These marked increases have not been due to any one single factor but rather to the cumulative effect of several important elements: a special appropriation of $100,000 by the Corporation for scholarships for 1956–57; a $50,000 gift from the M.I.T. Alumni Fund; slightly more than $250,000 from seventy-three sources which include alumni, individuals, M.I.T. alumni clubs, corporations, industrial and charitable organizations, trusts, and foundations.

NATIONAL SCHOLARSHIPS

In April, 1957, the M.I.T. Alumni Fund Board approved the establishment of the M.I.T. Alumni Fund National Scholarships, with an appropriation of $100,000 to finance national scholars in the Class of 1961 at the rate of $25,000 annually. Furthermore, the Board voted an additional $35,000 to continue aid extended to the members of the Class of 1960.

Undergraduate Scholarships and Loans

	1956–57			1955–56		
	Number	*Awards*	*Total*	*Number*	*Awards*	*Total*
Undergraduate scholarships						
From M.I.T. endowment funds:						
Freshman scholarships	203	$164,255.00		196	$100,870.50	
Other undergraduate scholarships	315	206,981.00	$371,236.00	298	118,121.65	$219,992.15
From outside sources:						
Freshman scholarships	88	102,180.00		45	55,020.00	
Other undergraduate scholarships	173	155,772.50	257,952.50	115	79,610.00	134,630.00
	779		**$629,188.50**	**654**		**$334,622.15**
Undergraduate loans						
Technology Loan Fund	454	$317,317.00		462	$262,286.00	
Mead Fund	57	39,435.00		67	41,325.00	
Other student loan funds	5	1,500.00	$358,252.00	6	3,850.00	$307,461.00
	1093*		**$987,440.50**	**1054***		**$662,083.15**

* The total is modified to allow for individuals receiving both scholarships and loans.

Twenty-two members of the Class of 1961 will enter this September holding Alumni Fund National Scholarships, marking the first time the Institute has financed its own national program. Previous to this our only national program has been supported by the Alfred P. Sloan Foundation, Inc., having been initiated by the Foundation in 1953. This year it is pleasing to report that the Foundation has increased the number of scholarships to thirteen per class, which means that eventually we will have fifty-two Sloan Scholars in our undergraduate student body as compared to thirty-six last year. This fall almost forty members of the Class of 1961 will hold National Scholarships.

The national standing of the Institute is clearly brought out in the country-wide competitions conducted by General Motors and the National Merit Corporations. For example, in 1956–57 M.I.T. placed second among 152 colleges and universities selected by 556 National Merit winners. It is expected that nearly 8 per cent of National Merit winners will enter M.I.T. with the Class of 1961. Assuming that all these programs continue in force, it is entirely probable that when each class has its complement of these different scholars, about 10 per cent of our undergraduates will be holding national scholarships under several different sponsors.

It is particularly significant to point out that, as the summary of scholarships shows, the amount of financial support from outside sources doubled over the previous year. Not shown in this table is the total "grant-in-aid to education," which is given to the Institute in addition to money furnished for scholarships; for this year these grants amounted to more than $94,000.

LOAN FUNDS

The increase in scholarship aid should not overshadow the substantial and supplemental assistance made available from the Technology Loan Fund and George J. Mead Fund. The total loans for the year reached a new high of $450,587. In all, 749 applications for loans were received from both graduate and undergraduate students during 1956–57; of this number 686 were presented to the Technology Loan Fund and 614, or 90 per cent, were acted upon favorably, totaling $407,562. For 1955–56 the corresponding figures were 693, 621, 90 per cent, and $342,264. Sixty-three applicants were

helped from the George J. Mead Fund, in the amount of $41,525; five others were helped from other student loan funds to the extent of $1,500, making a total of 682 loans granted for $450,587 during the year.

In addition to the usual loan statistics that are given with the annual report, some comparative items over the past five-year period will emphasize the importance of our loan funds as a form of student aid.

	As of June 30, 1952	*As of June 30, 1957*
Total amount loaned	$2,540,297	$4,152,916
Principal repayments	1,892,880	2,489,482
Notes outstanding	638,013	1,648,685
Number of debtors	1,042	1,827
Number fully paid	2,421	3,089

In this five-year period the capital amount of the Technology Loan Fund decreased only $545,609, while the loans to students increased by $1,010,672.

OTHER BENEFITS

Basically this report deals with financial assistance in which Institute funds or gifts to the Institute are employed. However, it is estimated that more than $100,000 was granted to 8 per cent of our student body under the provisions of Public Law 550, "The Korean G. I. Bill." These benefits are paid directly to veterans at the rate of $110 per month, with increased amounts to veterans with dependents. The following table gives the number receiving these benefits during the past twelve months.

	Number receiving benefit	*Per cent of total registration*
First term, 1956–57	478	7.9
Second term, 1956–57	456	8.0
Summer, 1957	146	9.7

STUDENT EMPLOYMENT

The Manager of Student Personnel reports that during the past year the number employed in part-time jobs increased some 10 per cent to 1,360, and $407,445 was earned. The total earnings increased by nearly 40 per cent, reflecting in part the upward adjustments in the hourly rate made effective at the beginning of the fiscal year.

TUITION EXCHANGE PLAN

The anticipated assistance of this plan for the benefit of faculty children failed to materialize in any noteworthy manner for another year. Twenty-four children of M.I.T. faculty members were certified as eligible to forty-three different colleges and universities which are participants in this plan. Only seven children out of this total were placed, which was an improvement over last year. It is regrettable that not more than one-third of our "exports" are placed and placement has been, in many instances, on the "turn of the wheel" basis.

The following table summarizes our "export" and "import" results over the past four years. Not included in this are children of M.I.T. faculty who are in attendance at M.I.T. as undergraduates. During 1956–57 there were ten children in this category receiving full-tuition benefits.

Export	*Certified*	*Accepted*	*Rejected*
1954–1958	81	28	53
Import			
1954–1958	21	21	0

In October, 1956, Joe Jefferson, who had served capably for almost two years in the student aid activities, was appointed Placement Officer. J. Samuel Jones, who has had several years' experience with the Harvard Financial Aid Office, was appointed in December, 1956, to fill the vacancy created by Mr. Jefferson's promotion.

T. P. Pitré

REPORTS OF OTHER ADMINISTRATIVE OFFICERS

SECRETARY OF THE INSTITUTE

The degree to which individual trustees help their schools is usually known only to the administration and faculty who see at first hand the work of the trustees. M.I.T. is particularly fortunate in having a strong, interested, and willing group. The Corporation represents a wide range of professional experience and skills; such breadth and depth of background is of paramount importance to a technological institution which is educating young men to take their places in industry and maintaining basic research programs which may be of significant importance to industry. The high attendance at the four stated meetings of the Corporation during the past year demonstrates the keen interest of the members in activities at the Institute. Of perhaps greater significance is the service given through the several standing and visiting committees, where the Corporation members bring to bear their wide professional knowledge on specific areas and provide direct assistance to department heads and the administration. Last year many members of the Corporation helped greatly by serving as hosts at informal luncheons and dinners throughout the country where President Killian has had an opportunity to discuss the Institute's programs and problems with local leaders and friends of M.I.T. The success of the regional conferences at Tulsa and Chicago last year, held under the auspices of the Alumni Association, was due in large measure to the efforts of Corporation members and prominent alumni in those areas.

DEVELOPMENT ACTIVITIES

Total gifts for the year were $8,304,000. This is less than the total gifts for 1955–56, when the Institute received a single

bequest of $1,000,000 from David F. du Pont '57. Not included in the total for the current year is the most generous offer of Alfred P. Sloan, Jr. '95 to give the Institute $1,250,000 through the Sloan Foundation for the Faculty Salary Adjustment Fund, provided that a total of $3,750,000 is secured from other sources. Of this, more than $1,500,000 has been paid or pledged as of mid-July. Walter J. Beadle '17 of the Corporation has accepted the chairmanship of the Corporation committee to seek the remainder of the funds during the coming year.

The Alumni Fund completed the year with the impressive total of $640,000, exceeding 1955–56 by nearly $70,000. Regional solicitation under the direction of Joseph Conrad has proven to be most effective in increasing participation in the Alumni Fund. On the basis of the widespread alumni interest in supporting scholarships, the Fund Board has made allocations to assure an M.I.T. education to at least twenty-five young men in the classes entering last fall and in 1957.

We continue to receive good support from industry through scholarships and fellowships, grants in support of research, and both large and small gifts of essentially unrestricted character. Financially, our most significant industrial support comes through the Industrial Liaison Program, accounting for more than $1,000,000 a year of income. Several new companies have joined in the last year. Professor Walter H. Gale has concentrated his efforts most effectively in this area of our solicitation; Professor Weems and his colleagues in the Industrial Liaison Office have provided imaginative service not only to participating companies but to prospective members. But all of us who are concerned with the administration of the program recognize that it is the faculty that gives it its real quality; the willingness of the members of the faculty to discuss freely their research activities provides ample evidence of the values of the program to industry.

Two areas of annual giving deserve special mention: the parents' program and the appeal for support from companies which have an interest in M.I.T. but which are not large enough to consider membership in the Industrial Liaison Program.

Last year, we made our first appeal to parents (who were not M.I.T. alumni) of graduate and undergraduate students of all classes back to 1954. In addition, we included

some parents who had previously given to the T.C.A. We received 849 gifts and pledges totaling $23,100. It is interesting to note that, in addition, more than eighty parents wrote to let us know why they were unable to give anything. This year we broadened the base of our corporate appeal, soliciting three times as many companies as previously. We received gifts and pledges totaling $43,915.

With the increased opportunities available to M.I.T. for service to the country, we must seek to broaden the base of our financial support as much as possible. Help from parents who can afford it is a potential source of major support if we are effective in pointing up our needs in terms of the relatively small part of the total cost which is met by tuition. Industry, too, which has come to accept its opportunity and responsibility to support education, is a major source of funds to help an institution like M.I.T.

ROBERT M. KIMBALL

DEAN OF THE GRADUATE SCHOOL

Pressure for admission to the Graduate School continues unabated, despite increasing competition from every quarter for top-quality young scientists and engineers. During essentially the entire period following World War II, the size of the Graduate School has been limited by departmental quotas for graduate students. However, emphasis on adherence to quotas was markedly reduced for the fall 1956 admissions, partly as an experiment to determine the need for quotas and partly because the idea of quotas needed revalidation to be effective. As a result, equivalent full-time graduate enrollment increased from five per cent under quota in the fall of 1955 to roughly ten per cent above quota in the fall of 1956, clear evidence that the pressures for growth are still present and that containment of the Graduate School requires conscious self-restraint. After careful review, departmental quotas for 1957 fall admissions have been re-established, usually at either the former quota or the actual fall 1956 registration, whichever was larger.

These actions on quotas reflect the administration's belief that the function and responsibility of an institution such as M.I.T. is primarily the development of the ablest students. This concept, so obvious in the abstract, requires moral assistance in some such form as quotas to help resist the strong human appeal of the adequate but second-best applicant.

To admit first-rate graduate students, we must attract first-rate applicants. Recognition of this principle by an increasing number of graduate schools has produced competition which emphasizes the limited supply of students with this quality of mind. The competition for superior talent among the new holders of the bachelor's degree is a dynamic and highly sensitive area in which we are doing well, but in which we cannot afford to relax for a moment.

Each department faces nationwide competition for good applicants, and each is using various devices to meet this competition and to reach the choice prospects. It is clear that nothing replaces the appeal of personal contact between our faculty and the faculty and individual students of the undergraduate institutions which provide our major graduate intake. Financial aid is another vital element in this attraction process. Certainly this idea of financial subsidy for graduate students is not new. The need for it has been mentioned as critical by every serious writer on graduate study in this country for over a century.

Providing support for the competent graduate student after the first year is relatively simple compared with providing support for the first-year graduate student, for whom offers of immediate employment compete highly with graduate study. Our Whitney Fellowship program, which uses general scholarship funds to provide a cash award plus tuition, has been in operation for three years. It has proved so successful in attracting outstanding individuals that its further enlargement this year to thirty-nine offers seemed justified. As an experiment, a few of these offers were allotted by the Graduate Committee for direct departmental offer prior to the customary April 1 date. On another front, it is evident that many sponsors of industrial fellowships are beginning to realize that their fellowships are often more productive when they are used to attract top-quality students to enter graduate work rather than to sustain students in their final year of doctoral study.

The Institute's attraction for National Science Foundation Fellows and for fellows of some of the principal national industrial foundations is gratifying, although it subjects us and a few sister institutions in comparable positions, as well as the sponsors, to potential popular and political hazards.

Industry shows increasing interest in supporting both full-time and part-time graduate study, both in terms of major support of full-fledged resident graduate study and in terms of collaboration with graduate schools to provide part-time formal study to upgrade their employees. While both the full-time residential type of graduate program and the course-by-course, out-of-hours study type are unquestionably worthwhile, the Institute has strongly adhered to the notion that its limited resources are best devoted to providing for its graduate students the "total immersion" type of intellectual experience in a university atmosphere.

In view of the vital part that teaching assistantships play in our graduate student aid — and indeed in graduate student educational experience — it was gratifying to see the quality of skill and devotion to teaching evidenced in this year's nominations for the Goodwin Medal, which is offered in recognition of conspicuously outstanding teaching by a graduate student. The performance of these graduate assistants attests to the Institute's recognition that superior teaching, particularly in engineering and the engineering sciences, is not the monopoly of oldsters.

For the past year a Committee to Study the Future of the Graduate School, under the chairmanship of Professor John Hrones, has deliberated on the characteristics of the ideal graduate school, its physical setting, and its social and intellectual climate. These studies promise important contributions to the formulation of our goals. The Committee has conscientiously striven for a leisurely and reflective spirit in their thinking, a process which in our dynamic atmosphere can be achieved only by conscious effort and design.

Our Graduate Student Council, under the leadership of chairman John Crowley, has likewise provided a serious, thoughtful contribution from the graduate students on the broad problem of optimum Graduate School environment. President Crowley was the recipient of the Compton Award "in recognition of unusual contributions to all phases of

graduate student life, particularly through modest but effective leadership of the Graduate Student Council."

Aside from continuing problems implicit in the subjects already discussed, one problem receiving current attention is that of coming closer to an ideal fee structure for doctoral thesis research, one which is fair to both the graduate student and to M.I.T. and at the same time easy to administer.

The Dean expresses his continuing appreciation to the members of the Committee on Graduate School Policy for their fundamental devotion to M.I.T. as a whole, so uniformly demonstrated by their consistently placing constructive resolution of potential stresses between departments and the Graduate School above the interests of any one department.

Some statistics of the Graduate School follow.

Graduate School Registration, 1956–57

	Summer, 1956	*Fall, 1956*	*Spring, 1957*
School of Engineering	600	1343	1262
School of Science	208	672	621
School of Architecture and Planning	26	57	50
Department of Economics and Social Science	3	82	69
School of Industrial Management	48	144	141
	885	**2298**	**2151**
U.S. or Canadian citizens	755	1954	1836
Others	130	344	315
	885	**2298**	**2151**
Regular students	811	1919	1932
Special students	74	379	319
	885	**2298**	**2151**
Civilian students	—	2156	2029
Military students	—	142	122
		2298	**2151**

Advanced Degrees Conferred, 1956–57

	S.M.	*Engineer*	*Sc.D.*	*Ph.D.*	*Total*
September, 1956	147	7	13	27	194
February, 1957	91	9	17	35	152
June, 1957	381	45	36	43	505
	691	**61**	**66**	**105**	**851**

1956–57 Awards of M.I.T. Fellowships, Scholarships, and Staff Appointments

	Number of Awardees	*Amount*
Fellowships	204	$381,570.50
Scholarships	109	115,533.50
Staff awards	407	184,699.00
	720	**$681,803.00**

H. L. HAZEN

DIRECTOR OF ADMISSIONS

This report, following the precedent of other years, covers the twelve-month period ending with the opening of the new academic year in September, 1957, which date marks the natural termination of the Admissions Office year.

The following table compares, for this year and last, applications for admission to the freshman year, and those for transfer from other colleges at the undergraduate level.

First-year class	*September, 1956*	*September, 1957*[1]
Total applications	5,735	5,904
Admissions granted	1,924	1,822
Actual registration	941	907
Registration as per cent of admissions	49.0%	49.8%
Number of secondary schools represented	646	645

College transfers	*September, 1956*	*September, 1957*
Total applications	760	764
Preliminary applications not followed up	198	226
Admissions granted	182	198
Actual registration	133	146
Combined Plan of Study (included in above)	26	24
Registration as per cent of admission	73.0%	73.7%

[1] Includes three former students returning and thirteen college transfers who entered the first year.

This year, for the first time, a nonreturnable application fee of $10.00 was required with all final applications at the undergraduate level, exceptions being made, however, for foreign students. This brought in a total of $37,350 toward the cost of processing applications. The fee had the effect of reducing the number of final applications by about 8 per cent. We expected that this would eliminate many casual

applicants and so result in a higher percentage yield of registrants from the group to whom admission was offered. This proved not to be the case; this result suggests that the tendency to submit multiple applications to colleges is increasing and that in the absence of the fee we might have had an even greater shrinkage.

SELECTION OF STUDENTS

For several successive years it has been possible to raise the standard of selection, and every effort has been made to prevent this from resulting solely in a progressively higher margin of marks and test scores. While the margin of academic achievement has risen markedly, our selection has also emphasized the search for students of outstanding personal qualifications. Evidence of leadership, originality, imagination, breadth of interest, and ability to work effectively with others is especially sought in reviewing the credentials of applicants. The reputation of the Institute must rest upon the social effectiveness of its graduates, and the broad objectives of our selection are to maximize the number of alumni who will make an impress on the life of their times. Statistical studies initiated by Richard W. Willard, now in progress, seek to relate our selection processes to the requirements of our several undergraduate curricula; we hope that the results will contribute to the attainment of our objectives.

More important, however, than the limited amount of selection which we can exercise is the pre-selection which occurs among the potential freshmen who consider M.I.T. among many institutions which they might attend. The caliber of our student body depends much more on attracting the ablest possible group of candidates than on the limited weeding-out operations we can carry on.

We are in some kind of contact each year with about 18,000 potential freshmen who receive our literature and are able to form some idea of what M.I.T. has to offer. Of these, about 900 enter. We refuse 1,300, of whom perhaps half would not have entered even if accepted (based on our experience with those actually admitted). Out of 18,000, then, we have in reality excluded only 650, while over 16,000 have refused us.

It is consequently of the first importance that we press forward actively with the various measures which bring M.I.T.

to the attention of promising candidates and which increase understanding of our work and aims among those responsible for counseling secondary school students. In addition to our program of publications, these measures are chiefly three: the school visiting program, the work of alumni on the M.I.T. Educational Council, and the annual guidance conference for school personnel.

The program of visits to secondary schools has continued as before, with thirty members of the faculty and administrative staff participating as well as six members of the admissions staff. They visited 719 high and preparatory schools and talked in small groups with 8,853 students. We were also invited to participate in more than 200 high school "college conferences." Of these, 132 were attended by alumni members of the Educational Council, who saw 1,863 students as well as numerous parents. The energy and enthusiasm of the school visiting group has made a very great contribution to the progress of M.I.T. and also to the educational welfare of youth. The following (in addition to the admissions staff) have participated in the program during the past year: Professors E. Eugene Allmendinger, Holt Ashley, Elery F. Buckley, W. Van Alan Clark, Jr., William H. Dennen, Peter S. Eagleson, Robley D. Evans, Daniel F. Fairbanks, Roland B. Greeley, Robert A. Hard, Donald R. F. Harleman, Delbar P. Keily, Erik L. Möllo-Christensen, S. Curtis Powell, James B. Reswick, Lockhart B. Rogers, Richard C. Sanborn, Miguel A. Santalo, William M. Siebert, H. Stephen Spacil, Kenneth R. Wadleigh, David F. Waugh, John S. Waugh, William A. Wilson, and Herbert H. Woodson; also Robert M. Briber, Walter L. Milne, John W. Sheetz III, Bernard P. Spring, and Warren D. Wells.

During the year the Admissions Office referred 5,227 students to alumni members of the Educational Council in their respective areas; of these 2,818 had a serious enough interest to look up a member of the Council for a personal conference, a report of which was forwarded to this office where it formed a part of the background information available in connection with the selection process. In addition, 1,374 interviews were held and recorded in the Admissions Office. Fuller details of Educational Council operations are included in the report of its Executive Secretary.

OTHER ACTIVITIES

The student guide service, operating in the Admissions Office under the direction of Eugene P. Chamberlain, employed twenty students and escorted a total of 4,150 visitors on tours of the campus during the year.

Freshmen who entered a year ago, after taking courses of freshman college grade in secondary schools followed by the Advanced Placement Tests of the College Entrance Examination Board, numbered fifty; of these, sixteen received freshman credit in one or more subjects here. This program for exceptional students, now entering its fourth year, continues to grow in the extent of participation by secondary schools and of recognition by colleges. Last year 104 schools gave advanced courses to 1,229 students entering 138 colleges.

In October, 1956, we held a two-day secondary school guidance conference on the campus. This was attended by 81 school guidance counselors from 26 states, representing schools of many types. The program, planned and carried out by Professor Paul M. Chalmers and Mr. Chamberlain, gave the participants first-hand acquaintance with M.I.T.'s educational objectives and also permitted extensive discussion of mutual problems of guidance, selection, and admission. Participants from the M.I.T. faculty and staff totaled 44. Two leading ideas guided the conference plans: first, we sought to include people in the schools who were on the actual firing line of college guidance counseling, rather than the principals and headmasters, whose connection with these activities may be only nominal; and second, we allowed ample time for discussion in small groups in order to encourage participation by our visitors. We felt a genuine interchange of ideas to be of first importance, rather than merely an exposure of the conferees to the M.I.T. story. The conference was well received, and it will be repeated this year on a somewhat larger scale.

Professor David A. Dudley, Associate Director of Admissions, has been granted leave of absence for one year from July 1, 1957, to join the staff of the College Entrance Examination Board as Director of the Advanced Placement Program, mentioned above. Richard W. Willard was appointed Statistical Analyst on March 1, 1957, and Willard W. Dickerson, Jr., was appointed Assistant to the Director of Admissions on August 15, 1957.

B. ALDEN THRESHER

ADVISER TO FOREIGN STUDENTS

For the term beginning in September, 1957, requests for admission were received from 2,536 foreign students in nearly every country of the world. After correspondence had established a real interest on the part of the inquirer, 866 of these filed complete application material on which some action was taken. Of these, 342 were granted admission. However, there was a considerable shrinkage in this number before the term opened. Some graduate students had more attractive scholarship offers than ours, and some students were unable to find the funds they had hoped for. About 260 foreign students (exclusive of Canadians) registered for the first time at M.I.T. in September, 1957. Of these, 50 were entering freshmen, 40 were undergraduate students with advanced standing, and 170 were graduate students.

The total foreign student population at M.I.T. in 1956–57 was 677, representing sixty-six different countries. They formed 11.3 per cent of the M.I.T. student body, again placing M.I.T. first in the country in the percentage of foreign students enrolled.

This office made a study, during the academic year 1955–56, of the sources of financial support for our foreign students. It is a common misconception that most foreign students in the United States are here on some kind of planned scholarship scheme. On the contrary, as will be seen by the following table, the majority are paying their own way.

The Major Source of Support of Foreign Students Registered at M.I.T., 1955–1956

	Undergraduate	*Graduate*	*Total*
Own money	238	105	343
M.I.T. source			
Scholarship	3	14	17
Assistantship		173	173
Government scholarship			
Own government	19	61	80
U.S. government		15	15
Private organization			
Own country	3	14	17
In U.S.	2	7	9
	265	**389**	**654**

Especially significant is the large number of foreign graduate students (173 of a total of 389) who are supporting them-

selves by working part-time as teaching or research assistants. Most of these are in their second or later years of attendance at M.I.T. Because of the severe competition for assistantships, it is difficult for foreign students to qualify for them before admission to the Institute. Most of these 173 students have come to M.I.T. on their own funds or on a one-year scholarship from a governmental or foundation source; having made an outstanding record, they have then qualified for an assistantship and have been able to support themselves for the remainder of their stay at the Institute.

The Hungarian Revolution had a considerable impact on the American university world, since a large number of its refugees were young people still in their student days. Many private foundations and religious service organizations initiated programs to help these students continue their college education. The lead was taken by President Eisenhower, who appointed Mr. Tracy Voorhees to coordinate private efforts.

During the first six months of 1957, this office received applications from eighty-eight Hungarian refugee students. Since each of these refugees was completely destitute, the application in each instance was not only for admission but also for complete financial support. Thirteen of these students have been admitted to M.I.T. for the academic year beginning in September, 1957. Six are graduate students who have been granted both admission and assistantships and who will thus be supporting themselves with part-time jobs. One is a graduate student who was placed with a local engineering firm in a job from which he will be released for part-time study. Another is an undergraduate who has been awarded a tuition scholarship by M.I.T. and is being helped by an M.I.T. professor. Still another is an undergraduate who is being supported by a local church.

Four of these students will be supported for the next two years by a scholarship program initiated by a group of M.I.T. undergraduate students. An *ad hoc* committee was formed under the leadership of John D. Holmfeld '57; living groups were solicited and funds raised. Three fraternities, Lambda Chi Alpha, Phi Beta Epsilon, and Phi Gamma Delta, each offered to provide housing and board for one student. The Alfred P. Sloan Foundation, Inc., generously offered to match the student effort to the amount of $4,000, and the

Institute administration agreed to find funds to pay tuition fees for these four students for two academic years. Four refugee students, who left their engineering studies at about the third-year level, have been chosen; it is expected that they can earn their bachelor's degrees in two academic years at M.I.T.

The Foreign Student Summer Project, after nine years of successful operation, was discontinued with the program of 1956. This decision was taken by the student committee and Faculty Advisory Committee with great reluctance, since the programs had been of great value to the participants themselves, and the initials F.S.S.P. were linked very favorably with those of M.I.T. in many countries around the world. The chief reason for the decision to discontinue was the changing nature of the M.I.T. Summer Session. The facilities of the Institute have been used increasingly each summer to serve representatives of American industry with short, intensive courses rather than to teach academic subjects to students. Thus it became increasingly difficult to find useful activities for F.S.S.P. participants. Great credit is due to those succeeding generations of undergraduate students who have given devoted leadership to F.S.S.P.; and these student leaders have in turn often acknowledged the enlightened generosity of the Sloan Foundation, which has been for years the major source of support for F.S.S.P.

Mrs. Houlder Hudgins has replaced Mrs. Norman J. Padelford as chairman of the Foreign Students Committee of the Technology Matrons. Mrs. Padelford brought an imaginative leadership to this important activity. She was largely responsible, with Mrs. Howard F. Taylor, for developing the service which helps newly arrived married students from abroad to find suitable housing. Over forty couples were helped in this way last year.

Professor David A. Dudley, Fulbright Adviser at M.I.T., reports that twenty-two M.I.T. students, an unusually large number, have been granted Fulbright Awards for study abroad next year. They will be going to Australia, England, Finland, France, Germany, Italy, the Netherlands, and Scotland. During Professor Dudley's year of absence from M.I.T., the Fulbright Adviser will be Professor Philip Franklin of the Department of Mathematics.

In addition to the Fulbright scholarships, two other outstanding awards were granted this spring to M.I.T. seniors for study abroad. Alar Toomre '57 of Hempstead, New York, received one of the twelve Marshall scholarships and will study next year at the University of Manchester, England. Benson T. Chertok '57 of Laconia, New Hampshire, will study next year at the University of Gottingen through a scholarship granted by the government of the German Federal Republic "in gratitude for the post-war help granted by the U.S.A. for the reconstruction of German economy."

Beginning in the fall of 1957, two members of the Admissions Office staff, Eugene R. Chamberlain and J. Peter Anderson, will assist the Adviser to Foreign Students in admitting and counselling foreign students. Both will assume the title of Associate Adviser to Foreign Students. Last April Mr. Chamberlain attended the annual meeting of the National Association of Foreign Student Advisers in Albuquerque, New Mexico.

The undersigned continues as a consultant to the Commission on Education and International Affairs of the American Council on Education. He has also been appointed to the Advisory Committee on Policy of the Washington International Center.

PAUL M. CHALMERS

DIRECTOR OF THE DIVISION OF SPONSORED RESEARCH

This constitutes a report of the first year's activities of the Division of Sponsored Research, which resulted from the consolidation in September, 1956, of the Division of Industrial Cooperation and the Division of Defense Laboratories. Simultaneously with the establishment of this Division, a number of administrative changes occurred.

Mr. Harvey Burstein joined the staff and has been devoting his entire effort to the problems of security and plant protection, working closely with many of the Institute's administrative staff in a variety of areas as well as handling the many activities concerned with security under classified projects. A training program was instituted for the Security

Guards and was successfully carried to completion, each man receiving instruction in seventeen subjects.

The Patent Section was strengthened and reorganized and has made great progress during the past year in completing the many commitments which the Institute has under its research contracts. Considerable headway has been made in clearing up many complex patent problems associated with the terminated contracts.

A survey of research salaries was conducted under the direction of Mr. Thomas W. Harrington, Jr., with the complete cooperation of twenty-one industrial and educational organizations engaged in the fields of research and development. The data collected proved of significant value to the Institute in establishing salary schedules for its professional personnel; we also supplied the participating companies with research salary information which they have found extremely useful. The success of the survey was such that it will be repeated during the fall of 1957.

Tabulated below are comparative volume figures for the fiscal years 1956–57, as well as information concerning the personnel employed on the various programs of sponsored research. The figures presented for the campus laboratories are comparable with those previously reported for the Division of Industrial Cooperation. In analyzing statistical information as presented for the defense laboratories, direct comparisons may be made with the reports for previous years for the Division of Defense Laboratories.

Research in the Campus Laboratories

Dollar Volume of Projects:

	1955–56	*1956–57*
Government	$ 9,889,980	$10,592,351
Industrial and foundations	1,771,060	1,908,326
Total	**$11,661,040**	**$12,500,677**

Personnel Employed:

	June 30, 1956	*June 30, 1957*
D.S.R. staff	317	277
Academic staff devoting time to research projects	783	805
Supporting personnel (includes part-time help)	670	635
Total	**1,770**	**1,717**

Although the dollar volume of research increased by more than 7 per cent during the fiscal year 1957, the total number of personnel employed actually decreased, and the total man hours devoted to research showed almost no change. Increasing costs of materials and rising salaries account for most of the increase in dollar volume. It is of interest to note that the participation of academic personnel and graduate students in the sponsored research programs continues to increase.

Research in the Defense Laboratories

	1955–56	*1956–57*
Dollar Volume	**$37,003,210**	**$43,069,574**
Personnel employed:	*June 30, 1956*	*June 30, 1957*
Defense research staff	922	998
M.I.T. staff	17	15
Supporting personnel	1,783	1,976
Total	**2,722**	**2,989**

The above figures clearly indicate a decided increase in the activities of these laboratories during the past year, resulting from the fact that the Institute has been asked to increase its participation in a number of defense programs.

F. L. Foster

DIRECTOR OF THE INDUSTRIAL LIAISON OFFICE

This year has been the ninth since the inception of the Industrial Liaison Program. As a vehicle for organized interchange of information between M.I.T. and selected industries, the Program continues to reflect the dynamic growth of the Institute and the ever-widening areas of technical interest on the part of participating companies. There has been an increase in the volume of activity with each company, and in addition the year has seen a record volume connected with solicitation and induction of new companies into the Program. A number of companies, mostly inactive in the Program, have been discontinued or have found it necessary to withdraw; these have been replaced by an even larger number of active, new companies. At year's end the roster stands at eighty-one companies.

The addition of a sixth staff member to the Industrial Liaison Office has made it possible to accommodate the attendant increase in over-all activity without departing from previously established policies and main procedures of operation. Generally speaking, this accommodation has continued the policy begun three years ago of streamlining our performance of the regular or "core" services for member companies, thereby leaving the professional staff of the Office with increased freedom to concentrate on special situations requiring personalized attention, and minimizing the load on the faculty. It is interesting to note that through the application of these policies the total number of visits by company representatives to faculty members arranged through the Office was held to approximately the same number as in the previous year. Furthermore, the visits were spread over a wider range of the faculty, as indicated by the fact that the number of visits with full and associate professors actually decreased by 10 per cent. Monitoring and guiding this important phase of the Liaison Program continued to occupy the major share of the Liaison Officers' attention.

The campus visitation activity resulted in a number of desirable by-products. Examples were: assistance to member companies in exploring sponsored research possibilities at the Institute, aid in locating faculty consultants, assistance to faculty members in securing needed information from industrial sources, arrangement of extended guest privileges for two member companies, and assistance to a member firm in establishing a nearby test facility.

A number of the activities of the Liaison Office have resulted in stimulation of professional interest at M.I.T., thus highlighting the two-way nature of the liaison between the faculty and their industrial counterparts. A typical example was the assembling of six faculty members of different disciplines to confer with top-caliber technical personnel of a company in an effort to elucidate a problem of major scientific importance as well as practical interest in industry. In another instance, eleven industrial representatives joined with faculty members in the Department of Mechanical Engineering to judge machine design projects submitted by undergraduate students.

One of the core activities of the Liaison Program consists of the forwarding of manuscript preprints, technical and

progress reports, and other special research literature. This work has proceeded under improved systems for screening and distribution. With the accent on selectivity and timeliness, some five hundred different publications were placed in the hands of company representatives. Certain reprinted material was replaced with fewer but more pertinent articles printed in advance of general publication. Economics of operation initiated three years ago have borne fruit in the easier handling of the Institute's enlarged publications output. The growth tendency of publications activity appears strong in spite of efforts to keep it in check. For example, for the past three years, the number of individuals on the regular mailing list has grown at a steady average rate of thirty-three per year. This may be attributed primarily to a proliferation of mailing points in the various companies, reflecting the trend toward more emphasis on research, combined with the general trend toward decentralization.

Member companies again expressed a strong interest in the series of private symposia offered especially for company representatives. Eleven symposia of one to two days' duration were held with an average attendance of fifty-one persons. Seventy-two companies participated in these meetings, sending a total of 567 representatives.

These symposia were especially fruitful in bringing together unusual combinations of faculty and industrial research interests. Notable examples included a symposium on the electrostatics of spark hazards, a meeting in which current research in M.I.T.'s High Voltage Engineering Laboratory was combined with recent industrial experience in considering spark hazards common to many chemical engineering operations. In another symposium, faculty members in the Department of Mechanical Engineering teamed up with company representatives to consider heat transfer phenomena in electronic equipment. In still another, the Departments of Aeronautical, Chemical, Electrical, and Mechanical Engineering were represented by M.I.T. staff members who presented papers devoted to the interpretation of dynamic measurements.

A feature of the Liaison Program that is much appreciated by the participating companies is that of encouraging M.I.T. personnel to visit the companies. Records show that

during the year twenty faculty members made some twenty-seven visits to companies at their respective laboratory locations on behalf of the Liaison Program. Included in these visits was an extended tour during which the activities of the Alumni Placement Bureau were presented by Mrs. Evelyn B. Yates, the Institute's Associate Placement Officer. The above visit activity was supplemented by at least one visit during the year to each company by a Liaison Officer, representing the first time such a complete coverage has been achieved.

Robert D. Haberstroh joined the staff as Industrial Liaison Officer at the beginning of the year to replace John O. Outwater, who resigned in order to assume the chairmanship of the Department of Mechanical Engineering at the University of Vermont. Lamar Washington, Jr. was similarly appointed on November 1 to replace Harold R. Lawrence, who resigned in order to accept administrative duties with the President's Board of Consultants on Foreign Intelligence Activities, in Washington. The other Industrial Liaison Officers serving throughout the year have been Merrill J. Baumann, who joined the staff in March, 1956, Ralph L. Wentworth, and Vincent A. Fulmer. Mr. Fulmer was appointed Assistant Director at the start of the year. Starting July 1, 1956, William R. Weems resumed his post as Director of the Office, following a leave of absence to assist in an educational rehabilitation project in Korea.

WILLIAM R. WEEMS

DIRECTOR OF LIBRARIES

Most of the changes in policy, operation, and planning in the libraries during 1956–57 reflect the larger numbers who have borrowed books and used the reading rooms. There have been improvements in staff salaries and plant, but for the most part the remedies of today have had to cope with the needs of yesterday rather than those of tomorrow. Long-term planning for better services indicates a need for larger library endowment funds.

Except for the School of Industrial Management, there has been no recent sizable increase in numbers of students and staff at the Institute. Some of the extra pressure of numbers comes from industrial and government laboratories in the

area; some of the increased Science Library activity seems to reflect a greater emphasis on science subjects in engineering curricula. As to the rest, the only conclusion is that the literature is in greater use.

SCIENCE LIBRARY

The Science Library has for some years been the busiest of all our libraries. This year a full-time man was provided to put books back on the shelves and keep the tables clear. A half-time librarian was engaged for evenings and Saturday mornings, thus for the first time giving professional library service at those periods. Still more important, Ryburn M. Ross was appointed Executive Officer to take charge of the reading room and circulation desk and to cooperate with the Departments of Chemistry and Chemical Engineering in buying materials for those fields and for nuclear engineering. Miss Marguerite Chamberlain is now relieved of administrative detail and is able to devote herself to the improvement of the collections, especially in math and physics.

The number of books borrowed from the Science Library desk increased from 42,461 in 1955–56 to 44,195 in 1956–57. The staff believes that there has been a proportionate increase in the number of people using the room for periodical and other reading. No figures have ever been collected for the number of people actually going in and out of the room, but such data would be valuable. To learn these figures for all the libraries, we plan to use a photoelectric counter next year.

During the daytime hours it frequently happens that every chair in the Science Library is occupied. More seating is needed, and fortunately there is some unused floor space. The Faculty Executive Committee has suggested that the tables and chairs of the Reserve Book Room, which match those of the Science and General and Humanities Libraries, be moved to the south wing to add to the capacity there, and that new furniture be provided for the north-wing reading room. Some such step is urgent. There are no window sills which could be used as additional seats.

It was mentioned in last year's report that the stacks in the basement might be opened to students and staff and take some of the pressure off the Science Library. This project has been studied and is considered feasible, but new lighting and study desks need to be installed. In addition, a part of

the stacks containing material awaiting processing, duplicates, and items stored for Dewey and other libraries would have to be separated from the public space by grill work. Funds will be requested in the coming year for this move.

OTHER FACILITIES

The Engineering Library Advisory Committee studied the Farmington Plan during the year and made recommendations for revising the commitments which now force us to buy material of which fifty per cent is worthless to us. Suggestions for changes have been forwarded to the headquarters of the Plan. The Committee has also suggested rearranging and augmenting the R.C.A.-Clark Collection to take full advantage of its wealth of historical material on radio.

Engineering Library book circulation has remained essentially the same; but thesis and periodical use in that library show a drop this year, reflecting the new restrictions on borrowing which went into effect in January. The heavy demand for these two categories of material persuaded the Engineering Library Advisory Committee, in fairness to all, to allow only staff members with the rank of Assistant Professor and above to borrow theses without special permission, and to limit all major periodicals to overnight loan.

Crowding has now become acute at the Dewey Library. Growth in the number of graduate students in the Department of Economics and in the School of Industrial Management has stepped up demands for library services, since their programs require an intensive use of the library. The enrollment was 150 in 1955–56, 201 in 1956–57, and will be as much as 250 in 1957–58. The number of books borrowed for home use has gone up from 26,202 in 1955–56 to 33,909 this year. Reserve books used in the room have increased from 11,572 last year to 21,412 this year. This represents a 46.4 per cent increase of clerical operations on the part of the staff in Dewey, where — in contrast to the Science Library — no increase has been made to the personnel. No more have been added simply because there is no more work space. Space cannot be taken from the reading room, where more chairs, tables, and book shelves are urgently needed. More space and more staff are an immediate necessity to permit the maintenance of good library service, as the School of Industrial Management

continues to grow. The Dewey Advisory Committee is working on plans for the future.

An increase in the size of the Music Library would be desirable also. Professor Klaus Liepmann, Director of Music, feels that more provision should be made for music study by groups and individuals by adding another music seminar room, more small listening rooms, and more shelving for records, scores, and books. The record storage space was designed to hold four thousand records and is now almost full. The Music Library is popular with the whole Institute community. Its facilities are in constant and heavy use. Of all the libraries, this is the one which attracts the most admiring comment from visitors. An occasional musician is offended by the fact that students and others sometimes read books or even newspapers while listening; but, as one said, it is possible that some will come to music in this way who would not come any other way.

The Aeronautical Engineering Library has had a 17.2 per cent increase in activity this year, attributable partly to student borrowers and partly to D.S.R. staff. Here, as elsewhere, there was more borrowing from outside the Institute. An extension of the hours and a small increase in staff have been provided.

As the year ends, the most serious problem of the Rotch Library — shortage of shelving — is about to be solved. Money has been appropriated for stacks to fill the space originally provided in the northeast corner of the room, while another overdue improvement is under way: the replacement of inadequate lighting by modern fluorescent fixtures. One new person has been added to the staff to aid in arranging and cataloging the collection of slides, which has been so enlarged by gifts in recent years as to become difficult to use.

The Reserve Book Room in the north wing of the Hayden building has now been converted into an excellent library space. In the summer of 1956, a partition was erected to provide a corridor along the south wall, so that the room itself is no longer used as a passageway. Now seats in the Reserve Book Room are in great demand. It is a pleasant, convenient place to study but overcrowded most of the day and evening.

It is sometimes suggested that the Institute provide study halls for commuters, but this is not an ideal solution. A

library will always be the most convenient place to study. The student who is studying mathematics now may soon want to go to the desk for a required-reading book for humanities or biology. When a new Student Center is built, it should include a library where copies of reserve books for undergraduate subjects, general reference works, and some recreational reading will be available. The room should be large enough for use as a study hall as well.

Part of the third floor of the Hayden building has been returned to use as library studies, now that the American Academy of Arts and Sciences, which for two years occupied six bays on the third floor, has moved to its new home in Jamaica Plain. A letter to the faculty announcing the availability of fourteen studies for the summer and subsequent terms brought thirty-one requests. This demand indicates the desirability of keeping the studies free to be assigned on a semester-to-semester basis to faculty members who need a place in the library to work with the literature of their field.

MISSING BOOKS

Last year the acute problem of missing books — items taken from the libraries without being signed for — was reported in some detail. The situation had become so serious that this year the Engineering and Science Library Committees recommended, and the Faculty Executive Committee on the Library voted, to station book checkers at the exits of the two libraries, starting in the second semester. The first reports indicate a decline in the number of books missing, though there are a few cases of whole articles being cut out of journals in the Engineering Library. This damage will be partly repaired by procuring and inserting photostats of the missing pages.

The inconvenience to library users of having to present all books to checkers at the door has had compensating advantages. Numbers of reference books which previously had to be locked up so that they would not disappear have been put on open shelves. Also, the checkers are constantly called on to answer questions and give directions; the librarians thus have fewer interruptions and are able to provide better service.

ACCESSIONS AND CATALOGING

While library service departments of course feel the impact of increased use of the system, the Accessions Department had

a decrease in items bought this year. The number of purchases has fallen in the last three years from 33,942 in 1954–55 to 31,864 in 1955–56 and to 31,541 in 1956–57. These figures reflect the drop in the purchasing power of the dollar, as book appropriations have remained substantially constant. Great care has been used in the selection of items for purchase, but the appropriations of several departments were exhausted by April 1. Whatever increased money has been available in the library budget in recent years has been put into salaries, in an attempt to bring them up to a level comparable with salaries in other libraries in the region. This has been accomplished, but book and periodical budgets have fallen far behind; they will be increased next year.

The numerous other duties of the Accessions Department more than made up for the smaller number of books purchased. The Department handles student payroll, fine money for lost books, payments for microfilm and photoprint copies, and individual gift volumes. It keeps statistics and does the accounting for the whole library system, providing monthly statements to library heads and departmental library representatives. It acquires each year an extraordinary number of reports, monographs, and the like put out by individual organizations and laboratories. Since much new research first appears in this form, we must have this literature; but it presents as-yet-unsolved problems in handling. We, like other technical libraries in the country, are having to develop special procedures and hire special personnel to deal with it.

Another recent development is the annually larger number of requests for exchanges coming from universities, academies, and laboratories in distant countries. These groups have no dollars but would like us to send our scientific publications in return for theirs. We want to cooperate and have entered into many such arrangements, but the Accessions Department, which would normally handle them, is unable to take on this additional load. These exchanges are being handled in the Director's Office for the present.

Gifts form a valuable supplement to the books we are able to purchase. This year, for example, we were particularly fortunate to receive from the Academy of Sciences of the U.S.S.R. in Moscow a subscription to the fine *Referativnyi Zhurnal*, an abstract journal which gives world coverage to nine fields of science and engineering. Other gifts have come

singly from authors, publishers, and friends, and sometimes in lots from alumni, staff members, and others. A good number have come from bequests. We regret that it is not possible to list all those who have given us books, but an acknowledgement has been sent in each case. For these gifts the library is grateful.

The drop in the number of items purchased this year has brought an accompanying drop in titles cataloged:10,706 in 1955–56, 9,674 in 1956–57. This reduction in routine work was fortunate, for it permitted two new projects to be undertaken by the Catalog Department. The first, to which one cataloger was assigned half-time throughout the year, was the recataloging of the scores, records, and books of the Music Library. The second project was larger, requiring the work of the Head Cataloger and five others for several months. At the same time it promises a high return in service to the M.I.T. community and to the growing number of industrial and government libraries of the Boston area which use our facilities. It is the recording on I.B.M. cards of information, including location and completeness of our holdings, on all the journals and serials currently received at any one of our libraries.

As of the end of the year we are receiving 7,396 journals and serials. New subscriptions are constantly being added; journals change their names or cease publication; collections have to be moved from time to time within the libraries. In fact, 1,392 additions and corrections had to be made during the year. The Catalog Department has been able to keep one list at the main catalog up to date, but additional copies of the list are needed, for the Reference and Information desk and for each of the other libraries. Some years ago five photographic copies of the list were made at a cost of $700. The figure would be higher today and can hardly be justified since the copies quickly go out of date. It has not been possible to provide the labor to correct them manually. With the entire list on I.B.M. cards, the set can be run through a printer at any time at less than a tenth of the cost of photography. The list will be reprinted periodically and copies furnished to all our libraries, to the document rooms of the laboratories, and to several industrial firms which have asked for them. More requests undoubtedly will come. We hope that these lists will save many telephone calls to the Reference Department

from inside and outside the Institute. Incidentally, although a few large-scale cataloging projects have been done on punched cards, this is the only one, to our knowledge, where economy and convenience have led to a relatively small-scale application within one library.

OTHER SERVICES

The Periodicals and Binding Department bound approximately the same number of volumes this year as last, reflecting again the drop in the number of items purchased. But 64 new subscriptions to journals were added, bringing our current total to 2,920. We now have 57 Russian periodicals, 9 in English translation, as opposed to 21 Russian journals two years ago, 2 in translation. In the future, we shall try to improve further our coverage of Russian technical journals and also to obtain the principal journals from other iron-curtain countries. It is now well recognized in this country that the quality of Russian research is high, that the Russians are well informed about our work, and that it behooves us to be informed of theirs. Since few of our staff read Russian, we are eager to add more English translations to our collections. To this end, the library is cooperating with the Research Laboratory of Electronics in a project to provide English translations of three Russian electronics journals. An application has been made to the National Science Foundation for funds.

The Reference Department provides answers to a great variety of questions, both technical and general, and gives assistance to anyone who may wish to use the facilities of our library or obtain materials from other libraries on interlibrary loan. Last year a 46.2 per cent increase in queries was reported by the Reference Department. A further 10.3 per cent this year brings the total number of inquiries at the desk, over the telephone, and by mail to 12,603. Practically all mail requests (1,130) were from outside the Institute. Almost half the telephone calls were from outside (3,354 as against 3,623 from M.I.T.); and even at the desk 10.5 per cent (480) of the inquiries were from outsiders, while 4,096 were made by M.I.T. people in person.

The Microreproduction Service kept pace with general increases. Production of microfilm increased 20 per cent over last year. Paper prints from microfilm are up 50 per cent,

but the latter figure includes a large, nonrecurring order for a special project. Without it, the rise is 41 per cent. Of these increases, more than half reflect services to organizations outside M.I.T.

The Microreproduction Service is intended to operate without profit or loss. This year a favorable balance will permit the purchase of overdue new equipment; but if the present rate of activity continues, consideration can be given to a decrease in charges or the provision of additional services. One such service might be the microfilming of all graduate theses immediately upon deposit in the library. This would permit them to be consulted during the first month or so, a time when there is a high demand which cannot now be met, as they have to be bound before they can circulate. Microfilm copies could then be supplied to libraries and laboratories immediately. Furthermore, the microfilm could be stored permanently in the archives. The drawbacks to large-scale microfilming have been expense, doubts as to the permanency of microfilm, and inconvenience of reading microfilm; even now storage must be under controlled conditions, quality standards leave something to be desired (our Microreproduction Service is working on improved tests), and viewers are clumsy and expensive. Still, the day will come when pressure for space will force this library, like others, to consider disposing of original material and keeping only microfilm or some other compact copy.

Some universities which microfilm all theses assess the cost against the students. Others pay for it from general funds. Were we to undertake the microfilming of graduate theses out of profits of the Microreproduction Service, we would spread the cost over the users of the Service but would not raise prices inordinately. The possibility will be given further consideration.

In addition to its film work, the Microreproduction Service does printing for the libraries. It produces lists of new books, notices, and the like — for example, leaflets were printed to explain the layout and use of the Engineering and Music Libraries this year.

As the use of the libraries becomes more intensive, the rate of deterioration of the furnishings increases. The interiors of the Hayden building and the Dewey Library as well as the new chairs in engineering are modern, emphasizing fabrics

and light colors. Durability has not always been a consideration in planning, nor has ease of maintenance. The finish applied to tables, chairs, and counters in the Hayden building was attractive when new; but it has now completely disappeared, leaving raw wood which soaks up ink and dirt. There is no program for cleaning and repairing fabrics early. To preserve the good appearance of the libraries, a regular policy of preventive maintenance and repair needs to be started at once.

PERSONNEL

This year saw the promotion of Miss Natalie N. Nicholson from Reference Librarian to Executive Assistant to the Director, and the appointment of Ryburn M. Ross, as already mentioned, to the position of Executive Officer of the Science Library. Miss Irma Johnson became Acting Reference Librarian. On September 1, Peter Scott was promoted to staff and Shaela Netzel replaced Stanley Altman, who resigned. Miss Eileen Kibrick was promoted to staff on July 1 and then, after the resignation of George Halpern on January 1, replaced him as Life Science Librarian. On June 13, Miss Arlene Kupis became Assistant Engineering Librarian after an absence of one year spent at library school. There were numerous changes in the nonprofessional staff of the library, but with the active assistance of the Personnel Office we were able most of the time to keep a full complement.

A generous increase in budgetary provisions this year has allowed the addition of several new people, substantial increases in salaries, and improvements in the physical layout of the libraries. These have helped offset the increased user load, but the curve shows no tendency to flatten out. While meeting current pressures for books and services, reorganized faculty library committees have been planning ahead. Effective library service for the future will require libraries strategically located to match such shifts in Institute population as the removal of undergraduates to West Campus. We must also have more thorough coverage of the world's technical literature, in order to be prepared with background material as teaching and research interests change.

It is unfortunate that rising costs each year mean a heavier drain on Institute general funds. Even heavily endowed libraries have this problem in times of inflation; but the burden

is particularly acute at the Institute, where the income from endowment is so small in proportion to the cost of library services. It would therefore seem that, at some appropriate date, a campaign for endowment funds for the library should be undertaken, either alone or in conjunction with a larger fund-raising effort.

WILLIAM N. LOCKE

DIRECTOR OF PUBLIC RELATIONS

With the retirement on July 1 of John James Rowlands, first Director of the News Service and for many years the Institute's sole public relations officer, this office lost the services of a wise and loyal colleague. During his thirty-two years at M.I.T., Mr. Rowlands set high standards in interpreting the aims and accomplishments of the Institute to the press and the general public. We shall seek to maintain the standards he set.

Two new responsibilities were assumed during the past year. One was for M.I.T.'s participation in the educational television and radio activities of WGBH. Volta Torrey joined our staff as Director of Television and has not only developed worthwhile programs but has proved himself an able performer as "The Science Reporter." Faculty members have contributed generously of their time to this program and to others such as "Brain Ticklers," "Weather for You," and "Film Critic," the latter a new program undertaken at the end of the year by Dr. Norman N. Holland.

A year of experimentation with television and films has given indications of directions which we should take. We have abandoned the effort for technical staff work on television and films, although one motion picture, "A Bell for M.I.T.," was completed. In the future we expect to concentrate on the development of material for television programs, both educational and commercial, including series for national distribution.

The other new responsibility is the publication of a semimonthly news bulletin, *Tech Talk*, for the seven thousand people of the M.I.T. community. As editor, Miss Margaret Richardson has created an informal and informative publication which, we believe, contributes to better communication within the Institute.

OFFICE OF PUBLICATIONS

Distinction in design continues to be characteristic of M.I.T. publications. Nine examples of work by Miss Muriel Cooper and Miss Jacqueline Shepard were chosen by a jury for inclusion in the 1956 exhibition of the Art Directors' Club of Boston, and Miss Cooper was awarded a medal and a certificate in recognition of the excellence of her work as a designer. She will study in Italy during the coming year under a Fulbright grant.

Quality in publications has been maintained in spite of increased demands upon the Office of Publications for design and editorial work, and this is evidence of excellent management by John I. Mattill, Director. Complete revision of the General Catalogue and the Treasurer's Report was accomplished, new editions of several other publications were issued, and a number of special brochures and booklets were published. It would be difficult to place a value on work done by the staff, but the volume is indicated by the fact that printing costs totaled more than $110,000.

The work of the student-operated mailing room has expanded rapidly; it now serves a number of M.I.T. offices and this year will pay more than $4,000 in wages to students.

FRANCIS E. WYLIE

DIRECTOR OF THE REGISTRY OF GUESTS

During the academic year 1956–57, the Registry of Guests has received eight hundred visitors on behalf of the Institute and arranged academic hospitality for them. Introduced by United States government agencies, by embassies or other agencies of foreign governments, by industrial interests abroad or by their American affiliates and, rarely, without any sponsorship, there have been ambassadors, ministers and other foreign government officials, educators, industrialists, and professional personnel. Their stated objectives have made it possible to arrange in advance suitable appointments with appropriate members of our staff.

The friendly response of faculty members to these visitors has been a significant factor in spreading the Institute's reputation as a place where experts freely share their technical knowledge with visiting colleagues.

The number of scholars who have extended their visits for observation and study under Corporation appointments without payment of fees or receipt of compensation has increased over the previous year by more than one-third. These visiting scholars have provided a cadre from which the School for Advanced Study has been able to select many of its Fellows — a process which, beginning in the academic year 1957–58, will have evolved into initial appointments by that School.

Such problems of Visiting Fellows as change of visa, taxation, eligibility for employment with compensation, and even weddings between aliens from antipodal regions of the world have been resolved with satisfaction to all concerned, largely through sympathetic interpretations of regulations by understanding officials of government agencies, who have come to trust the good faith of M.I.T. in such matters.

At the completion of its first five years on June 30, 1957, the Registry of Guests passes into the capable hands of Professor Thomas H. D. Mahoney. The friendships it has made for the Institute are due in large measure to the sympathetic and wise services of its Executive Secretary, Anne Barrows, to whom the faculty and the administrative officers of the Institute acknowledge a great debt of gratitude.

During the past year we have received visits from 830 citizens of 47 countries, classified as follows:

Guests of the Institute	35
Visiting Fellows	90
Visitors	607
Visiting Professors, Lecturers, etc.	98
Total	830

JOHN W. M. BUNKER

DIRECTOR OF THE SUMMER SESSION

The 1957 Summer Session saw no change from the activities of the recent past; its principal components consisted of (1) a series of Special Programs, (2) professional conferences or symposia, and (3) a limited number of regular subjects for M.I.T. graduate and undergraduate students.

SPECIAL SUMMER PROGRAMS

Eight years ago the Institute initiated a short series of special courses designed for professional men and women in business, industry, and government. From a modest beginning, this activity has developed into the major feature of the summer operation. Each program aims to present, in the short space of one or two weeks, a significant amount of material in one professional area, of benefit to people already established in that field or a related one. Each school in the Institute participates, as indicated by these figures showing the number of programs in the 1957 Summer Session:

Architecture and City Planning	2
Engineering	21
Humanities and Social Studies	2
Industrial Management	3
Science	5

In some instances a program was conducted by faculty members of two different departments.

The total registration in the thirty-three programs of the 1957 Summer Session was 2,000, compared with a registration of 2,698 in thirty-eight programs in 1956 and 1,717 in thirty programs in 1955. These figures indicate the widespread acceptance of this specialized type of education. The 2,000 registrants were drawn from 2,598 applicants.

The popularity and the need for this training can be illustrated by the program on Technique of Infrared Spectroscopy, which has been offered under the direction of Professor Richard C. Lord every year for the past eight years. Despite the repetition, 117 men and women applied this year; from this number, 60 were admitted — the maximum number that could be accepted. Every registrant held a bachelor's degree, and 10 of the 60 held doctor's degrees, thereby illustrating that the program continues to attract well-qualified people. Other repeat programs also continue to be very popular.

A typical registrant in a summer program is a man, thirty-six years of age, who holds at least a bachelor's degree. The chances are two out of three that he is employed by a company, rather than by a government agency or educational

institution, and four out of five that he is located east of the Mississippi River. It is to be noted here that a substantial number of registrants (416 in 1957) travel from the western part of the United States or from foreign countries to attend these one- and two-week sessions. In view of their short stay at the Institute, special efforts are made to make the registrants feel at home. Dinners and outings make it possible for them to become better acquainted with their fellow students and with our staff. The Summer Session Office provides recreational literature and travel information for registrants and their families, and all are acquainted on arrival with such M.I.T. facilities open to them as the sailing pavilion, the swimming pool, and the Faculty Club.

This unusual educational undertaking developed rapidly because of the need of those outside M.I.T. for this type of training. At the same time the Institute has benefited in various ways; not the least important is the stimulation which our staff receives through working with a group of men and women professionally active in industry and government. Almost without question the M.I.T. staff member is enthusiastic about his association with a special summer program.

An unusual feature this year was the presentation of a summer-type program from March 25 to April 3. At the urging of the Aircraft Industries Association, Professor J. Francis Reintjes and staff members of the Servomechanisms Laboratory in the Department of Electrical Engineering conducted a course entitled Programming for Numerically Controlled Machine Tools. Here was another example of a program which attracted more qualified engineers than we could accept.

The Science Teacher's Program was not listed in the preceding statistics because it is a distinctly different course of instruction. An evaluation of the programs of recent summers led to the adoption of a new plan this year. Twenty-four high school science teachers were selected by the Institute to receive $800 scholarships provided by the Westinghouse Educational Foundation for eight-week participation in one of the research activities within the School of Science. This intimate exposure of teachers to scientific research appears to be an appropriate way in which the Institute can assist the advancement of science teachers at the secondary school level.

CONFERENCES

Four professional conferences took place during the 1957 session. Professor William M. Murray conducted a conference on Crack Detection on June 13 and 14; Current Problems in Crystal Physics was held from July 3 to 6 under the direction of Professor John C. Slater; a national meeting of the Hydraulic Division of the American Society of Civil Engineers took place from August 26 to 28; and finally, the Electron Microscope Society of America conducted its national meeting from September 9 to September 12.

REGULAR INSTITUTE SUBJECTS

As indicated in the reports of previous years, there has been a steady reduction in the total offering of regular M.I.T. subjects for graduate and undergraduate students. For example, compared with the 235 subjects in 1952 there were only 80 in 1956. This year's total was substantially the same as that of 1956. Evidently the stage has now been reached where a further reduction is impossible as long as we continue to offer subjects for the undergraduate who needs to repeat a spring-term subject, to provide instruction for students in some cooperative plans, and to offer some subjects for graduate students. The total registration at the end of the first week of the summer session was 1,536, 17 fewer than the registration at the same time in 1956. Since 1954, even though the subject offering has decreased, the student enrollment has remained substantially the same. For example, in 1954 there were 1,546 students.

A substantial fraction (60 per cent) of the registrants are graduate students who are devoting most or all of their summer to research on a thesis problem.

SERIES IN THE ARTS

The success of the 1956 plan to present a series in the arts in cooperation with Harvard University led to a repetition of the program this year. Each school presented three functions. In M.I.T.'s case the events were held in Kresge Auditorium and consisted of a performance by our Choral Society, a play reading of Shaw's letters, and an organ recital. Students and faculty members of each institution were admitted to these performances without charge.

JAMES M. AUSTIN

DIRECTOR OF THE TECHNOLOGY PRESS

With an active list of about fifty titles in print, the Technology Press continues to grow. This year seven new titles were added, as follows:

Tables for the Variational Determination of Atomic Wave Functions, by Philip M. Morse and Huseyin Yilmaz. September, 1956.

An Interdisciplinary Bibliography on Nationalism, by Karl W. Deutsch. December, 1956.

Moscow and the Communist Party of India: a Study in the Post-war Evolution of International Communist Strategy, by John H. Kautsky. August, 1956.

Currents, Fields, and Particles, by Francis Bitter. September, 1956.

Science and Economic Development: New Patterns of Living, by Richard L. Meier. October, 1956.

Location and Space-Economy: A General Theory Relating to Industrial Location, Market Areas, Land Use, Trade, and Urban Structure, by Walter Isard. December, 1956.

On Human Communication: a Review, a Survey, and a Criticism, by Colin Cherry. February, 1957.

The first two of these titles are independent publications of the Technology Press. The others are joint publications with John Wiley & Sons.

Bitter's *Currents, Fields, and Particles* is a textbook that now appears in hard covers after a number of years of testing in preliminary editions. It illustrates the kind of support that the Press is prepared to offer the staff in the preparation of new educational materials. Cherry's *On Human Communication* is the introductory volume of a new series of studies in communication under the general editorship of Professors Leo L. Beranek, Roman Jakobson, and William N. Locke. Isard's *Location and Space-Economy* is also the first of a projected series in regional science.

At the end of the year, eight additional titles were in production, and ten more manuscripts were in preparation with the financial or editorial assistance of the Press.

On February 1, 1957, Professor Lynwood Bryant assumed the office of Director in order to allow Frederick G. Fassett, Jr., to devote full time to his enlarged responsibilities as Dean of Residence. Dean Fassett continues as an active member of the Technology Press Board.

LYNWOOD BRYANT

EXECUTIVE SECRETARY OF THE EDUCATIONAL COUNCIL

The Educational Council ends its sixth year with this report. Its growing pains are just about over, and stable organization — well established among alumni and among schools — is now a real possibility. An energetic and imaginative effort must continue to insure that there is no falling off of the *esprit de corps*, which is now good, and to insure that the best possible relationships exist between each Council member and his school.

From an internal point of view, the Council is a service organization, doing work for the Student Aid Office, Admissions Office, Alumni Association, and, indirectly, for the Public Relations Office. Since it aids each of these offices, it must have a relative amount of freedom to take actions which will be of the greatest benefit to all. It has had this freedom for six years, under the Secretary of the Institute, and, hopefully, it will continue to have it in the future.

The Council now stands at just over seven hundred members in 136 organized areas in almost all states and many foreign countries. Nearly five hundred of the members in this country are assigned to 1,048 high schools. These assignments to schools are among the most important functions of the Council members, for it is these relationships, cultivated over a period of years, which will make the Council a successful activity.

In the past year Council members attended 140 college nights at their high schools. These college nights are organized to direct students' attention to their future education and give them an opportunity to learn about several colleges. Council members as a whole visited their schools an average of approximately twice this past year; this indicates a good degree of attention to the schools. This must be maintained and even increased.

Equally as important is the relationship of a Council member to a prospective student. The ideal is to have a conscientious counselor who is both an official representative of M.I.T. and a local resident, one who can appraise the student in such a way as to assist the Student Aid and Admissions Offices. It is in this latter relationship that the Council members perform their most specific service and perform it

well. Although final figures are not available for this year, well over five thousand students were referred to Council members, and more than three thousand interviews were actually conducted and reported. From these three thousand interviews will come approximately 70 per cent of the Freshman Class which enters in September, 1957. In talking with so many students, the Council has an opportunity to be very influential.

The most notable change in the Council has been its extension to include the suburban Boston schools. Insofar as possible we have selected alumni who are on the M.I.T. staff, but we also have many nonstaff alumni. Their primary emphasis will be on the school relationship, but prospective students will be given the opportunity to talk with the local Council member.

For the future, the remaining major areas must be fully organized and increasing effort made towards guiding and assisting the members in doing their jobs more effectively.

B. F. KINGSBURY

EXECUTIVE VICE PRESIDENT OF THE ALUMNI ASSOCIATION

During 1954–1955 the goal of the Alumni Fund was to obtain contributions to make possible the Karl Taylor Compton Laboratories, the dedication of which took place on June 11, 1957, our twenty-third annual Alumni Day. The campaign of the 1955 Fund, as noted in last year's report, was stimulated by the generous "matching offer" of Alfred P. Sloan, Jr. '95, and the response was extraordinary: $546,745 from 11,176 contributors — both new records for our Alumni Fund.

The 1956 Fund, despite the lack of the previous year's special stimulus, during 1955–1956 raised even more: $574,221, although the number of contributors fell off to 10,787, a decline of 4 per cent.

In making plans for the 1957 Fund, we decided to invite Class Agents, Special Gifts Chairmen, and other "working personnel" of the Fund to attend a two-day meeting at the Institute on September 7 and 8, 1956; the attendance totalled almost three hundred. At this time we announced that emphasis would be placed upon increasing the number of alumni

participating as contributors; and that Joseph E. Conrad had been appointed Regional Director to be associated with Henry B. Kane '24, who has been Director of the Fund since its establishment in 1940.

Through Mr. Conrad's efforts the 1957 Fund subsequently had personal solicitation campaigns conducted by committees of local alumni in 73 communities having a total alumni population of 4,300. As a result, 64.5 per cent of these 4,300 alumni made contributions to the 1957 Fund, whereas their corresponding participation ratio for the 1956 Fund had been 37.4 per cent.

Thus the 1957 Fund, at the close of its fiscal year on June 30 last, totalled $641,371 from 12,069 contributors — both new records for our Alumni Fund.

Last autumn the M.I.T. Club of Niagara Falls, organized in 1918, combined with its elder neighbor the M.I.T. Club of Buffalo which, in 1958, will celebrate its sixtieth anniversary. Last January the M.I.T. Club of Peru was founded at Lima. Thus our roster of these geographical groups remains at a total of 93, divided as follows: 68 in the continental United States, 13 elsewhere in the Americas, and 12 in the other hemisphere.

During the 12 months ended last April, 64 members of the Institute staff and Alumni Council attended 104 meetings of 55 different M.I.T. clubs; hence in the past five years, an annual average of nearly 60 M.I.T. clubs have had at least one annual visitation from Cambridge.

Of the 104 M.I.T. club meetings attended from Cambridge during 1956–1957, two were Regional Conferences; these were our ninth and tenth, held at Tulsa and Chicago, respectively, on February 2 and 16. Each was decidedly successful in respect to programs, attendance, and demonstrated interest in the Institute.

Four other meetings of M.I.T. clubs during 1956–1957 should be noted in passing. The first of these took place on November 14, when the M.I.T. Club of New York presented its Silver Stein award to Alfred P. Sloan, Jr. '95. The second came toward the end of February, when the M.I.T. Club of Cuba carried out its first "M.I.T. Weekend in Havana," which attracted 48 visitors from abroad, including the current president and three former presidents of the Alumni Association. The third was the ninth annual Fiesta of the M.I.T.

Club at Mexico City in mid-March, which entertained 38 visitors from the United States. Finally, the fourth was the sixtieth anniversary celebration of the M.I.T. Club of Philadelphia on April 27, when nearly five hundred members and guests dined at Longwood Gardens near Wilmington, Delaware, the estate of the late Pierre S. du Pont '90.

A census of our membership rolls taken March 31, 1957, shows a total of 60,696 names — 47,993, or 79 per cent, being carried in living status and 12,703, or 21 per cent, as deceased. Four per cent of the 47,993 living alumni — that is, 1,871 — were 50 or more years out of the Institute; 23 per cent were 31 to 50 years out; 40 per cent were 11 to 30 years out; and the remaining 33 per cent were 10 or less years out. Of the 1,871 living alumni 50 or more years out, 64 were already nonagenarians or due to become so before the end of 1957; and, similarly, 617 were octogenarians.

H. E. Lobdell

HEAD OF THE DEPARTMENT OF AIR SCIENCE

Four years have passed since the new Air Force R.O.T.C. generalized program, now nationwide, was instituted at M.I.T.; and a fair evaluation can now be made on the basis of the performance of the four classes who were exposed to the new program only. The goal of the program, as applied to technical institutions, is to produce Air Force officers (either flyers or ground officers) with an engineering or scientific background who will also be effective military leaders. M.I.T. provides the technical training, and the curriculum in the Air Science Department concentrates on leadership training.

During the first year with the Air Science Department, the cadet is given a broad foundation in the concepts of air-age citizenship. He starts his training with an introduction to aviation, which includes some basic aerodynamics. This is followed by the fundamentals of global geography and a study of the impact of the airplane upon geographical concepts. He then studies international tensions and security organizations and learns how the military operates in supporting our national objectives and security.

During the second year the basic concepts of Air Force organization, facilities, and operations are taught, tying in with subjects studied earlier in the program. The cadet is exposed to air-age citizenship concurrently with the fundamentals of drill, leadership, and discipline. Leadership training during the first two years stresses the qualities of self-discipline and cooperation.

In the Advanced Course, the student starts an intensive leadership program. The subjects of navigation weather and military law acquaint him with problems he will face in the military. However, the bulk of the time is spent in training him to lead and manage. In his junior year he learns to instruct all phases of drill, and in class he is given a course in public speaking. In his senior year, under the supervision of the Air Science staff, he manages the cadet corps, teaches drill to basic cadets, and is offered the opportunity to teach classes. His academic subjects include a full semester of leadership and management and a half semester of current problems in political geography.

After four years of operation, the new A.F.R.O.T.C. program has completely fulfilled our expectations. The Air Science Department staff has, with the frequent and willing aid of civilian faculty members as guest lecturers, concentrated on building nontechnical Air Force leadership skills on top of the engineer-scientist skills taught by the civilian departments. Cadets enrolling in the ground-duty category of the Advanced Course (numbering slightly more than those entering flying categories) have been selected from academic fields equivalent to those from which the Air Force selects its active duty officers. Of course at M.I.T. there are very few fields which do not offer the type of background training required by the Air Force.

The clearly greater abilities of the cadets in the class of 1957 — the first group to complete all four years of the new program — attest to the soundness of this new leadership-technical education program.

HARMON LAMPLEY, JR.

HEAD OF THE DEPARTMENT OF MILITARY SCIENCE AND TACTICS

A total of 920 undergraduates were enrolled in the Army R.O.T.C. program at M.I.T. during the 1956–57 academic year. Of this number, 253 were Advanced Course students.

There was one major change in the curriculum during the year: instruction in subjects common to all branches of the Army was expanded to cover the sophomore as well as the freshman year; instruction in subjects pertaining to a particular technical service branch was concentrated in the junior and senior years. This revision provided a broader background of essential military fundamentals; it also permitted a more intensified program of instruction in appropriate branch tactics and techniques for those students selected for the Advanced Course.

During the 1956–57 school year, continued progress was made on developing those qualities of leadership so essential to military service. Emphasis was placed upon improving discipline and military courtesy within the cadet corps. The use of a selection board to screen applicants for the Advanced Course was continued; analysis of the results of this screening process indicate a decided improvement in the quality of the Advanced Course students.

Colonel Charles M. McAfee, Jr. completed his term as Professor of Military Science and Tactics and has been replaced by Colonel Gilbert G. Brinckerhoff, Jr.

CHARLES M. MCAFEE, JR.

HEAD OF THE DEPARTMENT OF NAVAL SCIENCE

The Naval Science Department at M.I.T. was created in the late summer of 1956 and commenced operating at the beginning of the academic year, with an initial enrollment of forty freshman students. The mission of the Department is to offer instruction in naval science subjects considered essential to prepare Institute graduates for commissions in the Naval Reserve as engineering duty officers.

The first year's study is the same as that offered in other N.R.O.T.C. institutions, but the other three years are devoted to study in the fields of guided missiles, nuclear ship propulsion, industrial management, and leadership techniques. The latter subjects are new to the N.R.O.T.C. concept and are still in the process of development. Some adjustments in certain undergraduate Courses were necessary in order to accommodate the program, but these were made with a minimum of delay, and it now appears that the program will fit into the Course schedules without difficulty. In this connection much valuable assistance was rendered to the Department by the *ad hoc* committee appointed for this and other purposes, under the chairmanship of Professor Warren M. Rohsenow. Progress in the development of the special naval science subjects is proceeding, and it is anticipated that the initial steps in the formulation of the industrial management and leadership will be taken during the coming year, with members of the M.I.T. School of Industrial Management participating.

Student attrition was limited to a total of six. Two students dropped out of the program at their own request, having decided not to continue at M.I.T., and two because of physical defects not waived by the Navy's Bureau of Medicine and Surgery; two were dropped for academic deficiencies. Some staff changes have been made since the Department was organized. Assistant Professor John G. Landers, Lieutenant, USN, was replaced by Herbert O. Burton, Lieutenant, USN. Commander Robert A. Weatherup has joined the Department as Associate Professor and will teach the course in guided missiles.

JOSEPH S. LEWIS

MEDICAL DIRECTOR

The most important developments during the past year have been personnel changes. Dr. Murray P. Horwood, Professor of Sanitary Science and Director of Sanitation, died on June 4. Dr. James Howard Means, Physician in the Department and at one time Acting Director, retired on June 30. Drs. Samuel

D. Clark and Albert O. Seeler were appointed full-time Physicians, and Dr. LeMoyne White was appointed full-time Psychiatrist in charge of the service. Dr. George White resigned as Radiologist as of June 30, 1957, after ten years of faithful service to the Department. We have been fortunate in securing the services of Dr. Richard Schatzki as Radiologist beginning July 1, 1957. Two of Dr. Schatzki's associates, Dr. E. Hoyle Schultz and Dr. John E. Gary, have been appointed Assistant Radiologists.

A review of the records, summarized in the following table, indicates that the volume of work done in the clinic remained about the same as the previous year.

	1955–56	*1956–57*
Medical	8426	7208
Surgical	9975	9564
Psychiatric	2599	2568
Eye	1254	1148
Ear, nose, and throat	1164	1077
Dermatology	1561	1428
Dental	4691	4418
Occupational medicine	258	308
Total	**29,928**	**27,719**

The number of clinic visits dropped off slightly, and there was an increase of 300 in the number of physical examinations, nearly all of which were for employees. The total number of X-rays taken decreased by 30 per cent. This was due chiefly to a change in policy by which we require chest X-rays for students only on admission.

The number of visits to the Dental Clinic remained approximately the same. The number of cases of contagious disease remained exactly the same, at 21.

The addition of a receptionist and a second trained nurse to the clinic staff has appreciably expedited the service.

The volume of work in the Infirmary also remained about the same. An exception is the fact that the Chief Nurse, Mrs. O'Sullivan, and her assistants administered 7,039 polio shots to 4,192 individuals during the year. Of these, 2,752 were students and 1,440 staff or employees.

Infirmary fees have been raised again this year from $10 a day for a ward bed and $12 a day for a private room to $12 and $15 a day, respectively. At the same time the Student Health Insurance fee has been raised from $11 to $13 per term.

Benefits have been increased to cover the increase in Infirmary rates, the hospital benefit has been increased from $14 to $15 a day, and the total benefit has been increased from $1,000 to $1,500.

FACULTY HEALTH SURVEY

Somewhat more than two-thirds of the eligible members of the faculty and administration participated in the annual medical check-up. This year proctoscopic examinations were included for the first time. In three instances rectal polyps, which are generally accepted as precancerous lesions, were thus detected and arrangements made for their removal. A sensitive blood test for early detection of cancer of the prostate was also carried out as a routine measure, with no positive findings.

SPORTS INJURIES

The total number of sports injuries reported was 328, as compared to 163 last year. We believe that the increase is due largely if not entirely to better reporting and that this is the first time we have had an accurate record of the number of injuries. The number is impressive, although the majority of injuries were of a minor character, and to our knowledge none has resulted in permanent disability.

LABORATORY TESTS

The volume of work performed in the clinical laboratory increased from 12,262 to 14,397 tests. This is a reflection of more exacting demands being made on the laboratory by our staff physicians.

OCCUPATIONAL MEDICAL SERVICE

The director of the Occupational Medical Service, Dr. Harriet L. Hardy, was on leave of absence from November 10, 1956, to the end of April, 1957. During this period she visited mines and research groups in Europe, Africa, and South America, collecting data on industrial hazards to the lungs in various types of mines. These observations are being brought together in book form.

The work of the service has grown in both scope and volume. Responsibility has been accepted for the radiation protection aspects of the nuclear reactor now under construction, and Dr. Constantine J. Maletskos has been appointed

Radiation Protection Officer for the nuclear reactor. A medical advisory committee for the nuclear reactor has been formed, with representatives from the three Boston medical schools and the medical department of M.I.T., to disseminate information regarding the biological and medical applications of the reactor in the community, to pass on the validity of projects in these fields involving the use of the reactor, and to assess the risk whenever human subjects are involved. A symposium at M.I.T. under the auspices of this committee is planned for the fall of 1957.

The increasing amount of research involving radioactive isotopes at the Institute is reflected in the work of the Radiological Safety Officer and the Industrial Hygiene Laboratory. Because of this increase we plan to move these facilities, together with those of the rest of the Occupational Medical Service, to more ample quarters in Building 20. This will provide needed space in the Infirmary building for expansion of clinical facilities.

A systematic room-by-room industrial hygiene survey of the Institute was begun by Frederick J. Viles, Jr., Industrial Hygiene Engineer, assisted by Miss Janet Walkley, Industrial Hygiene Chemist. A report of the complete survey of the Civil Engineering Department has been submitted, and a survey of the Department of Metallurgy is under way. This inspection pointed up such serious inadequacies of some hood facilities that an Institute-wide evaluation of ventilation was undertaken immediately. In addition, a detailed report has been submitted on Building 16, where the situation is particularly acute. The problem has arisen largely from expanding use of toxic chemicals and radioactive substances beyond the rated capacities of existing hood installations.

Thomas K. Wilkinson completed his first year as full-time Industrial Hygiene Engineer at the Lincoln Laboratory. He was also given responsibility for safety engineering at the Laboratory, a combination of duties which has kept him fully and productively occupied.

The Occupational Medical Service lost one of its most valued members in the death of Dr. Murray P. Horwood. Dr. Horwood joined the teaching staff at M.I.T. as an assistant in biology in 1916. He was a leader and a sought-after consultant in the field of municipal sanitation. As Director of Sanitation at M.I.T. he achieved a remarkable record of com-

plete freedom from epidemics traceable to food contamination in any of the dining services over a period of twelve years. From 1952 to 1954 he was Director of the M.I.T. Educational Project at the Engineering College of the University of Rangoon and made a valuable survey of health conditions in Burma. His high professional standards were an inspiration to the entire Department.

For the time being the responsibility for sanitary supervision of the dining facilities will be carried on a part-time basis by Fred E. Smith, an experienced sanitary engineer, who is on the staff of the Cambridge Health Department.

RESEARCH

Misses Janet Walkley and Joan Leary have continued their studies on methods for the assay of radioactive materials in the urine. Dr. Martin Lubin, with technical assistance from the Lincoln Laboratory, has continued his investigation of biological effects of high-frequency radiation. Such studies include measurement of lethality doses and complete examination of all tissue for possible harmful effects, including the production of cataracts. To date no effects have been observed on tissue beyond those ascribable to heating.

PSYCHIATRIC SERVICE

This service has continued a high rate of activity and the staff worked to near capacity throughout the entire year. Renewal of the Commonwealth Fellowships was not requested this year, and the only trainees in the program were two National Health Fellows. We planned this shift feeling that the work at M.I.T. demands more experienced men and is not as successfully carried on by young psychiatrists in their first or second year of training; trainees must now have had at least three and preferably four years of psychiatric training before working here. The formal group psychodynamics program was halted during the past year in order to evaluate its effectiveness. No definite conclusions have yet been reached.

The types of mental illness and emotional disorder encountered by the Department differed in no respect from those seen in previous years.

The contact of the Department with the faculty was maintained on a high level. Although the formal groups have been discontinued, the association with faculty members

through the Faculty Health Survey has proved a valuable way for the psychiatric service to acquaint the faculty with the services it can offer. The strength of this association was reflected in particular by the continued high number of referrals direct from faculty members and from the Dean of Students' Office. The contact with the administration has been maintained on a personal basis throughout the whole year, and it is our feeling that there is a firm working relationship between this Department and the Dean's Office. The administration and the Department undertook a special project to interview all boys who were withdrawing from M.I.T. The results showed that a large majority of the withdrawals were for emotional reasons and that very few of them were for reasons of financial necessity or family illness. This information has helped the Dean's Office and the Admissions Office in their thinking on the kind of boy who does well at M.I.T. We also believe that these interviews are helpful to the students who are withdrawing.

There is a continued increase in the number of students who come as self-referred. These self-referrals are usually boys who come after talking with classmates or friends; we believe that this reflects a trust in the Department even more than do the referrals made directly by faculty or administration. Six students were hospitalized during the year.

The Department still attempts to handle as many of the M.I.T. community problems as possible with its own staff. Thus the number of patients in longer term therapy, or more than six visits, remains approximately the same as in previous years. The number of students seen for less than six visits showed a marked increase, some of which can be accounted for by the students who were withdrawing. However, the great majority of students continued to show, when faced with an upset, the quick recuperative powers we have long noticed.

Dr. LeMoyne White assumed active direction of the psychiatric work at M.I.T. on July 1, 1956. Dr. Herbert I. Harris has continued on a half-time basis and Drs. Stanley Cobb and Edwin Cole on a part-time basis. Drs. E. Haskell Schell and James Wingate participated under training fellowships in psychiatry of the National Institutes of Health. Dr. Clinton Bagenstose, a part-time psychiatrist, resigned as of February 1, 1957, because of the demands of private practice.

Although the staff appears to be smaller than in past years, we feel that its caliber and experience make it well equipped to handle the problems of the community during the coming year.

LINCOLN LABORATORY

Visits to the Medical Clinic at the Lincoln Laboratory increased from a total of 10,479 in 1955–56 to 12,804 in 1956–57.

A total of 2,177 injections of Salk vaccine were given. The majority of those who participated in this program at Lincoln were I.B.M. and Rand personnel assigned there on a temporary basis. Of these, 1,163 were first injections, 1,009 second injections, and 5 third injections.

JAMES M. FAULKNER

PLACEMENT BUREAU

This year has marked a period of slow change in the job market. The demand for well-educated scientific personnel remained strong, but employers have been more selective than in the past five years. There is still considerable competition for able young graduates; however, much of the loose, even careless recruiting of past years has been absent this year.

STUDENT PLACEMENT

Our active campus recruiting period extends from mid-October until the end of April each year. This year 442 employer groups scheduled interview dates in our office during this period. While this is a small gain over last year, we are about at the saturation point determined for us by the time and space available for interviewing purposes. Interviewing and allied employment activity brought approximately the same number of representatives to the Institute as in recent years, and 8,615 interviews were conducted. This is a sharp gain over last year's total of 7,119, indicating that since employers are becoming more selective, candidates must intensify their job search to maintain their own standards of selectivity.

The salaries offered to graduates are indicated in the table below:

1956–57 Salaries Offered and Accepted[1]

	S.B.	*S.M.*	*Engineer*	*Ph.D./Sc.D.*
Median offer	465	562	625	719
Median acceptance	479	589	625	650

[1] All of these figures are for a forty-hour, five-day week. The sample of professional or engineer degree candidates reporting is so small that the 625 figure should not be directly compared to the other figures.

The fringe benefits are still generous, but again there has been a sounder approach to this many-times-abused part of the "employment package." Much sought after and increasingly offered to our graduates is the opportunity for advanced degree work while fully employed. A large though undetermined number of our graduates seek and gain this job benefit. Approximately 30 per cent of our bachelor's recipients go on to full-time graduate work each year. At a conservative estimate, at least 50 per cent of all graduates who have earned the bachelor's degree here go on to further schooling through immediate part- or full-time matriculation.

Student interest in summer technical training is increasing, and there continues to be an inadequate supply of good positions. However, some small but encouraging gains were made in numbers of employers considering freshmen and sophomores as well as the upperclassmen. The following figures show median salary offers for summer work for a forty-hour, five-day week.

	Per Month
Graduate Students	$481
Seniors	457
Juniors	385
Sophomores	369
Freshmen	340

The Institute's placement program has the counsel of a strong and active faculty and staff advisory group; this "team aspect" has through the years been a strong reason for the successful activity that continues to operate in the interest of students, alumni, and employers. Much of the placement

activity entered into by the faculty is never recorded but should be noted as most valuable to the Institute and its students.

ALUMNI PLACEMENT

This has been a good year, with no substantial changes in our level of activity with alumni.

Alumni Placement, 1955–1957

	1955–56	*1956–57*
Number of jobs	4763	4967
Men who went on available list	722	761
Placements	163	171

A shortage of men in the electronics and nuclear fields has continued troublesome, but in general the need for manpower has seemed healthy rather than desperate. While the number of positions open increased by 4 per cent, so did the number of men available, and we hope that this balance indicates a continuing and increasing awareness of satisfactory service, on the part of both industry and alumni. The 171 men whom we placed were hired by ninety-two different companies, distributed through twenty states and one foreign country.

JOE JEFFERSON

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; and 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	1956–57	6,000
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
1956	1553	2497

† Students attending regular subjects from M. I. T. Curricula.
* Regular Academic Term during summer.

TABLE 2. The Corps of Instructors

	'44	'45	'46	'47	'48	'49	'50	'51	'52	'53	'54	'55	'56
Faculty Members of the Staff	317	330	379	398	413	435	436	457	480	503	515	534	582
Professors	107	113	110	118	124	131	132	136	144	152	158	169	190
Associate Professors	105	103	128	131	131	141	137	144	149	157	155	167	169
Assistant Professors	92	101	125	137	133	138	144	154	166	170	178	175	199
Ex-Officio	10	10	11	11	10	10	8	11	10	12	14	15	16
Professors Emeriti (Lecturers)	—	—	—	—	14	13	13	10	9	10	9	7	7
Technical Instructors	1	1	1	—	—	—	—	—	—	—	—	—	—
Research Associates	2	2	2	—	—	2	2	2	2	2	1	1	1
Library Fellows	—	—	2	1	1	—	—	—	—	—	—	—	—
Other Members of the Staff	222	252	694	846	824	861	940	999	1051	1092	1047	1105	1177
Instructors	70	82	119	154	142	151	145	139	141	144	129	146	134
Technical Instructors	6	8	14	17	15	15	13	12	13	12	13	11	12
Administrative Assistants	—	—	1	—	—	—	2	2	2	2	2	4	2
Teaching Assistants	—	—	—	—	—	—	—	186	208	222	214	249	273
Teaching Fellows	8	18	74	77	72	91	98	—	—	—	—	—	—
Fellows in Applied Math.	—	—	4	3	—	—	—	—	—	—	—	—	—
Assistants	44	47	127	137	116	124	122	—	—	—	—	—	—
Consultant	—	—	—	—	—	1	—	—	—	—	—	—	—
Lecturers	7	7	11	10	13	11	22	32	25	25	28	33	42
Research Associates	33	39	151	176	155	120	105	86	100	97	93	86	92
Research Assistants	54	51	193	272	311	348	433	474	517	542	529	536	586
Technical Assistants	—	—	—	—	—	—	—	46	45	48	39	40	36
Carnegie Fellows	—	—	—	—	—	—	—	2	—	—	—	—	—
Fellows	—	—	—	—	—	—	—	20	—	—	—	—	—
Total	539	582	1073	1244	1237	1296	1376	1456	1531	1595	1562	1639	1759
Other Members of the Faculty	44	52	60	67	50	50	54	55	53	58	55	58	60
Faculty and Administrative Officers:													
Emeriti (not Lecturers)*	43	51	59	66	49	49	53	54	52	57	55	58	60
Non-Resident Professor	1	1	1	1	1	1	1	1	1	1	—	—	—

*Beginning 1948–49.

TABLE 3. Classification of Students by Courses and Years

COURSE (OR DEPARTMENT) NAME AND NUMBER	1954–55 YEAR						1955–56 YEAR						1956–57 YEAR					
	1	2	3	4	G	Total	1	2	3	4	G	Total	1	2	3	4	G	Total
Aeronautical Engineering XVI	66	40	36	34	115	291	60	53	31	30	111	285	82	56	37	25	132	332
Aeronautical Engineering (Cooperative) XVI-B	—	—	14	7	—	21	—	—	16	14	—	30	—	—	12	15	—	27
Architecture IV-A	18	25	40	30	31	144	17	26	28	39	28	138	14	32	26	32	28	132
Architecture (IV-A) Fifth Year	—	—	—	34	—	34	—	—	—	28	—	28	—	—	—	38	—	38
Biology VII	16	14	19	10	39	98	9	13	12	17	39	90	4	10	13	14	33	74
Building Engineering and Construction XVII	7	6	20	11	24	68	—	—	11	20	20	51	—	—	—	10	21	31
Chemical Engineering X	166	91	115	66	131	569	141	123	81	107	154	606	135	101	109	67	186	598
Chemical Engineering Practice X-A, X-B	—	—	—	9	20	29	—	—	—	5	30	35	—	—	—	10	48	98
Chemistry V	41	18	20	13	158	250	43	30	17	25	184	299	29	27	27	17	214	314
City Planning IV-B	—	—	—	—	18	18	—	—	—	—	22	22	—	—	—	—	31	31
Civil Engineering I	44	44	53	48	63	252	40	49	44	53	76	262	37	37	51	48	76	249
Army Engineer (in Civil Eng. Department)	—	—	—	—	10	10	—	—	—	—	15	15	—	—	—	—	9	9
Economics and Social Science XIV	1	6	14	7	49	77	1	10	17	14	63	105	4	5	10	21	83	123
Electrical Engineering VI	237	199	106	106	322	970	239	250	134	100	315	1,038	229	242	151	130	353	1,105
Electrical Engineering (Cooperative) VI-A	—	—	62	45	47	154	—	—	57	66	38	161	—	—	73	62	54	189
Food Technology XX, XX-A, XX-B	6	9	8	4	38	65	—	14	10	8	44	76	—	1	11	9	38	59
General Engineering IX-B	13	4	15	20	—	52	12	3	13	13	—	41	25	2	6	13	—	46
General Science IX-A	3	—	6	7	—	16	6	1	7	8	—	22	4	1	1	7	—	13
Geology and Geophysics XII	9	19	20	15	44	107	6	25	15	17	48	111	2	14	22	13	49	100
Humanities and Engineering (or Science) XXI-A (or XXI-B)	—	—	—	—	—	—	5	10	—	—	—	15	7	8	18	—	—	33
Industrial Management XV	40	88	93	92	84	397	41	63	87	90	91	372	21	70	78	98	143	410
Mathematics XVIII	21	16	24	17	71	149	15	24	13	27	75	154	28	33	22	20	105	208
Mechanical Engineering II	152	117	111	84	133	597	113	114	98	113	163	601	74	107	90	103	207	581
Mechanical Engineering (Cooperative) II-B	—	—	20	11	—	31	—	—	33	21	—	54	—	—	21	29	—	50
Metallurgy III	14	22	29	25	124	214	13	25	29	27	129	223	9	42	36	30	138	255
Ceramics (in Metallurgy Department)	—	—	—	—	12	12	—	—	—	—	12	12	—	—	—	—	11	11
Meteorology XIX	3	1	1	1	43	49	1	1	2	2	39	45	1	3	2	4	53	63
Naval Architecture and Marine Engineering XIII, XIII-B	11	6	21	14	12	64	6	8	11	20	13	58	6	6	10	13	21	56
Naval Construction and Engineering XIII-A	—	—	—	—	83	83	—	—	—	—	76	76	—	—	—	—	70	70
Physics VIII	126	93	55	48	173	495	178	109	74	44	183	588	223	129	93	68	180	693
Sanitary Engineering XI	—	—	—	—	23	23	—	—	—	—	23	23	—	—	—	—	26	26
Science Teaching IX-C	1	1	6	1	—	9	2	3	2	4	1	12	2	5	4	2	3	16
Total	995	819	908	759*	1,867	5,348	948	954	842	912*	1,992	5,648	936	931	923	898*	2,312	6,000

* These totals include fifth year in Architecture IV-A.

TABLE 4-A. Classification of Students by Courses, Options and Years

COURSE No.	Name	Option	Option	Year 1 Opt.	Year 1 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	—	37	—	37	—	51	15 / 33	48	76	85	258	I
		3. Construction and Management	3	—		—		—		—		—			
	Army Engineer			—		—		—		—		9			
II	Mechanical Engineering			—	74	—	107	—	90	—	103	192	207	581	II
	Textile Technology			—		—		—		—		15			
II-B	Mechanical Engineering (Cooperative)	a. At Plant	a	—	—	—	—	10	21	—	29	—	—	50	II-B
		b. At M. I. T.	b	—		—		11		—		—			
III	Metallurgy	Metallurgy		—	9	—	42	—	36	—	30	134	149	266	III
		Mineral Engineering		—		—		—		—		4			
		Ceramics		—		—		—		—		11			
IV-A	Architecture			—	14	—	32	—	26	32 / 38	70	—	28	170	IV-A
	Fifth Year			—		—		—		—		—			
IV-B	City Planning			—	—	—	—	—	—	—	—	—	31	31	IV-B
V	Chemistry			—	29	—	27	—	27	—	17	—	214	314	V
VI	Electrical Engineering			—	229	—	242	—	151	—	130	—	353	1105	VI
VI-A	Electrical Engineering (Cooperative)			—	—	—	—	—	73	—	62	—	54	189	VI-A
VII	Quantitative Biology			—	4	—	10	—	13	—	14	—	33	74	VII
VIII	Physics			—	223	—	129	—	93	—	68	—	180	693	VIII
IX-A	General Science			—	4	—	1	—	1	—	7	—	—	13	IX-A
IX-B	General Engineering			—	25	—	2	—	6	—	13	—	—	46	IX-B
IX-C	Science Teaching			—	2	—	5	—	4	—	2	—	3	16	IX-C
X	Chemical Engineering			—	135	—	101	—	109	—	67	—	186	598	X
X-A	Chemical Engineering Practice — Graduate			—	—	—	—	—	—	—	—	—	48	48	X-A
X-B	Chemical Engineering Practice — Undergraduate			—	—	—	—	—	—	—	10	—	—	10	X-B
XI	Sanitary Engineering			—	—	—	—	—	—	—	—	—	26	26	XI
XII	Geology and Geophysics			—	2	—	14	—	22	—	10	—	49	97	XII
XII-A	Geology and Geophysics			—	—	—	—	—	—	—	3	—	—	3	XII-A
XIII	Naval Architecture and Marine Engineering			—	6	—	6	—	10	—	12	—	20	54	XIII
*XIII-A	Naval Construction and Engineering			—	—	—	—	—	—	—	—	—	70	70	XIII-A
XIII-B	Shipping and Shipbuilding Management			—	—	—	—	—	—	—	1	—	1	2	XIII-B
XIV-A	Economics, Politics and Engineering			2	4	3	5	7	10	18	21	—	83	123	XIV
XIV-B	Economics, Politics and Science			2		2		3		3		—			
XV	Business and Engineering (Administration)	A. Physical Sciences	A	19	21	53	70	58	78	79	98	—	143	410	XV
		B. Chemical Sciences	B	2		17		20		19		—			
XVI	Aeronautical Engineering			—	82	—	56	—	37	—	25	—	132	332	XVI
XVI-B	Aeronautical Engineering			—	—	—	—	—	12	—	15	—	—	27	XVI-B
XVII	Building Engineering and Construction			—	—	—	—	—	—	—	10	—	21	31	XVII
XVIII	Mathematics			—	28	—	33	—	22	—	20	—	105	208	XVIII
XIX	Meteorology			—	1	—	3	—	2	—	4	—	53	63	XIX
XX	Food Technology			—	—	—	1	—	7	—	7	—	35	50	XX
XX-A	Food Technology			—	—	—	—	—	—	—	—	—	—	—	XX-A
XX-B	Biochemical Engineering			—	—	—	—	—	4	—	2	—	3	9	XX-B
XXI-A	Humanities and Engineering			—	7	4	8	5	18	—	—	—	—	33	XXI
XXI-B	Humanities and Science			—		4		13		—		—			
	Total				936		931		923		**898		2312	6000	

* First Graduate Year, 26. Second Graduate Year, 22. Third Graduate Year, 22.

** 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	—	—	—	—	5	5	I
II	Mechanical Engineering	—	1	—	1	27	29	II
III	Metallurgy	—	—	2	2	23	27	III
IV-A	Architecture	—	2	1	2	4	9	IV-A
	Fifth Year	—	—	—	1	—	1	
IV-B	City Planning	—	—	—	—	8	8	IV-B
V	Chemistry	—	—	1	2	6	9	V
VI	Electrical Engineering	1	3	1	3	114	122	VI
VII	Quantitative Biology	—	—	—	—	5	5	VII
VIII	Physics	—	2	—	1	18	21	VIII
X	Chemical Engineering	—	—	—	—	14	14	X
XI	Sanitary Engineering	—	—	—	—	2	2	XI
XII	Geology and Geophysics	—	—	—	—	4	4	XII
XIII	Naval Architecture and Marine Engineering	—	—	—	1	9	10	XIII
XIV	Economics and Social Science	—	—	—	—	16	16	XIV
XV	Business and Engineering Administration	—	1	—	—	15	16	XV
XVI	Aeronautical Engineering	—	—	—	—	41	41	XVI
XVII	Building Engineering and Construction	—	—	—	—	5	5	XVII
XVIII	Mathematics	—	—	—	1	38	39	XVIII
XIX	Meteorology	—	1	—	1	18	20	XIX
XX	Food Technology	—	—	1	—	10	11	XX
XXI	Humanities and Engineering or Science	—	—	2	—	—	2	XXI
Total		1	10	8	15	382	416	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	—	2	1	1	3	7	I
II	Mechanical Engineering	—	3	3	4	11	21	II
III	Metallurgy	—	—	2	1	4	7	III
IV-A	Architecture	—	3	1	5	—	9	IV-A
V	Chemistry	1	—	1	2	4	8	V
VI	Electrical Engineering	3	11	13	7	12	46	VI
VII	Quantitative Biology	—	—	2	—	—	2	VII
VIII	Physics	2	3	3	1	4	13	VIII
IX-B	General Engineering	1	—	1	1	—	3	IX-B
X	Chemical Engineering	1	—	1	1	9	12	X
XI	Sanitary Engineering	—	—	—	—	2	2	XI
XII	Geology and Geophysics	—	1	—	—	3	4	XII
XIII	Naval Architecture and Marine Engineering	—	—	2	1	1	4	XIII
XIV	Economics and Social Science	—	—	—	—	4	4	XIV
XV	Business and Engineering Administration	1	5	7	11	4	28	XV
XVI	Aeronautical Engineering	—	1	2	—	2	5	XVI
XVII	Building Engineering and Construction	—	—	—	—	4	4	XVII
XVIII	Mathematics	—	—	1	2	—	3	XVIII
XIX	Meteorology	—	1	—	—	2	3	XIX
XXI	Humanities and Engineering or Science	—	—	2	—	—	2	XXI
Total		9	30	42	37	69	187	Total

* Excludes 68 special students.

TABLE 5. Classification of Students by Courses since 1949

	1949–50	1950–51	1951–52	1952–53	1953–54	1954–55	1955–56	1956–57
School of Engineering . . . . . *Total*	4,055	3,287	3,094	3,269	3,370	3,489	3,616	3,693
Aeronautical Engineering XVI, XVI-B	274	276	246	290	318	312	315	359
Building Engineering and Construction XVII	124	116	94	76	69	68	51	31
¶Business and Engineering Administration XV	415	—	—	—	—	—	—	—
Chemical Engineering X, X-A, X-B	596	541	482	522	553	598	641	656
Civil Engineering I	277	277	273	279	277	262	277	258
¶Economics and Engineering XIV-A, XIV-B	81	—	—	—	—	—	—	—
Electrical Engineering VI, VI-A	996	900	908	977	1,011	1,124	1,199	1,294
General Engineering IX-B	62	44	40	49	53	52	41	46
Mechanical Engineering II, II-B	711	617	526	593	602	628	655	631
Metallurgy III	243	231	218	220	228	226	235	266
††Meteorology XIX	65	71	115	93	71	49	45	—
***Naval Arch. and Marine Eng. XIII, XIII-B, XIII-C	92	101	85	70	76	64	58	56
Naval Construction and Engineering XIII-A	98	91	86	80	89	83	76	70
Sanitary Engineering XI	21	22	21	20	23	23	23	26
School of Science . . . . . *Total*	1,151	1,176	1,159	1,164	1,136	1,189	1,352	1,540
*Biology VII, VII-A, VII-B	85	89	92	89	97	98	90	74
Chemistry V	281	272	258	266	237	250	299	314
Food Technology, XX, XX-A, XX-B	46	49	43	46	48	65	76	59
General Science IX-A	10	15	20	21	12	16	22	13
**Geology and Geophysics XII, XII-A, XII-B	86	99	82	82	102	107	111	100
Mathematics XVIII	165	140	147	148	148	149	154	208
††Meteorology XIX	—	—	—	—	—	—	—	63
Physics VIII	478	512	514	505	485	495	588	693
Science Teaching IX-C	—	—	3	7	7	9	12	16
School of Architecture and Planning . . . . . *Total*	202	224	205	219	196	196	188	201
Architecture IV-A	169	194	179	193	172	178	166	170
City Planning IV-B	33	30	26	26	24	18	22	31
¶*School of Humanities and Social Studies* . . . . *Total*	—	484	92	83	77	77	120	156
Business and Engineering Administration XV	—	371	—	—	—	—	—	—
Economics XIV	—	113	92	83	77	77	105	123
Humanities and Engineering (or Science) XXI-A, XXI-B	—	—	—	—	—	—	15	33
¶*School of Industrial Management* . . . . . *Total*	—	—	324	339	404	397	372	410
Business and Engineering Administration XV	—	—	324	339	404	397	372	410
†Economics and Eng. or Natural Science, Industrial Economics, and Group Psychology . . . . . *Total*	50	—	—	—	—	—	—	—
Grand Total	5,458	5,171	4,874	5,074	5,183	5,348	5,648	6,000

* 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. July 1956, Courses XII-A and XII-B changed to Geology and Geophysics, XII and XII-A.
*** XIII-C discontinued June 1953. XIII-B started September 1954.
†† July 1956, Meteorology changed from School of Engineering to School of Science.

TABLE 6

Geographical Classification of Students since 1952

United States	1952	1953	1954	1955	1956
North Atlantic . . . . . Total	3,276	3,274	3,313	3,298	3,348
Connecticut	150	161	162	172	212
Maine	44	41	43	54	47
Massachusetts	1,547	1,466	1,447	1,241	1,121
New Hampshire	42	39	46	42	57
New Jersey	282	291	331	346	358
New York	939	990	987	1,088	1,162
Pennsylvania	199	209	238	287	316
Rhode Island	49	51	43	51	57
Vermont	24	26	16	17	18
South Atlantic . . . . . Total	269	288	318	355	407
Delaware	12	17	16	15	11
District of Columbia	40	45	39	44	48
Florida	62	60	72	90	97
Georgia	17	20	26	31	35
Maryland	43	47	53	54	79
North Carolina	14	23	20	17	17
South Carolina	9	5	12	16	15
Virginia	56	61	66	73	83
West Virginia	16	10	14	15	22
South Central . . . . . Total	148	166	178	210	238
Alabama	15	18	13	15	19
Arkansas	8	5	7	11	16
Kentucky	24	21	22	26	24
Louisiana	14	25	17	19	27
Mississippi	11	7	12	11	14
Tennessee	17	24	28	31	32
Texas	59	66	79	97	106
North Central . . . . . Total	626	665	674	762	866
Illinois	169	175	196	202	217
Indiana	28	30	29	46	41
Iowa	15	18	20	21	30
Kansas	19	23	22	24	30
Michigan	92	95	103	107	129
Minnesota	38	39	42	52	51
Missouri	45	51	53	54	61
Nebraska	18	23	15	18	20
North Dakota	4	4	8	10	13
Ohio	148	154	140	170	201
South Dakota	3	5	6	6	11
Wisconsin	47	48	40	52	62
Western . . . . . Total	272	266	287	348	398
Arizona	14	13	9	10	17
California	109	105	121	145	172
Colorado	18	23	22	30	35
Idaho	6	5	8	11	8
Montana	10	10	11	16	16
Nevada	2	2	3	3	3
New Mexico	9	14	13	9	10
Oklahoma	20	20	23	32	36
Oregon	21	19	15	21	21
Utah	8	9	10	9	11
Washington	49	40	47	56	61
Wyoming	6	6	5	6	8
Territories and Dependencies . . . . Total	19	25	27	30	38
Alaska	2	3	1	2	2
Canal Zone	2	2	2	2	1
Hawaii	12	14	16	15	21
Puerto Rico	3	6	8	11	14
Total for United States	4,610	4,684	4,797	5,003	5,295

(*Continued on page 307*)

TABLE 6 — (*Continued*)

Geographical Classification of Students since 1952

Foreign Countries	1952	1953	1954	1955	1956
Total	464	499	551	645	705
Afghanistan	—	1	—	—	—
Algeria	—	—	—	—	1
Argentina	12	15	17	20	20
Australia	8	6	2	5	8
Austria	1	1	—	2	2
Bahamas	—	—	1	—	2
Belgian Congo	—	—	1	—	—
Belgium	4	7	3	12	9
Bermuda	—	—	—	—	1
Bolivia	1	1	1	—	1
Brazil	10	18	19	35	38
British Honduras	—	—	—	—	1
British North Borneo	—	1	1	1	—
British West Indies	2	5	5	5	4
Burma	3	5	15	11	8
Canada	74	74	78	93	116
Channel Isles	—	—	—	—	1
Chile	2	1	3	3	7
China	16	15	6	17	12
Colombia	13	16	17	24	23
Costa Rica	1	1	—	1	2
Cuba	17	12	17	18	17
Cyprus	—	1	1	2	2
Czechoslovakia	—	—	—	—	1
Denmark	1	—	1	1	—
Dominican Republic	1	2	2	1	1
Ecuador	2	2	2	3	—
Egypt	5	3	5	7	7
England	16	21	19	6	18
Ethiopia	1	1	1	—	—
Finland	3	3	5	5	3
Formosa	—	1	2	6	14
France	13	18	19	25	26
Germany	2	6	6	7	10
Gold Coast	—	—	—	—	1
Greece	17	22	21	24	27
Guatemala	2	1	5	8	8
Haiti	1	1	1	1	—
Honduras	—	—	2	2	2
Hong Kong	10	1	6	4	9
Hungary	—	—	—	1	—
Iceland	2	2	—	2	—
India	37	43	44	36	35
Indonesia	—	—	2	3	1
Iran	2	2	4	5	6
Iraq	2	2	4	2	3
Ireland	1	—	1	1	1
Israel	23	21	12	16	24
Italy	1	5	7	8	6
Japan	9	10	16	15	19
Jordan	—	—	—	—	1
Kenya	1	—	—	—	—
Korea	—	1	6	17	27
Lebanon	3	2	—	1	1
Liberia	—	—	1	—	—
Luxembourg	—	1	2	2	1
Malaya	1	1	2	2	2
Mauritius	1	1	1	1	2
Mexico	18	21	26	29	32
Morocco	—	—	1	1	1
Mozambique	1	1	1	1	1
Netherlands	2	1	4	4	4
Netherlands West Indies	3	1	1	1	2

(*Continued on page 308*)

TABLE 6 — (*Continued*)

Geographical Classification of Students since 1952

Foreign Countries	1952	1953	1954	1955	1956
New Zealand	3	2	—	3	2
Nicaragua	3	1	1	2	1
Nigeria	1	3	2	2	1
Norway	13	16	16	16	14
Pakistan	4	4	2	2	1
Panama	2	2	2	2	2
Peru	8	8	4	4	6
Philippines	16	13	16	15	14
Poland	1	—	—	—	—
Portugal	2	—	—	—	—
Salvador	1	3	3	2	3
Saudi Arabia	—	—	1	2	4
Scotland	5	2	2	3	2
Singapore	1	1	—	—	2
Spain	3	3	2	4	4
Sweden	9	5	9	6	4
Switzerland	1	3	5	6	8
Syria	2	2	4	4	2
Tanganyika	—	—	—	1	—
Thailand	5	5	5	10	11
Timor	—	—	1	—	—
Transjordan	1	—	2	2	1
Turkey	5	4	4	6	8
Union of South Africa	2	5	7	11	9
Union of Soviet Socialist Republic	—	—	—	—	1
Uruguay	5	4	4	6	6
Venezuela	25	35	35	36	22
Vietnam	—	1	1	2	3
Wales	—	—	4	1	1
Yugoslavia	1	—	—	—	2
Grand Total, United States and Foreign	5,074	5,183	5,348	5,648	6,000

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	8	4	3	4	19
Second Year	17	12	7	14	50
Third Year	—	7	24	25	56
Fourth Year	—	—	—	2	2
Graduate Year	—	—	34	592	626
Total	25	23	68	637	753

TABLE 8. Women Students Classified by Courses and Years

Course	YEAR					Total
	1	2	3	4	G	
II Mechanical Engineering	—	—	2	—	—	2
Textile Technology	—	—	—	—	2	2
III Metallurgy	2	—	—	—	3	5
IV-A Architecture	2	1	3	3	2	11
Fifth Year	—	—	—	3	—	3
IV-B City Planning	—	—	—	—	3	3
V Chemistry	1	—	1	3	12	17
VI Electrical Engineering	2	—	—	2	6	10
VII Biology	1	—	—	—	8	9
VIII Physics	6	6	2	2	3	19
IX-B General Engineering	—	—	1	1	—	2
IX-C Science Teaching	1	—	1	—	—	2
X Chemical Engineering	4	—	2	—	2	8
XIV Economics and Social Science	—	—	—	—	7	7
XV Business and Eng. Administration	—	1	—	—	—	1
XVI Aeronautical Engineering	2	1	1	—	1	5
XVIII Mathematics	2	1	4	—	9	16
XX Food Technology	—	—	1	1	2	4
XXI-B Humanities and Science	—	—	3	—	—	3
Total	23	10	21	15	60	129

TABLE 9. Old and New Students

Year	1951–52	1952–53	1953–54	1954–55	1955–56	1956–57
Students registered at end of last academic year (including specials)	3,251	3,130	3,361	3,395	3,621	3,870
Students who have previously attended the Institute but were not registered at end of last academic year (including specials)	204	214	212	218	244	255
New students who entered by examination	443	605	803	955	913	906
New students who entered without examination	238	304	—	—	—	—
New students who entered from other colleges as candidates for degrees	575	631	677	639	724	753
New students (specials, not candidates for degrees)	163	190	130	141	146	216
Total	4,874	5,074	5,183	5,348	5,648	6,000

TABLE 10. List of American Colleges and Universities with Number of Graduates Attending the Institute

College		College		College	
*Alabama Polytechnic Inst.	5	Denver, University of	1	Macalester College	1
Alabama, University of	4	DePauw University	1	Maine, University of	10
Alfred University	7	Drew University	2	Maine Maritime Academy	1
Allegheny College	2	Drexel Inst. of Technology	2	Manhattan College	9
American International Coll.	2	Duke University	8	Manhattanville College of Sacred Heart	1
American University	1	Duquesne University	1	Marietta College	3
Amherst College	22	Eastern Nazarene College	3	Marquette University	7
Amos Tuck School of Business Administration & Finance	1	Eastern Washington College of Education	1	Marshall College	1
Antioch College	5	Emmanual College	1	Maryland, University of	5
Arizona, University of	1	Evansville College	1	Massachusetts Institute of Technology	679
Arkansas, University of	1	Fenn College	1	Massachusetts Maritime Academy	3
Bard College	1	Florida, University of	2	Massachusetts, University of	14
Barnard College	2	Fordham University	4	Memphis State College	1
Bethany College	2	Fort Hays Kansas State College	1	Merrimack College	3
Boston College	24	Franklin and Marshall College	3	Miami University (Ohio)	3
Boston University	21	General Motors Institute	6	Miami, University of	3
Bowdoin College	10	George Pepperdine College	1	Michigan College of Mining & Technology	3
Bradford Durfee Technical Institute	1	Georgetown University	1	Michigan State University	4
Brandeis Univeristy	4	George Washington Univ.	3	Michigan, University of	30
Bridgeport University	1	Georgia Institute of Tech.	13	Middlebury College	12
Brigham Young University	2	Georgia, University of	1	Millsaps College	1
Brooklyn College	8	Gettysburg College	3	Milwaukee School of Engineering	3
Brown University	19	Grinnell College	1	Minnesota, University of	16
Bryn Mawr College	1	Hamilton College	3	Mississippi Southern Coll.	1
Bucknell University	4	Hamline University	1	Mississippi State College	2
Buffalo, University of	4	Harvard University	59	Mississippi, University of	2
California Institute of Tech.	10	Haverford College	1	Missouri School of Mines & Metallurgy	2
California State Polytechnic College	1	Hawaii, University of	1	Missouri, University of	2
California, University of	34	Hiram College	2	Monmouth College	1
Carleton College	4	Hobart College	1	Montana School of Mines	2
Carnegie Institute of Tech.	10	Holy Cross, College of	4	Montana State College	1
Case Inst. of Technology	3	Hofstra College	1	Montana State University	1
Catholic University of America	1	Hope College	1	Mount Holyoke College	3
Chicago, University of	19	Houston, University of	1	Nevada, University of	1
Cincinnati, University of	10	Howard University	1	Newark Coll. of Engineering	2
Citadel, The	1	Hunter College of the City of New York	1	New Bedford Institute of Textiles and Technology	1
City College, The (N.Y.)	35	Idaho, University of	3	New Hampshire, Univ. of	8
Claremont Men's College	1	Illinois Inst. of Technology	12	New Mexico Institute of Mining & Technology	1
Clarkson College of Tech.	5	Illinois, University of	29	New Mexico, University of	2
Clark University	4	Indiana Technical College	1	New York University	20
Clemson College	2	Indiana University	3	North Carolina State Coll.	4
Coe College	1	Iowa State College	11	North Carolina, Univ. of	3
Colby College	2	Iowa Wesleyan College	1	North Dakota, University of	1
Colgate University	4	Johns Hopkins University	4	North Dakota Agric. Coll.	3
College of the Pacific	1	Juniata College	3	Northeastern University	45
College of Puget Sound	1	Kansas State College of Agric. and Applied Science	1	Northwestern University	9
College of Wooster	3	Kansas, University of	5	Norwich University	1
Colorado Agriculture and Mechanical College	1	Kentucky, University of	4	Notre Dame, University of	10
Colorado College	1	Kenyon College	1	Oberlin College	7
Colorado School of Mines	3	Lafayette College	2	Occidental College	2
Colorado, University of	5	LaSalle College	1	Ohio State University	9
Columbia College	4	Lawrence Institute of Tech.	2	Ohio University	4
Columbia University (N.Y.)	16	Lebanon Valley College	1	Ohio Wesleyan University	2
Concord College	1	Lehigh University	13	Oklahoma Agricultural and Mechanical College	7
Connecticut, University of	9	Lincoln University	1	Oklahoma, University of	5
Cooper Union, The	11	Louisiana State Univ. & Agric. & Mech. College	3	Orange Coast Coll.(Calif.)	1
Cornell University	37	Louisville, University of	2	Oregon State College	3
Dartmouth College	8	Lowell Technical Institute	4	Otterbein College	1
Davidson College	2	Loyola University (Ill.)	3		
Dayton, University of	3	Luther College	1		
Delaware, University of	4				

(Continued on page 311)

TABLE 10. List of American Colleges and Universities with Number of Graduates Attending the Institute (*Continued*)

College		College		College	
Pacific Union College	1	San Diego State College	1	U.S. Naval Postgraduate School	13
Pembroke College	1	Sarah Lawrence College	1	Utah, University of	6
Pennsylvania State College	3	Seattle University	1		
Pennsylvania State Univ.	19	Simmons College	1	Valparaiso, University of	1
Pennsylvania, University of	10	South, University of the	1	Vanderbilt University	6
Philadelphia Textile Inst.	1	South Carolina, Univ. of	1	Vassar College	2
Pittsburg, University of	5	South Dakota School of Mines & Technology	4	Vermont, University of	5
Polytechnic Institute of Brooklyn	19	South Dakota State Coll. of Agric. & Mech. Arts	1	Villanova College	4
Pomona College	5	Southern California, Univ. of	3	Virginia Military Institute	5
Portland (Ore.), Univ. of	2	Southern Methodist Univ.	2	Virginia Polytechnic Inst.	9
Pratt Institute	1	Southwestern at Memphis	2	Virginia, University of	10
Princeton University	34	Southwestern Louisiana Inst.	1		
Principia College, The	3	Stanford University	12	Washington & Jefferson Coll.	5
Providence College	1	State Teacher's College	1	Washington, State Coll. of	3
Puget Sound College	1	State University of Iowa	1	Washington, University of	14
Purdue University	27	State Univ. of New York	1	Washington & Lee Univ.	1
Puerto Rico, University of	2	Stetson University	1	Washington University	4
		Stevens Inst. of Technology	10	Wayne University	5
Queen's College (N.Y.)	2	Swarthmore College	9	Webb Inst. of Naval Arch.	1
		Syracuse University	10	Wellesley College	2
Radcliffe College	3			Wesleyan University	7
Reed College	3	Temple University	2	West Texas State College	1
Rensselaer Polytechnic Inst.	47	Tennessee, University of	6	Western Reserve Univ.	1
Rhode Island School of Design	4	Texas Agric. & Mech. Coll.	7	Weston College	1
Rhode Island, University of	7	Texas Christian University	1	West Virginia, University of	3
Rice Institute	4	Texas Technical College	8	Wilkes College	1
Ripon College	2	Texas, University of	17	William Jewell College	1
Roanoke College	1	Toledo, University of	1	William & Mary, Coll. of	3
Rochester, University of	13	Trinity College	3	Williams College	22
Rockhurst College	2	Trinity University	1	Wisconsin, University of	20
Rutgers University	13	Tufts College	31	Wittenberg College	1
		Tulane University of Louisiana	5	Worcester Polytechnic Inst.	6
St. Anselm's College	1			Wyoming, University of	3
St. Bernadine of Siena Coll.	1	Union College (N.Y.)	4	Yale University	29
St. Bonaventure University	1	Urismus College	1	Yeshiva College	6
St. Elizabeth College	1	U.S. Air Force Inst. of Tech.	4	Total	2373
St. Francis College	1	U.S. Coast Guard Academy	22		
St. John's Univ. (N.Y.)	2	U.S. Merchant Marine Academy	4	Number of American Colleges Represented	289
St. Joseph's College	1	U.S. Military Academy	26	Number of Foreign Colleges Represented (not listed)	176
St. Lawrence University	5	U.S. Naval Academy	67	Total	465
St. Louis University	5				
St. Mary's University	1				

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. 1956		Previous Years					
	Sept. 1956	Previous Years	Total	Undergrad.	Grad.	Undergrad.	Grad.	Total	S.B. Degree 1956	Other Graduates	Total
Aeronautical Engineering XVI	7	15	22	2	44	5	22	73	16	9	25
Architecture IV-A	10	19	29	5	15	13	7	40	1	1	2
Biology VII	—	1	1	—	10	—	13	23	1	4	5
Building Engineering and Construction XVII	—	2	2	—	8	1	4	13	1	3	4
Business and Engineering Administration XV	5	21	26	1	87	2	30	120	5	6	11
Chemical Engineering X, X-A, X-B	6	15	21	3	72	—	78	153	39	31	70
Chemistry V	1	2	3	1	61	1	138	201	—	9	9
City Planning IV-B	—	—	—	—	12	—	10	22	—	1	1
Civil Engineering I	4	18	22	—	30	3	25	58	8	17	25
Economics and Engineering XIV	—	2	2	—	24	1	33	58	4	6	10
Electrical Engineering VI, VI-A	25	68	93	13	72	17	112	214	64	45	109
Food Technology XX, XX-A, XX-B	—	—	—	—	4	—	14	18	2	8	10
General Engineering IX-B	—	1	1	2	—	—	—	2	—	—	—
General Science IX-A	—	2	2	—	—	—	—	—	—	—	—
Geology and Geophysics XII, XII-A	—	4	4	—	10	—	20	30	2	13	15
Humanities and Eng. or Science, XXI-A, XXI-B	—	1	1	—	—	—	—	—	—	—	—
Mathematics XVIII	3	5	8	2	18	—	37	57	4	8	12
Mechanical Engineering II	17	38	55	8	55	12	63	138	23	39	62
Metallurgy III	2	3	5	—	21	—	67	88	6	32	38
Meteorology XIX	—	2	2	—	15	—	14	29	1	5	6
Naval Architecture and Marine Eng. XIII	—	8	8	1	3	1	5	10	1	2	3
Naval Construction and Engineering XIII-A	—	—	—	—	26	—	44	70	—	—	—
Physics VIII	8	17	25	1	27	—	87	115	8	40	48
Sanitary Engineering XI	—	—	—	—	12	—	12	24	—	—	—
Science Teaching IX-C	—	—	—	—	—	—	—	—	3	—	3
Shipping and Shipbuilding Management XIII-B	—	—	—	—	—	—	—	—	1	—	1
Total	88	244	332	39	626	56	835	1,556	190	279	469

TABLE 12. Number of Degrees Awarded in September 1956, January 1957, and June 1957

Name of Degree	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
Aeronautical Engineering	7	—	30	—	—	—	5	1	27	—	—	—	—	1	3	—	—	—	1	—	1	13	2	61
Architecture	—	—	—	4	1	17	—	—	—	17	1	4	—	—	—	—	—	—	—	—	—	21	2	21
Biochemical Engineering	1	—	2	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	1	—	3
Biochemistry	—	—	—	—	—	—	1	—	1	—	—	—	—	—	—	—	—	—	—	—	—	1	—	1
Biology	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	4	—	—	—	—	2	4
Biophysics	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Building Eng. and Constr.	6	—	10	—	—	—	4	1	3	—	—	—	—	—	—	—	—	—	—	—	—	10	1	13
Business and Eng. Admin.	7	12	79	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	7	12	79
Ceramics	—	—	—	—	—	—	—	1	1	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1
Chemical Biology	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Chemical Engineering	5	7	54	—	—	—	8	5	17	—	—	—	—	1	1	—	—	—	2	2	3	15	15	75
Chemical Engineering Practice	—	—	9	—	—	—	5	10	29	—	—	—	—	—	—	—	—	—	—	—	—	5	10	38
Chemistry	—	2	11	—	—	—	—	1	2	—	—	—	—	—	—	13	12	17	—	—	—	13	15	30
City Planning	—	—	—	—	—	—	—	—	—	3	—	3	—	—	—	—	—	—	—	—	—	3	—	3
Civil Engineering	3	1	35	—	—	—	8	3	21	—	—	—	—	—	—	—	—	—	—	1	5	11	5	61
Economics and Engineering	1	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	1	—	1
Economics, Politics, and Eng.	—	—	14	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	14
Economics, Politics and Science	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2
Electrical Engineering	17	21	123	—	—	—	30	25	62	—	—	—	4	3	11	—	—	—	3	2	5	54	51	201
Food Technology	2	—	5	—	—	—	1	—	1	—	—	—	—	—	—	—	2	5	—	2	—	3	4	11
General Engineering	4	2	8	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4	2	8
General Science	—	2	6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	6
Geology	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—
Geology and Geophysics	—	—	5	—	—	—	—	—	—	—	—	—	—	—	—	—	1	2	—	—	—	—	1	7
Geophysics	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—
Industrial Economics	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	6	3	2	—	—	—	6	3	2
Industrial Management	—	—	—	—	—	—	8	1	57	—	—	—	—	—	—	—	—	—	—	—	—	8	1	57
Mathematics	4	2	9	—	—	—	2	1	11	—	—	—	—	—	—	—	1	3	—	—	—	6	4	23
Mechanical Engineering	9	11	105	—	—	—	12	18	33	—	—	—	1	2	5	—	—	—	3	4	6	25	35	149
Metallurgy	1	2	22	—	—	—	12	3	8	—	—	—	—	2	1	—	—	—	3	6	11	16	13	42
Meteorology	—	—	1	—	—	—	4	2	3	—	—	—	—	—	—	—	1	4	—	—	1	4	3	9
Naval Arch. and Marine Eng.	2	1	6	—	—	—	3	3	25	—	—	—	2	—	24	—	—	—	—	—	—	7	4	55
Nuclear Engineering	—	—	—	—	—	—	10	9	13	—	—	—	—	—	—	—	—	—	—	—	—	10	9	13
Physics	—	1	61	—	—	—	3	3	5	—	—	—	—	—	—	8	13	6	—	—	2	11	17	74
Quantitative Biology	1	1	10	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	1	10
Sanitary Engineering	—	—	—	—	—	—	4	1	10	—	—	—	—	—	—	—	—	—	1	—	2	5	1	12
ShippingandShipbuildingMan.	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1
Textile Technology	—	—	—	—	—	—	1	—	3	—	—	—	—	—	—	—	—	—	—	—	—	1	—	3
Without Course Classification	—	—	—	—	—	—	4	2	39	—	—	—	—	—	—	—	—	—	—	—	—	4	2	39
Total	71	65	607	4	1	17	127	90	374	20	1	7	7	9	45	27	35	43	13	17	36	269	218	1,129

TABLE 13

Degrees of Bachelor of Science According to Class in Which They Were Awarded

Class (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, Politics and Engineering or Science	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
1868	—	—	—	—	—	—	—	—	1	6	—	—	—	—	—	1	—	—	1	—	—	—	6	—	—	—	14	
1869	—	—	—	—	—	—	—	—	1	2	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	5	
1870	—	—	—	—	—	—	—	—	1	4	—	—	—	—	—	1	—	—	2	—	—	—	2	—	—	—	10	29
1871	—	—	—	—	—	—	—	—	2	8	—	—	—	—	—	—	—	—	2	—	—	—	5	—	—	—	17	
1872	—	—	—	—	—	—	—	—	3	3	—	—	—	—	—	—	—	—	1	—	—	—	5	—	—	—	12	
1873	—	—	1	—	—	—	—	—	7	12	—	—	—	—	—	1	—	—	2	—	—	—	3	—	—	—	26	
1874	—	—	1	—	—	—	—	—	—	10	—	—	—	—	—	2	—	—	4	—	—	—	1	—	—	—	18	
1875	—	—	1	—	—	—	—	—	1	10	—	—	—	—	—	2	—	—	7	—	—	—	6	—	1	—	28	
1876	—	—	1	2	—	—	—	—	5	12	—	—	—	—	—	4	—	—	8	—	—	—	8	—	3	—	43	
1877	—	—	4	—	—	—	—	—	2	12	—	—	—	—	—	—	—	—	6	—	—	—	8	—	—	—	32	
1878	—	—	3	—	—	—	—	—	3	8	—	—	—	—	—	1	—	—	2	—	—	—	2	—	—	—	19	
1879	—	—	1	1	—	—	—	—	3	6	—	—	—	—	—	—	—	—	8	—	—	—	3	—	1	—	23	
1880	—	—	—	—	—	—	—	—	1	3	—	—	—	—	—	1	—	—	—	—	—	—	3	—	—	—	8	226
1881	—	—	3	1	—	—	—	—	8	3	—	—	—	—	—	2	—	—	5	—	—	—	6	—	—	—	28	
1882	—	—	3	1	—	—	—	—	6	2	—	—	—	—	—	1	—	—	5	—	—	—	5	—	1	—	24	
1883	—	—	1	—	—	—	—	—	3	3	—	—	—	—	—	—	—	—	7	—	—	—	5	—	—	—	19	
1884	—	—	—	—	—	—	—	—	12	5	—	—	—	—	—	—	—	—	6	—	—	—	13	—	—	—	36	
1885	—	—	2	—	—	—	—	—	4	4	—	2	—	—	—	1	—	—	7	—	—	—	8	—	—	—	28	
1886	—	—	1	1	—	—	—	—	7	9	—	10	—	—	—	1	—	—	23	—	—	—	7	—	—	—	59	
1887	—	—	1	1	—	—	—	—	9	10	—	8	—	—	—	3	—	—	17	—	—	—	8	—	1	—	58	
1888	—	—	5	3	—	—	—	—	10	11	—	17	—	—	—	1	—	—	25	—	—	—	4	—	1	—	77	
1889	—	—	3	1	—	—	—	—	8	14	—	17	—	—	—	2	—	—	24	—	—	—	5	—	1	—	75	
1890	—	—	5	3	—	—	—	—	13	25	—	18	—	—	—	6	—	—	28	—	—	—	3	—	2	—	103	507
1891	—	—	6	3	—	—	7	—	11	18	—	23	—	—	—	1	1	—	26	—	—	—	4	—	3	—	103	
1892	—	—	13	6	—	—	4	—	7	22	—	36	—	—	—	7	1	—	26	—	—	—	4	—	1	6	133	
1893	—	—	2	2	—	—	8	—	8	25	—	41	—	—	—	6	2	—	30	—	—	—	5	—	—	—	129	
1894	—	—	14	1	—	—	12	—	11	21	—	33	—	—	—	5	—	—	31	—	—	—	4	—	3	3	138	
1895	—	—	15	—	—	—	11	—	14	25	—	33	—	—	—	4	—	—	30	—	—	—	3	5	2	4	146	
1896	—	—	24	3	—	—	7	—	17	26	—	48	—	—	—	7	3	—	34	—	—	—	10	5	3	4	191	
1897	—	—	16	2	—	—	12	—	20	25	—	33	—	—	—	7	1	—	40	—	—	—	7	9	3	4	179	
1898	—	—	29	3	—	—	9	—	25	32	—	33	—	—	—	6	—	—	41	—	—	—	7	7	4	3	199	
1899	—	—	22	2	—	—	10	—	22	30	—	32	—	—	—	1	—	—	37	—	—	—	9	8	2	1	176	
1900	—	—	21	3	—	—	11	—	19	32	—	23	—	—	—	5	—	—	34	—	—	—	21	9	3	4	185	1,579

* 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 on page 315)

TABLE 13 — (*Continued*)

Degrees of Bachelor of Science According to Class in Which They Were Awarded

Class (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, Politics and Engineering or Science	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
1901	—	—	21	1	—	—	14	—	17	37	—	25	—	—	—	6	1	—	39	—	—	—	18	16	1	4	200	
1902	—	—	18	5	—	—	9	—	14	24	—	35	—	—	—	3	—	—	46	—	—	—	14	14	3	7	192	
1903	—	—	15	1	—	—	10	—	13	26	—	39	1	—	—	1	1	—	37	—	—	—	27	12	3	4	190	
1904	—	—	24	3	—	—	7	—	15	34	—	34	8	—	—	5	1	—	45	—	—	—	32	17	5	2	232	
1905	—	—	12	3	—	—	13	—	23	46	—	31	3	—	—	3	1	—	54	—	—	—	26	24	—	5	244	
1906	—	—	22	2	—	—	10	—	21	47	—	37	3	—	—	—	—	—	69	—	—	—	38	19	4	6	278	
1907	—	—	21	—	—	—	14	—	10	37	—	32	5	—	—	—	2	—	52	—	—	—	22	10	—	3	208	
1908	—	—	19	4	—	—	15	—	16	48	—	38	2	—	—	—	—	—	62	—	—	—	19	5	—	2	230	
1909	—	—	18	5	—	—	13	—	12	51	—	42	3	—	—	—	—	—	41	—	—	—	30	5	3	9	232	
1910	—	—	18	3	—	—	18	—	10	57	—	36	3	—	—	2	—	—	57	—	—	—	24	11	—	12	251	2,257
1911	—	—	10	1	—	—	19	—	12	46	—	49	5	—	—	2	—	—	49	—	—	—	17	6	1	15	232	
1912	—	—	21	4	—	—	31	—	7	55	—	52	3	—	—	1	—	—	47	—	—	—	21	3	2	14	261	
1913	—	—	26	2	—	—	30	—	12	58	—	43	8	—	—	—	—	—	50	—	—	—	20	4	1	15	269	
1914	—	—	19	6	—	—	37	—	9	60	—	51	8	—	—	4	—	—	65	—	—	—	17	8	1	19	304	
1915	—	—	30	3	—	—	33	—	23	49	—	42	10	—	—	3	—	—	69	—	—	—	5	7	3	12	289	
1916	—	—	37	5	—	—	32	—	11	45	—	56	14	—	—	2	—	—	84	—	—	—	5	9†	3	18	321	
1917	—	—	27	10	—	37	43	—	13	49	—	45	10	—	—	5	2	—	63	—	—	—	14	9†	1	17	345	
1918	—	—	28	7	—	29	40	—	10	45	—	50	11	—	2	4	1	—	75	—	—	—	10	4	3	5	324	
1919	—	—	16	9	—	28	44	—	8	45	—	50	6	—	3	1	—	—	66	—	—	—	7	7	4	6	300	
1920	—	—	19	2	—	48	63	—	6	52	—	30	9	—	1	4	—	—	55	—	—	—	13	12	2	2	318	2,963
1921	—	—	11	3	—	70	92	—	9	98	—	75	15	—	15	—	3	—	128	—	—	—	24	18	1	3	565	
1922	—	—	32	8	—	126	98	15	11	65	—	109	25	—	25	1	8	—	56	—	—	—	27	16	8	7	637	
1923	—	13	18	6	—	115	73	19	16	64	—	78	16	—	23	2	8	3	106	—	—	—	23	13	9	3	608	
1924	—	6	15	6	—	82	57	8	13	69	—	125	17	—	36	4	2	1	82	—	—	—	19	11	3	1	557	
1925	—	6	18	2	—	94	53	8	18	57	—	110	9	—	37	2	3	2	98	—	—	—	23	10	5	—	555	
1926	—	9	24	5	—	95	45	13	19	76	—	108	14	—	33	2	4	1	76	—	—	—	20	14	1	2	561	
1927	2	15	19	6	—	89	39	6	13	73	—	121	8	—	22	2	3	3	72	—	—	1	9	4	4	3	514	
1928	8	19	16	5	—	73	38	7	13	59	—	114	11	—	12	2	1	3	67	—	—	—	12	3	3	5	471	
1929	29	25	26	7	9	69	37	11	18	46	—	84	10	—	14	1	2	5	64	—	—	—	11	5	4	6	483	
1930	29	15	44	9	23	59	39	12	11	46	—	76	8	—	9	1	2	1	48	—	—	—	6	6	11	4	459	5,410

* 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 on page 316*)

TABLE 13 — (*Continued*)

Degrees of Bachelor of Science According to Class in Which They Were Awarded

Class (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, Politics and Engineering or Science	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	—	—	—	18	23	—	501	
1942	39	—	—	17	3	61	60	8	34	16	—	66	—	—	20	11	5	4	98	34	—	—	—	29	25	1	531	
1943	38	—	—	10	5	49	49	14	21	14	—	83	—	—	18	11	2	6	80	24	—	—	—	33	14	1	472	
1944	57	—	—	4	3	28	41	20	12	18	—	47	—	—	14	4	1	2	78	8	—	—	—	37	20	2	396	
1945	22	—	—	1	1	22	36	—	5	9	—	45	—	—	6	1	—	5	70	3	—	—	—	13	16	—	255	
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	45	—	—	15	21	77	102	6	20	55	13	133	—	10	12	11	15	23	119	26	2	—	—	15	39	—	759	
§1957	30	—	—	11	10	91	61	9	13	36	16	144	—	7	10	8	5	11	116	24	1	—	—	7	62	—	672	
Total	1,135	172	865	457	375	3,204	2,830	370	1,202	2,895	160	5,097	301	82	812	326	205	249	4,962	454	88	5	880	859	977	264	29,226	

** 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	—	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 on page 318*)

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	30	—	4	11	50	1	40	34	1	41	1	108	6	6	7	42	26	5	7	—	—	10	12	41	483
*1957	28	—	1	4	58	2	44	39	3	24	1	87	2	—	12	54	11	5	29	—	—	8	11	41	464
Total	686	84	85	65	484	11	811	946	202	671	38	2,253	38	83	140	1,034	290	217	156	478	5	198	145	955	10,075

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	10,201

* 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	18	—	19	8
*1957	18	—	5	3
Total	454	31	336	162

* 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 (Calendar Year)	Aeronautical Engineer	Building Engineer	Chemical Engineer	Civil Engineer	Electrical Engineer	Marine Mech. Engineer	Mechanical Engineer	Metallurgical Engineer	†Meteorologist	Naval Architect	Naval Engineer	Sanitary Engineer	Total
1949 . .	—	—	—	—	2	—	—	—	1	—	37	—	40
1950 . .	2	—	—	—	10	—	8	2	—	—	27	—	49
1951 . .	3	—	1	—	9	—	10	2	—	1	33	—	59
1952 . .	2	—	—	1	6	—	13	1	1	—	38	3	65
1953 . .	3	—	—	3	4	—	8	1	—	—	19	—	38
1954 . .	4	2	2	1	7	—	8	3	—	1	29	2	59
1955 . .	3	2	—	2	8	1	5	—	—	1	25	—	47
1956 . .	6	—	—	2	6	2	12	1	—	1	29	2	61
*1957 . .	4	—	2	—	14	—	7	3	—	2	22	—	54
Total .	27	4	5	9	66	3	71	13	2	6	259	7	472

* Includes only January and June degrees.
† Discontinue June 1956.

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 on page 323)

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	32	—	2	5	13	7	1	29	—	93
*1957	6	29	—	7	3	5	4	5	19	—	78
Total	78	621	2	21	105	73	113	6	419	9	1,447

*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 on page 325*)

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	4	3	12	—	2	14	—	1	—	—	16	16	3	—	—	—	—	2	73
1954	4	6	10	—	2	10	—	—	2	1	13	18	3	—	—	—	—	2	71
1955	3	4	12	—	4	16	—	2	—	—	11	20	3	—	—	—	—	1	76
1956	5	1	11	1	3	17	—	1	—	—	12	16	—	—	—	—	—	2	69
*1957	1	—	5	—	6	7	—	2	—	—	10	17	1	—	—	—	2	2	53
Total	54	41	288	13	66	170	2	11	14	6	133	229	46	5	2	1	43	21	1,145

* Includes only January and June degrees.

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 (1868–1957)

Bachelor of Science	29,226
Bachelor in Architecture	454
Bachelor in City Planning	31
Master of Science	10,201
Master in Architecture	336
Master in City Planning	162
Master in Public Health (Discontinued after 1944)	104
Advanced Engineering	472
Doctor of Philosophy	1,447
Doctor of Science	1,145
Doctor of Public Health (Discontinued after 1944)	9
Doctor of Engineering (Discontinued after 1918)	4
Grand Total	43,591

ROBERT E. HEWES

PRINCIPAL HONORS AND AWARDS TO THE STAFF

ADMINISTRATION

PIETRO BELLUSCHI
Honorary Degree of Doctor of Science, Christian Brothers College, Memphis, Tennessee.
Gold Medal award for professional achievement of the Memphis Chapter, American Institute of Architects.
Academician, National Academy of Design.
Principal speaker, Centennial Celebration, American Institute of Architects.

JOHN E. BURCHARD
Honorary Degree of Doctor in Architecture, University of Michigan.
President of the American Academy of Arts and Sciences (third term).

VANNEVAR BUSH
Honorary Fellow of the American College of Surgeons.
Jefferson Medal of the New Jersey Patent Law Association.

MARK J. DONDERO
National Representative and Member of the Executive Committee, Boston Chapter, American Society of Safety Engineers.
Member of the Board of Directors, Massachusetts Safety Council.

GEORGE R. HARRISON
Pittsburgh Spectroscopy Award of the Spectroscopy Society of Pittsburgh.

HAROLD L. HAZEN
Chairman of the Committee on the Development of Engineering Faculties, American Society for Engineering Education.
Member of the Board of Visitors to the Air University, Maxwell Air Force Base.

JAMES R. KILLIAN, JR.
Decoration for Exceptional Civilian Service from the Department of the Army.
Public Welfare Medal of the National Academy of Sciences.
Officiér of the French Legion of Honor.

JOHN I. MATTILL
Chairman of the Public Relations Committee, American Society for Engineering Education.

DONALD P. SEVERANCE
President of the Appalachian Mountain Club.

H. GUYFORD STEVER
Fellow of the Institute of Aeronautical Sciences.
Exceptional Civilian Service Medal of the United States Air Force.
Vice Chairman of the United States Air Force Scientific Advisory Board.

JULIUS A. STRATTON
Medal of Honor of the American Institute of Radio Engineers.
Honorary Degree of Doctor of Laws, Northeastern University.

B. ALDEN THRESHER
Vice Chairman of the College Entrance Examination Board.

DEPARTMENT OF AERONAUTICAL ENGINEERING

HOLT ASHLEY
Vice President of the Cambridge Council, Boy Scouts of America.

EUGENE J. BRUNELLE, JR.
Lecture Award of the Institute of the Aeronautical Sciences for 1957, presented by the M.I.T. student chapter.

CHARLES S. DRAPER
State Air Power Award from the Massachusetts Wing of the Air Force Association.
Thurlow Award of the Institute of Navigation.

RENE H. MILLER
Secretary of the American Helicopter Society.

ERIK L. MOLLO-CHRISTENSEN
Fellowship, John Simon Guggenheim Memorial Foundation.

H. PHILIP WHITAKER
Selected by the Boston Junior Chamber of Commerce as "one of the outstanding young men of 1956."

DEPARTMENT OF ARCHITECTURE

LAWRENCE B. ANDERSON
Awards to Buildings by Anderson, Beckwith and Haible:

For the Middlesex Mutual Building Trust, Waltham, Massachusetts:
National First Honor Award of the American Institute of Architects.
Grand Architecture Award of 1957, Boston Arts Festival.
Parker Medal Award of the Boston Society of Architects.

For the Lincoln-Sudbury Regional School, Sudbury, Massachusetts:
Prize Design in the Architectural Division, Boston Arts Festival.

ALBERT BUSH-BROWN
Editor of the *Journal of Collegiate Schools of Architecture.*
Editor of the Section on Architecture, *Encyclopaedia Britannica.*

DEPARTMENT OF BIOLOGY

ETHEL H. BAILEY
Director and Chairman of the Harrington-Emerson Award Committee, Boston Chapter, Society for the Advancement of Management.
Chairman of the Professional Guidance and Education Committee, Boston Section, Society of Women Engineers.

NORMAN GESCHWIND
Research Fellowship, National Foundation for Infantile Paralysis.

ROBERT L. HERRMANN
Damon Runyon Postdoctoral Fellowship.

HOWARD P. JENERICK
Co-chairman of the Session on Biophysical Transport Systems, National Biophysics Conference.

FRANCIS O. SCHMITT
Albert Lasker Award.
Honorary Degree of Doctor of Science, University of Chicago.

CLAIR E. TURNER
Chief Adviser (Haut-Conseiller) of the International Union for Health Education of the Public.

DEPARTMENT OF CHEMICAL ENGINEERING

CHARLES A. HOMSY
Fulbright Award for study at the University of Sheffield, England.

THOMAS K. SHERWOOD
Chairman of the Divisional Committee for the Mathematical, Physical, and Engineering Sciences, National Science Foundation.

DEPARTMENT OF CHEMISTRY

PAUL E. BURTON
Fellowship, National Science Foundation.

CHARLES D. CORYELL
Honorary Member of Technion Society.

FRANK A. COTTON
Fellowship, John Simon Guggenheim Memorial Foundation.

LAWRENCE J. HEIDT
Member of the *Ad Hoc* Committee on Solar Energy, Scientific Advisory Board, United States Air Force.
Chairman and Responsible Officer of the National Academy of Sciences—National Research Council Symposium on Photochemical Storage of Energy.
Chairman of the Committee on Local Groups, Northeastern Section, American Chemical Society.
Member of the Advisory Board, Association for Applied Solar Energy.

RICHARD C. LORD
Honorary Degree of Doctor of Science, Kenyon College (Ohio).

NICHOLAS A. MILAS
Honorary Degree of Doctor of Science, Coe College (Iowa).

LOCKHART B. ROGERS
Chairman of the Massachusetts Science Talent Search Committee.
Vice Chairman of the Boston Section, The Electrochemical Society.
Program Chairman of the Northeastern Section, American Chemical Society.

CHARLES H. SEDERHOLM
Fellowship, National Science Foundation.
President of Phi Lambda Upsilon (honorary chemical fraternity).

JOHN C. SHEEHAN
Member of the National Academy of Sciences.

WALTER H. STOCKMAYER
Member of the National Academy of Sciences.

C. GARDNER SWAIN
Award in Petroleum Chemistry of the American Chemical Society.

JOHN T. WASSON
Fellowship, National Science Foundation.

DEPARTMENT OF CITY AND REGIONAL PLANNING

BERNARD J. FRIEDEN
Bettman Scholarship Award.

DEPARTMENT OF CIVIL AND SANITARY ENGINEERING

JOHN M. BIGGS
Chairman of the Structural Section, Boston Society of Civil Engineers.

ALEXANDER J. BONE
Vice President of the Educational Division, American Road Builders Association.

ALBERT G. H. DIETZ
Award of Merit of the American Society for Testing Materials.

ROBERT J. HANSEN
Chairman of the Construction Section, Boston Society of Civil Engineers.
Chairman of the Dynamics Committee, Column Research Council.

ARTHUR T. IPPEN
Member of the Advisory Board to the Garfield Thomas Water Tunnel.
Member of the Board of Directors, Boston Society of Civil Engineers.

T. WILLIAM LAMBE
Desmond Fitzgerald Prize of the Boston Society of Civil Engineers.

ROSS E. MCKINNEY
Chairman of the Publications Committee, Sanitary Engineering Division, American Society of Civil Engineers.
Chairman of the Rudolf Hering Award Committee, American Society of Civil Engineers.

CHARLES L. MILLER
Surveying and Mapping Award of the Boston Society of Civil Engineers.

VINCENT J. ROGGEVEEN
Doctoral Dissertation Fellowship, Ford Foundation.

CLAIR N. SAWYER
President of the New England Sewage and Industrial Wastes Association.
Vice Chairman of the Sanitary Section, Boston Society of Civil Engineers.

WALTER C. VOSS
Award of Merit of the American Society for Testing Materials.

DEPARTMENT OF ECONOMICS AND SOCIAL SCIENCE

E. CARY BROWN
Fellowship, John Simon Guggenheim Memorial Foundation.
Faculty Research Fellowship, Ford Foundation.

EVERETT E. HAGEN
Purington Memorial Lecturer, Mount Holyoke College.

DANIEL LERNER
Chairman of the Committee on International Studies, World Association for Public Opinion Research.

NORMAN J. PADELFORD
Member of the Board of Trustees, Denison University (Ohio).

DEPARTMENT OF ELECTRICAL ENGINEERING

JORDAN J. BARUCH
Eta Kappa Nu Award for the "outstanding young electrical engineer."

LEO L. BERANEK
Head of the American Delegation to the International Standards Organization Meeting, Paris, France.
Chairman of the Awards Committee, Boston Section, Institute of Radio Engineers.
Chairman of the Acoustics Standards Board, American Standards Association.
Vice Chairman of the Editorial Board, *Noise Control Magazine.*

Associate Editor of the Journal and Chairman of the Nominating Committee of the Acoustical Society of America.
Member of the Board of Trustees, Cornell College (Iowa).

RICHARD H. BOLT
Member of the Governing Board, American Institute of Physics.
Member of the Council, American Association for the Advancement of Science.

GORDON S. BROWN
Member of the Board of Overseers, Dartmouth College.
Member of the Board of Trustees, Foundation for Instrumentation Education and Research.

DUDLEY A. BUCK
Browder J. Thompson Memorial Prize of the Institute of Radio Engineers.

TRUMAN S. GRAY
Chairman of the Subcommittee on Organization, Instrumentation Division Committee, American Institute of Electrical Engineers.
Vice Chairman of the A.I.E.E. Committee on Nucleonics.
Secretary of the A.I.E.E. Committee on Nucleonic and Radiation Instruments.
Chairman of the Nominating Committee, Professional Group on Nuclear Science, Institute of Radio Engineers.

ELIAS P. GYFTOPOULOS
Television Shares Management Corporation Award.

OSMAN K. MAWARDI
Member of the New York Academy of Science.

WALTER A. ROSENBLITH
Chairman of the Panel on Convergent Fields, National Academy of Sciences and National Research Council.

LOUIS D. SMULLIN
Fellow, Institute of Radio Engineers

THOMAS G. STOCKHAM, JR.
Goodwin Medal.
Television Shares Management Corporation Award.

WALTER A. STURM
Medal from the National Academy of Sciences.

JOHN A. TUCKER
Chairman of the Branch Liaison Committee, Boston Section, American Institute of Electrical Engineers.

ARTHUR R. VON HIPPEL
Fellow of the New York Academy of Sciences.

DAVID R. WHITEHOUSE
Television Shares Management Corporation Award.

JEROME B. WIESNER
Member of the Scientific Advisory Panel, Secretary of the Army.
Member of the Ballistic Committee, Department of Defense.

WILLIAM A. YOUNGBLOOD
Television Shares Management Corporation Award.

DEPARTMENT OF FOOD TECHNOLOGY

SAMUEL A. GOLDBLITH
Chairman of the Northeast Section, Institute of Food Technologists.

United States Delegate to the Inter-American Symposium on Peaceful Uses of Atomic Energy.

DEPARTMENT OF GEOLOGY AND GEOPHYSICS

ROBERT R. SHROCK
President of the Society of Economic Paleontologists and Mineralogists.
Chairman of Section E and Vice President of the American Association for the Advancement of Science.

DEPARTMENT OF HUMANITIES

CARVEL COLLINS
General Committeeman, New England College English Association.
Member of the Board of Directors, National College English Association.

KARL W. DEUTSCH
Fellow, Center for Advanced Study in the Behavioral Sciences.

THOMAS H. D. MAHONEY
President of the American Catholic Historical Association.

HAROLD A. T. O. REICHE
Danforth Associate.

WILLIAM D. STAHLMAN
Treasurer of the History of Science Society.

GREGORY TUCKER
Fellowship, John Simon Guggenheim Memorial Foundation.
Staff member, Composers Conference, Bennington, Vermont.

ROGER W. WESTCOTT
Fellowship in linguistic anthropology, Ford Foundation.

SCHOOL OF INDUSTRIAL MANAGEMENT

DONALD A. CORBIN
Fellowship of the Joint Committee on Education representing the American securities business.

BILLY E. GOETZ
Vice President of the Academy of Management.
Director of the Boston Chapter, Society for the Advancement of Management.

HERBERT F. GOODWIN
Director of the Boston Chapter, American Institute of Industrial Engineers.

WILLIAM A. W. KREBS, JR.
Chairman of the Committee on Legal Problems, Atomic Industrial Forum, Inc.
Member of the Commission on Atomic Energy, Commonwealth of Massachusetts.

DOUGLAS M. MCGREGOR
Fellow of the American Academy of Arts and Sciences.

LEO B. MOORE
Member of the Board of Directors, Standards Engineers Society.

ALBERT H. RUBENSTEIN
Vice Chairman of the Boston Professional Group on Engineering Management, Institute of Radio Engineers.
University Seminar Associate, Columbia University.
Consultant to the Annual Conference on Industrial Research, Columbia University.

ELI SHAPIRO
Faculty Fellowship, Ford Foundation.

LIBRARIES

NATALIE NICHOLSON
Member of the Executive Committee for the 48th Annual Convention, Special Libraries Association.

BURTON A. ROBIE
Program Chairman of the Association of College and Reference Libraries Section, New England Library Association Conference.

DEPARTMENT OF MATHEMATICS

ERIC REISSNER
Member of the Council of the American Academy of Arts and Sciences.

STANISLAW M. ULAM
Fellow of the American Academy of Arts and Sciences.

DEPARTMENT OF MECHANICAL ENGINEERING

DOUGLAS P. ADAMS
Visiting Lecturer in Engineering Sciences, Harvard University.

ROBERT R. ARCHER
Fulbright Lectureship to the Technische Höchschule, Darmstadt, Germany.

STANLEY BACKER
Member of the Governing Council, Fiber Society.
Chairman of the Fabrics Committee and Member of the Body Armor Advisory Committee, Quartermaster Advisory Board.

EARLE BUCKINGHAM
Gold Medal of the American Society of Tool Engineers.

JACK B. CHADDOCK
Vice Chairman of the Boston Section, American Society of Refrigeration Engineers.

DOUGLAS A. EAST
Karl Taylor Compton Prize.

FREDDIE D. EZEKIEL
Member of the Board of Directors of the International Student Association of Greater Boston.

JOSEPH H. KEENAN
Special Lecturer, University of London, England.

ROBERT W. MANN
Chairman of the *Ad Hoc* Advisory Group on Missile Auxiliary Power Systems, United States Department of Defense.

WILLIAM M. MURRAY
Secretary-Treasurer of the Society for Experimental Stress Analysis.
Honorary Chairman of the Western Regional Strain Gage Committee.

WARREN G. NELSON
Fulbright Award for study in Germany.

ERNEST RABINOWICZ
Walter D. Hodson Award of the American Society of Lubrication Engineers.

WARREN M. ROHSENOW
Fellow of the American Academy of Arts and Sciences.
Alumni Merit Award, Northwestern University.
Chairman of the Boston Section, American Society of Mechanical Engineers.

MILTON C. SHAW
Distinguished Alumnus Citation, Drexel Institute of Technology.
Guest Professor, Aachen Technische Höchschule, Germany.
United States Delegate to the United Nations meeting on the Economic Development of South America.

ARTHUR L. TOWNSEND
James H. McGraw Award in Technical Institute Education of the American Society for Engineering Education.

JOHN A. WELSH
Arthur L. Williston Award and Medal of the American Society of Mechanical Engineers.

MEDICAL DEPARTMENT

MARTIN J. BELLINGER
Member, Boston Surgical Society.

STANLEY COBB
Honorary member of the Royal Society of Medicine, London, England.

JAMES M. FAULKNER
Member of the National Board of Medical Examiners.
Director of the Harvard Alumni Association.
Member of the Advisory Board, National Fund for Medical Education.

HARRIET L. HARDY
Research Grant for study of occupational lung disease, National Institutes of Health.
Member, Association of American Physicians.

ROBERT J. HERM
Certified by the American Board of Ophthalmology.

JAMES H. MEANS
Honorary member of the Medical Society of Finland.

JOHN L. ROWBOTHAM
Diplomate of the American Board of Surgery.

ROBERT F. TILLEY
Secretary-Treasurer of the Boston Dermatology Club.

DEPARTMENT OF METALLURGY

WALTER A. BACKOFEN
Chairman of the New England Regional Conference, Institute of Metals Division, American Institute of Mining, Metallurgical, and Petroleum Engineers.

JOHN C. CAMPBELL
First prize in the Metallurgy Division of the 1956 Student Essay Competition, Canadian Institute of Mining and Metallurgy (co-author).

JOHN CHIPMAN
Priestley Lecturer at the Pennsylvania State University.

JEROME B. COHEN
Fulbright Award for study in France.

MORRIS COHEN
American Society for Metals Visiting Lectureship, University of Minnesota.
Institute of Metals Annual Lecture of the American Institute of Mining, Metallurgical, and Petroleum Engineers.

JOHN F. ELLIOT
Frank L. Toy Award of the Pittsburgh Section, American Institute of Metallurgical Engineers.

ANTOINE M. GAUDIN
Robert H. Richards Award of the American Institute of Mining, Metallurgical, and Petroleum Engineers.
Chairman of the Research Procedure Committee, Engineering Foundation.

CARLE R. HAYWARD
Legion of Honor of the American Institute of Mining, Metallurgical, and Petroleum Engineers.
Fifty Year Membership Medal of the Rural Lodge, A.F. and A.M., Quincy, Massachusetts.

W. DAVID KINGERY
Chairman of the New England Section and Vice Chairman of the Basic Science Division, American Ceramic Society.

FREDERICK H. NORTON
Councilor of the New England Section, American Ceramic Society.

CARL W. WAGNER
Willis Rodney Whitney Award of the National Association of Corrosion Engineers.

DEPARTMENT OF METEOROLOGY

KIRK BRYAN, JR.
Swedish Government Fellowship for research and study in Sweden.

HENRY G. HOUGHTON
Secretary and Councilor of the American Meteorological Society.

DEPARTMENT OF MODERN LANGUAGES

MARTIN DYCK
Guest Lecturer in Scientific Russian, Woods Hole Oceanographic Institution.

WILLIAM N. LOCKE
Fellow of the American Academy of Arts and Sciences.

DEPARTMENT OF NAVAL ARCHITECTURE AND MARINE ENGINEERING

MARTIN A. ABKOWITZ
Chairman of the Committee on Control and Maneuvering, American Towing Tank Conference.

LAURENS TROOST
The President's Award of the Society of Naval Architects and Marine Engineers.
Chairman of the Sub-committee for Resistance and Propulsion, Society of Naval Architects and Marine Engineers.

DEPARTMENT OF PHYSICS

SANBORN C. BROWN
Chairman of the Rumford Committee, American Academy of Arts and Sciences.
Chairman of the Apparatus Committee and New England Representative to the Council, American Association of Physics Teachers.

WILLIAM W. BUECHNER
Visiting Professor, National University of Mexico.

ARTHUR C. HARDY
Frederic Ives Medal of the Optical Society of America.

M. STANLEY LIVINGSTON
Director of the Cambridge Electron Accelerator.
Named "Outstanding Wisconsinite in Science for 1957" by the Junior Achievement Club of Southeast Wisconsin.

MALCOM W. P. STRANDBERG
Fellow of the American Academy of Arts and Sciences.

GEORGE E. VALLEY, JR.
Exceptional Civilian Service Medal of the United States Department of Defense.

BERTRAM E. WARREN
Fulbright Lectureship at the College de France, Paris.

JERROLD R. ZACHARIAS
Member of the National Academy of Sciences.

CENTER FOR INTERNATIONAL STUDIES

FRANCIS M. BATOR
Faculty Lecturer, Salzburg Seminar in American Studies, Austria.

LINCOLN P. BLOOMFIELD
Chase Prize "for the best essay on a subject tending to the promotion of world peace," Harvard University.

MAX F. MILLIKAN
Fellow of the American Academy of Arts and Sciences.
President of the World Peace Foundation.

WALT W. ROSTOW
Fellow of the American Academy of Arts and Sciences.

DIVISION OF SPONSORED RESEARCH

RICHARD H. BAKER
Chairman of the Program Committee, 1958 Transistor and Solid State Circuit Convention.

J. THOMAS BORTON
Publicity Chairman of the Professional Group on Automatic Control, Institute of Radio Engineers.

DAVID R. BROWN
Chairman of the Electronic Computers Committee, Institute of Radio Engineers.

JOHN P. COYLE
President of the Washington Chapter, Operations Research Society of America.

WARNER C. DANFORTH, JR.
Chairman of the High School Guidance Committee and Vice President, Boston Alumni Chapter, Eta Kappa Nu.

WILBUR B. DAVENPORT, JR.
Vice Chairman of the Administrative Committee, Professional Group on Information Theory, Institute of Radio Engineers.

STEPHEN H. DODD, JR.
Secretary of the Committee on Computing Devices, American Institute of Electrical Engineers.

RONALD G. ENTICKNAP
Chairman of the Boston Chapter, Professional Group on Aeronautical and Navigational Electronics, Institute of Radio Engineers.

MARTIN L. ERNST
Secretary of the Operations Research Society of America.

IRVING GOLDBERG
Clarkson Alumni Award for the highest standing in the accounting curriculum, Northeastern University.

LEONARD KLEINROCK
Medal of the Department of Electrical Engineering, College of the City of New York.

CARL F. J. OVERHAGE
Fellow of the American Academy of Arts and Sciences.

WILLIAM H. RADFORD
Citation and Honorary Degree of Doctor of Engineering, Drexel Institute of Technology.
Vice Chairman of the Joint Technical Advisory Committee, Institute of Radio Engineers.
Consultant to the U.S. Air Force Electronics and Communications Panel, Scientific Advisory Board.
Member of the *Ad Hoc* Committee (Special Study of Advanced Weapons Techniques and Environment), Scientific Advisory Board.

JACINTO STEINHARDT
Member of the Council, Operations Research Society of America.

JOHN E. WARD
Chairman of the Technical Committee on Feedback Control Systems, Institute of Radio Engineers.
Vice Chairman of the Professional Group on Automatic Control, Institute of Radio Engineers.

ARTS AND THE FACULTY

ADMINISTRATION

PIETRO BELLUSCHI

Design of First Lutheran Church of Boston, Massachusetts.
Design (with Carl Koch and Associates) of Temple Israel, Swampscott, Massachusetts.
Design and report (with Eduardo Catalano) of a site plan for Civic Center Project, Washington, D.C.
Design and report (with Eduardo Catalano) of a site plan for Potomac Plaza, Washington, D.C.

DEPARTMENT OF ARCHITECTURE

MARVIN E. GOODY

Design of "The Monsanto House of the Future," an all-plastic house exhibited in Anaheim, California.

DEPARTMENT OF HUMANITIES

ERNST LEVY

First Boston performance of Chamber Symphony (Symphony No. 12), in Kresge Auditorium, M.I.T., March, 1957.
First performance (recording for the Swiss Radio) of Symphony No. 13, commissioned by the City of Basle, Switzerland.

GREGORY TUCKER

Premiere performance of Suite for Orchestra, in Kresge Auditorium, May, 1957.
Premiere performance of Divertimento for Violin and Piano, at Wellesley College, May, 1957.

DEPARTMENT OF MODERN LANGUAGES

MARTIN DYCK

First performance of "The Fair-Haired Boy," translation from the Russian comedy "Enough Stupidity in Every Wise Man," by Alexander Ostrowsky.

DEPARTMENT OF PHYSICS

ROBERT A. SCHLUTER

Awarded the Hudson Cup for the best color photograph and several citations in the Annual Exhibition of the Alpine Club of Canada.

DIVISION OF SPONSORED RESEARCH

ARTHUR L. LOEB

Public recorder and harpsichord recitals: M.I.T. Chapel (with David C. Johnson); First Church Unitarian, Cambridge; Jordan Hall, Boston; Fenway Court, Gardner Museum; and Boston Y.W.C.A.

PUBLICATIONS FROM THE INSTITUTE

PERIODICAL PUBLICATIONS, BOOKS AND REVIEWS BY THE STAFF, JULY 1, 1956–JUNE 30, 1957[1]

DEPARTMENT OF AERONAUTICAL ENGINEERING

ASHLEY, HOLT and R. L. HALFMAN. The Flutter of Low-Aspect-Ratio Wings. (In *Ninth International Congress on Theoretical and Applied Mechanics Proc.* 1956.)

ASHLEY, HOLT and G. ZARTARIAN. Piston Theory — A New Aerodynamic Tool for the Aeroelastician. *J. Aero. Sci.* 23, pp. 1109–1118, December, 1956.

DRAPER, CHARLES S. Education in the Astronautical Sciences. (In *American Astronautical Society, Third Annual Meeting Proc.* 1956.)

FINSTON, MORTON. A Further Note on Aerodynamic Heating. (In *Ninth International Congress on Theoretical and Applied Mechanics Proc.* 1956.)

FINSTON, MORTON. Free Convection Past a Vertical Plate. *Zeit. f. Angewandte Math. u. Phys.* 7, pp. 527–529, 1956.

GARRICK, I. EDWARD. Nonsteady Wing Characteristics. (In Section E, Vol. VII, *Aerodynamic Components of Aircraft at High Speeds*, edited by A. F. Donovan & H. R. Lawrence, Princeton, Princeton Univ. Press, 1957.)

GARRICK, I. EDWARD. Some Concepts and Problem Areas in Aircraft Flutter. *Sherman M. Fairchild Fund Paper* FF-15, 1957.

MAR, JAMES W. The Failure of Bx Beams under Bending and Rapid Heating. *Inst. Aero. Sci. Preprint* 716, January, 1957.

MILLER, RENE H. and C. W. ELLIS. Helicopter Blade Vibration and Flutter. *Am. Helicopter Soc. J.* 1, pp. 19–38, July, 1956.

PIAN, THEODORE H. H. Structural Damping of a Simple Built-up Beam with Riveted Joints in Bending. *J. Appl. Mech.* 24, pp. 35–38, March, 1957.

[1] For reprints of periodical publications and reviews, consult the author; for copies of books, consult the publishers or a retail bookseller. This compilation has been prepared under the direction of Miss Eleanor Bartlett, Special Collections and Gifts Librarian.

SANDORFF, PAUL E. Design of Structural Models with Application to Stiffened Panels Under Combined Shear and Compression. *J. Aero. Sci.* 23, pp. 623–632, July, 1956.

TRILLING, LEON. Soviets Pick Electives, Then Jobs. *Aviation Week* 65, pp. 50–63, August 20, 1956.

TRILLING, LEON. Ivan Studies Fifty Five Hours a Week. *Aviation Week* 65, pp. 48–59, August 27, 1956.

TRILLING, LEON. Soviet Training Well Integrated. *Aviation Week* 65, pp. 59–79, September 3, 1956.

TRILLING, LEON. Russian Engineering Training. *Aviation Week* 65, pp. 57–78, September 10, 1956.

TRILLING, LEON. Soviet Scientists Competent. *Missiles & Rockets* 2, pp. 62–63, February, 1957.

WRIGLEY, WALTER and J. HOVORKA. This is Inertial Navigation. *Research & Eng.* 2, pp. 10–12 ff., December, 1956.

WRIGLEY, WALTER, R. B. WOODBURY, and J. HOVORKA. Inertial Guidance. *Sherman M. Fairchild Fund Paper* FF-16, 1957.

DEPARTMENT OF ARCHITECTURE

BOYD, ROBIN. The Search for Pleasingness. *Progressive Arch.* 38, pp. 193–206, April, 1957.

BUSH-BROWN, ALBERT. This New Shell Game: Are the Ground Rules Function, Structure, Symbolism — or Art? *Arch. Record* 121, pp. 185–189, June, 1957.

GOODY, MARVIN E., A. G. H. DIETZ, F. J. HEGER, F. J. McGARRY and R. W. HAMILTON. The Architectural Evolution and Engineering Analysis of a Plastic House. A Report for the Monsanto Chemical Company.

LYNCH, KEVIN and A. LUKASHOK. Some Childhood Memories of the City. *Am. Inst. Planners J.* 22, pp. 142–152, Summer, 1956.

DEPARTMENT OF BIOLOGY

BELL, EUGENE. Removal of Embryonic Layers with Ultrasound. Abstract. *Anatom. Record* 125, pp. 622–623, 1956.

BELL, EUGENE and T. S. ARGYRIS. Response of the Skin to Focussed Ultrasound. *Acoustical Soc. Am. J.* 29, pp. 239–242, February, 1957.

BROWN, GENE M. Metabolism of Pantothenic Acid. *National Vitamin Foundation. Symposium on Vitamin Metabolism* 13, pp. 65–75, August, 1956.

BROWN, GENE M. Enzymatic Synthesis of Acetyl Pantetheine. *Federation Proc.* 16, p. 159, April, 1957.

BROWN, GENE M. Pantothenylcysteine, A precursor of Pantetheine in *Lactobacillus helveticus*. *J. Biol. Chem.* 226, pp. 651–661, June, 1957.

BUCHANAN, JOHN M., S. C. HARTMAN and B. LEVENBERG. Biosynthesis of the Purines. XI. Structure, Enzymatic Synthesis, and Metabolism of Glycinamide Ribotide and (α-N-Formyl)-glycinamide Ribotide. *J. Biol. Chem.* 221, pp. 1057–1070, August, 1956.

BUCHANAN, JOHN M. and B. LEVENBERG. Biosynthesis of the Purines. XII. Structure, Enzymatic Synthesis, and Metabolism of 5-Aminoimidazole Ribotide. *J. Biol. Chem.* 224, pp. 1005–1018, February, 1957.

BUCHANAN, JOHN M. and B. LEVENBERG. Biosynthesis of the Purines. XIII. Structure, Enzymatic Synthesis, and Metabolism of (α-N-Formyl)-glycinamideine Ribotide. *J. Biol. Chem.* 224, pp. 1019–1027, February, 1957.

BUCHANAN, JOHN M. and I. MELNICK. Biosynthesis of the Purines. XIV. Conversion of (α-N-Formyl)-glycinamide Ribotide to (α-N-Formyl)-glycinamidine Ribotide; Purification and Requirements of the Enzyme System. *J. Biol. Chem.* 225, pp. 157–162, March, 1957.

BUCHANAN, JOHN M., B. LEVENBERG and I. MELNICK. Biosynthesis of the Purines. XV. The Effect of L-azaserine and 6-Diazo-5-oxo-L-norleucine on Inosinic Acid Biosynthesis *de novo*. *J. Biol. Chem.* 225, pp. 163–176, March, 1957.

BUCHANAN, JOHN M. The Effect of Azaserine and 6-Diazo-5-oxo-L-norleucine on the Biosynthesis of Inosinic Acid *de novo*. *Texas Reports on Biol. & Medicine* 15, pp. 148–153, Spring, 1957.

BUCHANAN, JOHN M., L. N. LUKENS and others. The Enzymatic Synthesis of Inosinic Acid *de novo*. *Ciba Foundation Symposium on the Chemistry & Biology of Purines*, pp. 233–242, 1957.

DEFFNER, GOTTFRIED G. J. and others. Uber den Gerbstoff der Fichtenrinde. *Chemische Berichte* 11, pp. 2523–2535, 1956.

GESCHWIND, NORMAN, J. WALTON and J. SIMPSON. Benign Congenital Myopathy with Myasthenic Features. *J. Neurology, Neurosurgery & Psychiatry* 19, pp. 224–231, 1956.

GOULD, BERNARD S. and J. F. WOESSNER. Biosynthesis of Collagen. *J. Biol. Chem.* 226, pp. 289–300, May, 1957.

HALL, CECIL E. Method for the Observation of Macromolecules with the Electron Microscope Illustrated with Micrographs of DNA. *J. Biophys. & Biochem. Cytology* 2, pp. 625–629, September, 1956.

HALL, CECIL E. Improved Method for the Observation of Shadow-cast Macromolecules. *J. Appl. Phys.* 27, p. 1390, November, 1956.

HALL, CECIL E. Visualization of Individual Macromolecules with Electron Microscope. *Nat. Acad. Sci. Proc.* 42, pp. 801–806, November, 1956.

HERRMANN, ROBERT L. and others. The Synthesis of Purines and Thymine from Formaldehyde in the Rat. *Biochimica & Biophysica Acta* 21, pp. 394–395, August, 1956.

JENERICK, HOWARD P. The Effects of Several Chelating Agents on Excitation and Conduction in Frog Sciatic Nerve. *J. Cellular & Comp. Physiol.* 49, pp. 171–186, April, 1957.

JENERICK, HOWARD P. The Effects of Calcium on Several Electrical Properties of Muscle Membrane. (In *National Biophysics Conference, Abstracts of Papers*, 1957.)

LEWIS, HERMAN W. and F. O. SCHMITT. Macromolecular Organization of Drosophila Salivary Gland Chromosomes. (Abstract) *Genetics* 41, p. 651, 1956.

LEWIS, HERMAN W. Contribution to the Discussion of Chromosome Structure. (In *Symposium on the Chemical Basis of Heredity*, edited by W. D. McElroy and B. Glass, pp. 62–64, Baltimore, Johns Hopkins Press, 1957.)

LUKENS, LEWIS N. and J. M. BUCHANAN. 5-Amino-4-carboxyimidazole Ribotide; a New Intermediate in Purine Biosynthesis. *Federation Proc.* 16, pp. 214–215, March, 1957.

LUKENS, LEWIS N. and J. M. BUCHANAN. Further Intermediates in the Biosynthesis of Inosinic Acid *de novo*. *Am. Chem. Soc. J.* 79, pp. 1511–1512, March 20, 1957.

LUKENS, LEWIS N., J. M. BUCHANAN and R. W. MILLER. The Enzymatic Cleavage of 5-Amino-4-imidazole-N-succinocarboxamide Ribotide. *Am. Chem. Soc. J.* 79, pp. 1513–1514, March 20, 1957.

LUKENS, LEWIS N. and K. A. HERRINGTON. Enzymatic Formation of 6-Mercaptopurine Ribotide. *Biochimica & Biophysica Acta* 24, pp. 432–433, May, 1957.

NYBORG, WESLEY L. and J. KOLB. Small-Scale Acoustic Streaming in Liquids. *Acoustical Soc. Am. J.* 28, pp. 1237–1242, November, 1956.

NYBORG, WESLEY L. and J. BRACKENRIDGE. Acoustical Characteristics of Oscillating Jet-Edge Systems in Water. *Acoustical Soc. Am. J.* 29, pp. 459–463, April, 1957.

SCHMITT, FRANCIS O. Biological Sciences and Man's Health. *The Technology Review* 58, pp. 1–4, July, 1956.

SCHMITT, FRANCIS O. Macromolecular Interaction Patterns in Biological Systems. *Am. Phil. Soc. Proc.* 100, pp. 476–486, October, 1956.

SCHMITT, FRANCIS O. Chairman's Prefactory Remarks. *Nat. Acad. Sci. Proc.* 42, pp. 789–791, November, 1956.

SCHMITT, FRANCIS O. Patterns of Interaction of Biological Macromolecules in Relation to Cell Function. *Nat. Acad. Sci. Proc.* 42, pp. 806–810, November, 1956.

SIZER, IRWIN W. Chemical Aspects of Enzyme Inhibition. *Science* 125, pp. 54–59, January 11, 1957.

SIZER, IRWIN W. and W. T. JENKINS. Glutamic-Aspartic Transaminase. *Am. Chem. Soc. J.* 79, pp. 2655–2656, May 20, 1957.

SIZER, IRWIN W. Life Sciences — M. I. T. Style. *The Technology Review* 5, pp. 423–426, June, 1957.

STRUCK, JACOB, JR. and I. W. SIZER. Oxidation of L-α-Amino Acids by Chicken Liver Microsomes. *Federation Proc.* 16, p. 257, March, 1957.

TURNER, CLAIR E., C. M. SELLERY and S. L. SMITH. *School Health and Health Education.* Ed. 3, St. Louis, Mosby, 1957.

WAUGH, DAVID F. and P. H. von HIPPEL. k-Casein and the Stabilization of Casein Micelles. *Am. Chem. Soc. J.* 78, pp. 4576–4582, September 20, 1956.

WAUGH, DAVID F., J. E. FITZGERALD and N. S. SCHNEIDER. Molecular Stability and Sub-Structure of Bovine Fibrinogen. *Am. Chem. Soc. J.* 79, pp. 601–608, February 5, 1957.

DEPARTMENT OF CHEMICAL ENGINEERING

BADDOUR, RAYMOND F. and M. H. HUTCHINSON. Ripple Trays — a New Tool for Vapor-Liquid Contacting. *Chem. Eng. Progress* 52, pp. 503–508, December, 1956.

BADDOUR, RAYMOND F. and M. H. HUTCHINSON. Ripple Trays — a New Tool for Vapor-Liquid Contacting. *Refining Eng.*, pp. C-6–C-9, February, 1957.

BARGER, J. PERRY, W. M. ROHSENOW and K. T. TREADWELL. A Comparison of Refrigerants When Used in Vapor Compression Cycles Over an Extended Temperature Range. *A.S.M.E. Trans.* 79, pp. 681–685, April, 1957.

BENEDICT, MANSON and T. H. PIGFORD. Fuel Cycles in Single-Region Thermal Reactors. Part I. *Chem. Eng. Progress* 53, pp. 96F–109F, February, 1957.

BENEDICT, MANSON and T. H. PIGFORD. Fuel Cycles in Single-Region Thermal Reactors. Part II. *Chem. Eng. Progress* 53, pp. 145M–151M, March, 1957.

HOTTEL, HOYT C. and H. W. EMMONS. Fire Research and Fire Models. (In *Fire Research — First Correlation Conference.* Washington, D. C. National Acad. of Sci. & National Res. Council, 1956.)

HOTTEL, HOYT C., W. P. JENSEN and C. P. MARION. Flame Stabilization in Liquid Fuel Sprays. (In *Sixth Symposium (International) on Combustion.* N. Y. Reinhold, 1957.)

HOTTEL, HOYT C., T. Y. TOONG and J. J. MARTIN. Flame Stabilization in a Boundary Layer. *Jet Propulsion* 27, pp. 28–30, January, 1957.

IZAWA, KEISUKE. Frequency Response Computational Aids. (In *Frequency Response*, edited by Rufus Oldenburger. N. Y. Macmillan, 1956.)

MERRILL, EDWARD W. Coaxial Cylinder Viscometer. *British Patent 763,875*, December 19, 1956.

MERRILL, EDWARD W. Apparatus for Making Battery Separators. *U. S. Patent 2,786,233*, March 26, 1957.

MICHAELS, ALAN S. and V. PUZINAUSKAS. Additives as Aids to Asphalt Stabilization of Fine Grained Soils. *Highway Research Board Bull.* No. 129, 1956.

MICKLEY, HAROLD S., T. K. SHERWOOD and C. E. REED. *Applied Mathematics in Chemical Engineering.* Ed. 2. N. Y. McGraw-Hill, 1957.

REID, ROBERT C. and J. E. VIVIAN. M. I. T. Graduate Program at Oak Ridge. *The Technology Review* 59, pp. 93–96, December, 1956.

SATTERFIELD, CHARLES N. and R. L. WENTWORTH. Hydrogen Peroxide as a Source of Energy. *Research Rev.*, pp. 7–12, October, 1956.

SATTERFIELD, CHARLES N. Hydrogen Peroxide. (In *Encyclopedia of Chemistry*, edited by G. L. Clark and G. G. Hawley. N. Y. Reinhold, 1957.)

SATTERFIELD, CHARLES N. Oxidation. (In *Encyclopedia of Chemistry*, edited by G. L. Clark and G. G. Hawley. N. Y. Reinhold, 1957.)

SATTERFIELD, CHARLES N. Peroxides. (In *Encyclopedia of Chemistry*, edited by G. L. Clark and G. G. Hawley. N. Y. Reinhold, 1957.)

SATTERFIELD, CHARLES N. and T. W. STEIN. Homogeneous Decomposition of Hydrogen Peroxide Vapor. *J. Phys. Chem.* 61, pp. 537–540, May, 1957.

SHERWOOD, THOMAS K. and N. E. COOKE. Mass Transfer at Low Pressures. *Am. Inst. Chem. Engrs. J.* 3, p. 37, March, 1957.

SHERWOOD, THOMAS K. and J. C. WEI. Interfacial Phenomena in Liquid Extraction. *Ind. Eng. Chem.* 49, p. 1030, June, 1957.

THOMPSON, THEOS J. and T. CANTWELL. MITR: The M. I. T. Research Reactor. *Nucleonics* 15, pp. 38–40, January, 1957.

VIVIAN, J. EDWARD and D. W. PEACEMAN. Liquid-Side Resistance in Gas Absorption. *Am. Inst. Chem. Engrs. J.* 2, pp. 437–443, December, 1956.

VIVIAN, J. EDWARD. Science Education Possibilities in Co-operative Education. Panel 3, Part IV. (In *Seventh Thomas Alva Edison Foundation Institute Proc.* N. Y. N. Y. Univ. Press, 1957.)

WHITMAN, WALTER G. Developments in the United Nations Program Since 1955. *United Nations Rev.* 3, pp. 42–44, February, 1957.

DEPARTMENT OF CHEMISTRY

AMDUR, ISADORE and E. A. MASON. Scattering of High Velocity Neutral Particles. VII. Xenon-Xenon. *J. Chem. Phys.* 25, pp. 624–625, October, 1956.

AMDUR, ISADORE and E. A. MASON. Scattering of High Velocity Neutral Particles. VIII. H-He. *J. Chem. Phys.* 25, pp. 630–632, October, 1956.

AMDUR, ISADORE and E. A. MASON. Scattering of High Velocity Neutral Particles. IX. Ne-A; A-Ne. *J. Chem. Phys.* 25, pp. 632–634, October, 1956.

AMDUR, ISADORE and L. A. GUILDNER. Thermal Accommodation Coefficients on Gas-Covered Tungsten, Nickel and Platinum. *Am. Chem. Soc. J.* 79, pp. 311–315, January 20, 1957.

AMDUR, ISADORE. Review of *Transport Processes in Applied Chemistry*, by R. C. Bosworth. (N. Y. Wiley 1956.) *Physics Today* 10, p. 42, June, 1957.

ASHDOWN, AVERY A. Arthur Alphonzo Blanchard. *The Nucleus* 34, pp. 188–192, May, 1957.

BACHELOR, FRANK W., C. H. SHUNK and K. FOLKERS. 3-Isoxazolidone. *J. Organic Chem.* 22, pp. 76–77, January, 1957.

BUCHI, GEORGE H. and D. ROSENTHAL. Terpenes VI. The Structures of Helenalin and Isohelenalin. *Am. Chem. Soc. J.* 78, pp. 3860–3861, August 5, 1956.

BUCHI, GEORGE H. and D. M. WHITE. The Ring Fission of Cyclopropanes: the Constitution of Maaliol. *Am. Chem. Soc. J.* 79, pp. 750–751, February 5, 1957.

COPE, ARTHUR C. and T. Y. SHEN. The Stereochemistry of 1,4:3,6-Dianhydrohexitol Derivatives. *Am. Chem. Soc. J.* 78, pp. 3177–3182, July 5, 1956.

COPE, ARTHUR C., T. A. LISS and G. W. WOOD. Proximity Effect in the Cycloheptane Series. *Chem. & Industry* 31, pp. 823–824, August 11, 1956.

COPE, ARTHUR C., H. E. JOHNSON and J. S. STEPHENSON. Proximity Effects. III. Trans-1,4-Cyclohexanediol from Cyclohexene and Performic Acid. *Am. Chem. Soc. J.* 78, pp. 5599–5600, November 5, 1956.

COPE, ARTHUR C. and T. Y. SHEN. The Detosylation of 1,4:3,6-Dianhydrohexitol Ditosylates and Syntheses of 1,4:2,5:3,6-Trianhydro-D-Mannitol. *Am. Chem. Soc. J.* 78, pp. 5912–5916, November 20, 1956.

COPE, ARTHUR C. and T. Y. SHEN. Syntheses of D- and L-2,6-dihetero-bicyclo [3.3.0] -octanes. *Am. Chem. Soc. J.* 78, pp. 5916–5920, November 20, 1956.

COPE, ARTHUR C., T. A. LISS and D. S. SMITH. Cyclic Polyolefins XLI. Reaction of Acetyl Bromide and Propionyl Chloride with Cyclooctatetraene. *Am. Chem. Soc. J.* 79, pp. 240–243, January 5, 1957.

COPE, ARTHUR C. and C. L. BUMGARDNER. Amine Oxides. I. 1,4-Pentadiene, 3-Phenylpropene and 3-Phenylcyclohexene by Amine Oxide Pyrolysis. *Am. Chem. Soc. J.* 79, pp. 960–964, February 20, 1957.

COPE, ARTHUR C. and H. H. LEE. Amine Oxides. II. Conversion to N, N-Dialkylhydroxylamines. *Am. Chem. Soc. J.* 79, pp. 964–965, February 20, 1957.

CORYELL, CHARLES D., W. E. BENNETT, T. T. SUGIHARA and R. H. HERBER. Probable Absence of K Capture in the Decay of Lead-205. *Phys. Rev.* 103, pp. 955–956, August 15, 1956.

COTTON, F. ALBERT and F. E. HARRIS. The Thermodynamics of Chelation. II. A Monte Carlo Study of the Distribution of Configurations in Short Chains. *J. Phys. Chem.* 60, pp. 1451–1454, October, 1956.

COTTON, F. ALBERT and C. J. BALLHAUSEN. Soft X-ray Absorption Edges of Metal Ions in Complexes. I. Theoretical Considerations. *J. Chem. Phys.* 25, pp. 617–619, October, 1956.

COTTON, F. ALBERT and H. P. HANSON. Soft X-ray Absorption Edges of Metal Ions in Complexes. II. The Cu K Edge in Some Cupric Complexes. *J. Chem. Phys.* 25, pp. 619–623, October, 1956.

COTTON, F. ALBERT, A. K. FISCHER and G. WILKINSON. Heats of Combustion and Formation of Metal Corbonyls. I. Chromium, Molybdenum and Tungsten Hexacarbonyls. *Am. Chem. Soc. J.* 78, pp. 5168–5171, October 20, 1956.

COTTON, F. ALBERT and G. WILKINSON. Some Experimental Observations on Transition Metal Hydrocarbonyls. *Chem. & Industry*, p. 1305, November 10, 1956.

COTTON, F. ALBERT. Bond Energies in Transition Metal Complexes. *Acta Chemica Scandinavica* 10, pp. 1520–1526. 1956.

COTTON, F. ALBERT and G. WILKINSON. Infrared Spectrum of Iron Dodecacarbonyl. *Am. Chem. Soc. J.* 79, pp. 752–753, February 5, 1957.

COTTON, F. ALBERT, A. K. FISCHER and G. WILKINSON. Heats of Combustion and Formation of Metal Carbonyls. II. Nickel carbonyl. *Am. Chem. Soc. J.* 79, pp. 2044–2046, May 5, 1957.

COTTON, F. ALBERT and H. P. HANSON. K X-ray Absorption Edges of Cr, Mn, Fe, Co, Ni Ions in Complexes. *J. Chem. Phys.* 26, pp. 1758–1759, June, 1957.

GREENE, FREDERICK D. Review of *Mechanism of Organic Chemical Reactions*, by E. de Barry Bennett. (N. Y. Interscience 1956.) *Am. Chem. Soc. J.* 78, p. 5133, October 5, 1956.

GREENE, FREDERICK D., W. A. REMERS and J. W. WILSON. Stereospecificity in Brominations of Bibenzyl and Acenaphthene with N-Bromosuccinimide. *Am. Chem. Soc. J.* 79, pp. 1416–1420, March 20, 1957.

GREENE, FREDERICK D. Organic Particle Information Center. Review of *The Reactive Intermediates of Organic Chemistry*, by J. E. Leffler. (N. Y. Interscience 1956.) *Chem. Eng. News* 35, p. 110, May 20, 1957.

HEIDT, LAWRENCE J. *Review of Physical Techniques in Biological Research. Vol. 1, Optical Techniques*, edited by G. Oster. (N..Y. Academic Press, Inc., 1955.) *J. Chem. Educ.* 33, p. 418, August, 1956.

HEIDT, LAWRENCE J. and L. EKSTROM. Influence of Dissolved Air on Optical Density Measurements of Water Solutions. *Am. Chem. Soc. J.* 79, pp. 1260–1261, March 5, 1957.

HEINTZ, EDWARD A. and D. N. HUME. Interfacial Tension and Complex Formation. *J. Phys. Chem.* 61, pp. 462–465, April, 1957.

HORNE, RALPH A., C. D. CORYELL and L. S. GOLDRING. Generalized Acidity in Radiochemical Separations. *Annual Rev. Nuclear Sci.* 6, pp. 163–178, 1956.

HOUSE, HERBERT O. and R. L. WASSON. The Rearrangement of α,β-Epoxy Ketones. IV. The Synthesis of Cyclic β-Diketones. *Am. Chem. Soc. J.* 78, pp. 4394–4400, September 5, 1956.

HOUSE, HERBERT O. The Chlorohydrins Derived from *trans*-Benzalacetophenone Oxide. *J. Organic Chem.* 21, pp. 1306–1307, November, 1956.

HOUSE, HERBERT O., R. C. LORD and H. S. RAO. The Synthesis of Spiropentane-d_8. *J. Organic Chem.* 21, pp. 1487–1491, December, 1956.

HOUSE, HERBERT O., E. A. CHANDROSS and B. J. PUMA. The Rearrangement of 2,3,5,6-Tetraphenylindenone Oxide. *J. Organic Chem.* 21, pp. 1526–1527, December, 1956.

HOUSE, HERBERT O. and R. L. WASSON. The Rearrangement of α,β-Epoxy Ketones. V. Rearrangements Resulting in Ring Contraction. *Am. Chem. Soc. J.* 79, pp. 1488–1492, March 20, 1957.

HUME, DAVID N. and T. L. MARPLE. Automatic Photometric Titrations. *Anal. Chem.* 28, pp. 1116–1119, July, 1956.

HUME, DAVID N. and H. J. KEILY. Thermometric Titration Curves. *Anal. Chem.* 28, pp. 1294–1297, August, 1956.

HUME, DAVID N. and E. A. BURNS. Acetate Complexes of Lead in Aqueous Solution. *Am. Chem. Soc. J.* 78, pp. 3958–3962, August 20, 1956.

HUME, DAVID N., G. W. LEONARD and M. E. SMITH. Thiocyanate Complexes of Lead and Thallium in Solution. *J. Phys. Chem.* 60, pp. 1493–1495, November, 1956.

HUME, DAVID N., T. L. MARPLE and E. P. PRZYBYLOWICZ. Photometric Titration of Cerium (III). *Anal. Chem.* 28, pp. 1892–1894, December, 1956.

HUME, DAVID N. Negativ-Temperatur-Coefficient Modstande eller Termistorer. *Fysisk Tidsskrift* 54, pp. 31–40, 1956.

HUME, DAVID N. and H. M. HERSHENSON. Photometric Determination of Aliphatic Amines. *Anal. Chem.* 29, pp. 16–19, January, 1957.

HUME, DAVID N., G. W. LEONARD and H. J. KEILY. Amperometric Titration of Cerium (III) with Ferricyanide. *Analytica Chimica Acta* 16, pp. 185–188, February, 1957.

HUME, DAVID N. and E. A. BURNS. A Spectrophotometric Study of the Indium Bromide Complex Ions. *Am. Chem. Soc. J.* 79, pp. 2704–2711, June 5, 1957.

IRVINE, JOHN W., JR. and P. KAFALAS. Nuclear Excitation Functions and Thick Target Yields: (Cr+d). *Phys. Rev.* 104, pp. 703–705, November 1, 1956.

IRVINE, JOHN W., JR. and others. Solvent Extraction Systems. I. As(III) and Ge(IV) in Hydrochloric Acid and As(III) in Hydriodic Acid with Several Solvents. *Am. Chem. Soc. J.* 79, pp. 1303–1305, March 20, 1957.

KEYES, FREDERICK G. Review of *Temperature — Its Measurement and Control in Science and Industry*, edited by H. S. Wolf. (N. Y. Reinhold 1955.) *Am. Chem. Soc. J.* 78, pp. 5070–5708, November 5, 1956.

LANPHER, EDWARD J. The Infrared Spectra of Aromatic Organoalkali Compounds. *J. Organic Chem.* 21, pp. 830–831, July, 1956.

LORD, RICHARD C. and T. K. McCUBBIN, JR. Etudes à Grande Resolution dans l'Infrarouge avec un Petit Spectrometre a Reseau Plan. *Comptes Rendus, Eighteenth Congres. Group pour l'Avancement des Methodes Spectrographique*, Paris, 1955.

LORD, RICHARD C., T. K. McCUBBIN, JR. and H. H. GUNTHARD. Rotation-Vibration Spectra and theMolecular Constants of Cyclopropane and Cyclopropane-d_6. *J. Chem. Phys.* 25, p. 768, October, 1956.

LORD, RICHARD C. and F. A. MILLER. Factors Influencing Characteristic Vibrational Frequencies of Molecules: Intramolecular Effects. *Applied Spectroscopy* 10, pp. 115–123, 1956.

LORD, RICHARD C. and J. C. MORROW. Calculation of the Heat Capacity of α-Quartz and Vitreous Silica from Spectroscopic Data. *J. Chem. Phys.* 26, pp. 230–232, February, 1957.

LORD, RICHARD C. and E. R. LIPPINCOTT. Vibrational Spectra of 1,3,5-Cycloöctatriene Bicyclo[4.2.0]octa-2,4-diene and Their Dichlorides. *Am. Chem. Soc. J.* 79, pp. 567–569, February 5, 1957.

LORD, RICHARD C. and A. P. GRAY. Rotation-Vibration Spectra of Methyl Amine and Its Deuterium Derivatives. *J. Chem. Phys.* 26, pp. 690–705, March, 1957.

LORD, RICHARD C. and D. G. REA. The Vibrational Spectra and Structure of Cyclobutene and Cyclobutene-d_6. *Am. Chem. Soc. J.* 79, pp. 2401–2406, May 20, 1957.

MILAS, NICHOLAS A. and D. FLES. Synthesis of Muconyldimalonates. *Am. Chem. Soc. J.* 78, pp. 5903–5906, November 20, 1956.

MORTON, AVERY A. and C. E. CLAFF, JR. Hydrocarbo Acidity and Metalation. *J. Organic Chem.* 21, pp. 736–738, July, 1956.

PEARSON, ARTHUR D. and M. J. BUERGER. Confirmation of the Crystal Structure of Pentlandite. *Am. Mineralogist* 41, pp. 804–805, September–October, 1956.

POWELL, ARNET L. and A. E. MARTELL. The Properties of Tetraethylammonium and Tetra-n-butylammonium Picrates in Anisole-Nitrobenzene Solutions. *Am. Chem. Soc. J.* 79, pp. 2118–2123, May 5, 1957.

ROGERS, LOCKHART B. and J. T. BYRNE. Anodic Coprecipitation of Trace Amounts of Manganese and Silver with Lead Dioxide. *Electrochem. Soc. J.* 103, p. 442, August, 1956.

ROGERS, LOCKHART B. and J. P. SCHWING. Comparison of Different Palladium-hydrogen Electrodes as pH Indicators. *Analytica Chimica Acta* 15, p. 379, October, 1956.

SCATCHARD, GEORGE and R. H. BOYD. The Equilibrium of α-Silver-Cadmium Alloys with Cadmium Vapor. *Am. Chem. Soc. J.* 78, pp. 3889–3893, August 20, 1956.

SCATCHARD, GEORGE. General Introduction to Discussion of Membrane Phenomena. *Faraday Soc. Discussions* 21, pp. 27–30, 1956.

SCATCHARD, GEORGE and F. HELFFERICH. The effect of Stirring on Cells with Cation Exchanger Membranes. *Faraday Soc. Discussions* 21, pp. 70–82, 1956.

SCATCHARD, GEORGE, J. S. COLEMAN and A. L. SHEN. Physical Chemistry of Protein Solutions VII. The Binding of Some Small Anions to Serum Albumin. *Am. Chem. Soc. J.* 79, pp. 12–20, January 5, 1957.

SCHINDEWOLF, ULRICH L., J. W. WINCHESTER and C. D. CORYELL. Decay Properties of 74-Second Ag^{111m}. *Phys. Rev.* 105, pp. 1763–1765, March 15, 1957.

SCHINDEWOLF, ULRICH L. Ionenaustauscher in der Analytischen Chemie. *Angewandte Chemie* 69, pp. 226–236, April 7, 1957.

SCHUMB, WALTER C. Some Properties of Very Concentrated Hydrogen Peroxide Solutions. *Record Chem. Progress* 17, pp. 191–204, October, 1956.

SHEEHAN, JOHN C. and P. A. CRUICKSHANK. The Synthesis of Substituted Penicillins and Simpler Structural Analogs. IX. 4-Carboxy-5,5-dimethyl-α-phthalimido-2-thiazolidineacetic Acid Derivatives. *Am. Chem. Soc. J.* 78, pp. 3677–3680, August 5, 1956.

SHEEHAN, JOHN C. and P. A. CRUICKSHANK. The Synthesis of Substituted Penicillins and Simpler Structural Analogs. X. The Cyclization of 4-Carbo-methoxy-5, 5-dimethyl-α, phthalimido-2-thiozolidineacetic Acid to Methyl 6-Phthalimidopenicillanate. *Am. Chem. Soc. J.* 78, pp. 3680–3683, August 5, 1956.

SHEEHAN, JOHN C. and P. A. CRUICKSHANK. The Synthesis of Substituted Penicillin and Simpler Structural Analogs. XI. Methyl 6-Benzylsulfonamido-penicillanate. *Am. Chem. Soc. J.* 78, pp. 3683–3686, August 5, 1956.

SHEEHAN, JOHN C., K. R. HENERY-LOGAN, C. W. BECK and J. J. RYAN. The Reaction of Phthaloylglycyl Chloride with 2-Methyl-2-thiazoline. *Am. Chem. Soc. J.* 78, pp. 4478–4483, September 5, 1956.

SHEEHAN, JOHN C. and G. F. HOLLAND. The Isomerism of Dithiolphthalates. *Am. Chem. Soc. J.* 78, pp. 5631–5633, November 5, 1956.

SHEEHAN, JOHN C., W. F. ERMAN and P. A. CRUICKSHANK. The Formation of Five- and Six-membered Rings by the Acyloin Condensation. V. A Novel Conversion of 16-Ketoestradiol-3-methyl Ether to Estrone. *Am. Chem. Soc. J.* 79, pp. 147–148, January 5, 1957.

SHEEHAN, JOHN C. and K. R. HENERY-LOGAN. The Total Synthesis of Penicillin V. *Am. Chem. Soc. J.* 79, pp. 1262–1263, March 5, 1957.

SHOEMAKER, DAVID P., C. B. SHOEMAKER and F. C. WILSON. The Crystal Structure of the P Phase, Mo-Ni-Cr. II. Refinement of Parameters and Discussion of Atomic Coordination. *Acta Crystallographica* 10, pp. 1–14, January, 1957.

SILLÉN, LARS G. On Equilibria with Polynuclear Complexes. *Rec. Trav. Chim.* 75, pp. 705–710, 1956.

SILLÉN, LARS G. and S. HIETANEN. The Equilibrium $Hg^{2+} + Hg(1) \rightleftharpoons Hg_2^{2+}$ in Nitrate and Perchlorate Solutions. *Suomen Kemistilehti*, pp. 31–35, 1956.

SILLÉN, LARS G. and S. HIETANEN. On the Standard Potentials of Mercury, and the Equilibrium $Hg^{2+} + Hg(1) \rightleftharpoons Hg_2^{2+}$ in Nitrate and Perchlorate Solutions. *Arkiv Kemi* 9, pp. 103–125, 1956.

SILLÉN, LARS G. Some Graphical Methods for Determining Equilibrium Constants IV. On Methods for Three-variable data w(x,y). *Acta Chemica Scandinavica* 10, pp. 803–811, 1956.

SILLÉN, LARS G. and H. KAKIHANA. Studies on the Hydrolysis of Metal Ions. Part 16. The Hydrolysis of the Beryllium Ion Be^{2+}. Data and Main Reaction. *Acta Chemica Scandinavica* 10, pp. 985–1005, 1956.

SILLÉN, LARS G. and G. BIEDERMANN. On Equilibria in Systems with Polynuclear Complex Formation IV. The Transition from Polynuclear to Mononuclear Products. *Acta Chemica Scandinavica* 10, pp. 1011–1019, 1956.

SILLÉN, LARS G., F. GRANÉR and A. OLIN. On the Hydrolysis of the Bi^{3+}ion — a Preliminary Note. *Acta Chemica Scandinavica*, p. 476, 1956.

SILLÉN, LARS G., J. SEIM and U. ULFVARSON. Can Micelles be Treated as Ideal Mixtures of Ions and Neutral Molecules? *Acta Chemica Scandinavica* 10, pp. 683–686, 1956.

SILLÉN, LARS G. and others. Studies on the Hydrolysis of Metal Ions. 18. The Scandium Ion. Sc^{3+}. *Acta Chemica Scandinavica* 10, 1327–1339. 1956.

SILLÉN, LARS G. and others. Equilibrium Studies of Polyanions II. Polyborates in $NaClO_4$ Medium. *Acta Chemica Scandinavica* 11, 1957.

SILLÉN, LARS G. and H. HAGLUND. Studies on the Detection of Toxic Agents with Sorption Methods. *Sv. Kem. Tidskr.* 69, 1957.

SLUTSKY, LEON J. and C. W. GARLAND. Latice Dynamics of Hexagonal Close-Packed Metals. *J. Chem. Phys.* 26, pp. 787–793, April, 1957.

STOCKMAYER, WALTER H. Note on Kinetics of Emulsion Polymerization. *J. Polymer Sci.* 24, p. 314, April, 1957.

SWAIN, C. GARDNER, A. J. KRESGE and T. E. C. KNEE. Relative Reactivities of Toluene, Toluene-$\alpha\alpha\alpha$-D_3 and Toluene-α-T in Electrophilic Nitration, Mercuration and Bromination. *Am. Chem. Soc. J.* 79, p. 505, January 20, 1957.

SWAIN, C. GARDNER and M. M. LABES. The Mechanism of Exchange of Hydrogen Between Ammonium and Hydroxyl Groups. I. *Am. Chem. Soc. J.* 79, pp. 1084–1088, March 5, 1957.

SWAIN, C. GARDNER, J. T. McKNIGHT and V. P. KREITER. The Mechanism of Exchange of Hydrogen Between Ammonium and Hydroxyl Groups. II. *Am. Chem. Soc. J.* 79, pp. 1088–1093, March 5, 1957.

TAYLOR, EDWARD C., R. B. GARLAND and C. F. HOWELL. Pteridines. XIV. Further Studies on a New Approach to Pteridine Synthesis. *Am. Chem. Soc. J.* 78, pp. 210–213, January 5, 1956.

WAUGH, JOHN S. and R. W. FESSENDEN. Nuclear Resonance Spectra of Hydrocarbons: the Free Electron Model. *Am. Chem. Soc. J.* 79, pp. 846–849, February 20, 1957.

WAUGH, JOHN S. Self-Diffusion in Solid Methane. *J. Chem. Phys.* 26, pp. 966–967, April, 1957.

WHITEKER, ROY A. Review of *Introductory Quantitative Chemistry*, by A. R. Olson, C. W. Koch and G. C. Pimentel. (San Francisco. W. H. Freeman, 1956.) *Anal. Chem.* 28, p. 26A, August, 1956.

WHITEKER, ROY A. A Spectrophotometric Study of the Thallium (III) Nitrate Complex. *Am. Chem. Soc. J.* 79, pp. 866–870, February 20, 1957.

YOUNG, RALPH C. and R. A. LANDISE. The Formation of $K_5W_2Cl_{14}$ During the Reduction of Chlorotungstates with Tin. *Am. Chem. Soc. J.* 77, p. 5288, October 20, 1955.

YOUNG, RALPH C. and R. A. LANDISE. The Action of Bromine on Some Complex Chlorides of Molybdenum and Tungsten: Preparation of $WBrCl_5$. *Am. Chem. Soc. J.* 78, pp. 4861–4862, October 5, 1956.

DEPARTMENT OF CITY AND REGIONAL PLANNING

GREELEY, ROLAND B. A City Planner Looks at Zoning Laws. *Boston Univ. Law Rev.* 36, pp. 337–346, Summer, 1956.

KELLY, BURNHAM. This Modern World, Challenges and Opportunities in a Developing Environment. *Landscape Arch.* 47, pp. 261–264, October, 1956.

KELLY, BURNHAM. Impact of Plastic Construction Materials on Future Community Development. (In *Building Research Institute, Report of Meeting of Plastics Study Group.* Washington, D. C. October, 1956.)

RODWIN, LLOYD. *The Puerto Rico Planning Board: An Evaluation.* Santurce, Puerto Rico Planning Board, September, 1956.

RODWIN, LLOYD. Linking Economic Development and Urbanization Policy in Developing Areas. (In *Regional Science Assoc. Proc.* December, 1956.)

RODWIN, LLOYD. The British New Towns Policy and Developing Areas. *Vivienda y Planeamiento, Bull. Pan American Union,* 1957.

RODWIN, LLOYD. Review of *Housing the Aged,* by W. Donahue. (Ann Arbor, Univ. of Michigan Press, 1954.) *Am. Inst. Planners J.* 22, p. 261, Fall, 1956.

RODWIN, LLOYD. Review of *Native Housing in South Africa,* by D. M. Calderwood. (Johannesburg, Univ. Witwatersland, 1956.) *Am. Inst. Planners J.* 22, p. 262, Fall, 1956.

DEPARTMENT OF CIVIL AND SANITARY ENGINEERING

ALDRICH, HARL P., JR. and R. F. SCOTT. Hydraulic Analog Computer Aids in Solution of Frost Problems. *Civil Eng.* 26, pp. 64–66, August, 1956.

ALDRICH, HARL P., JR. Frost Penetration Below Highway and Airfield Pavements. *Highway Research Board Bull.* 135, 1956.

ALDRICH, HARL P., JR. Site Preloading Eliminates Piles for Two Oil Storage Tanks. *Boston Soc. Civil Engrs. J.* 44, pp. 16–35, January, 1957.

BIGGS, JOHN M., S. NAMYET and J. ADACHI. Wind Loads on Girder Bridges. *Am. Soc. Civil Engrs. Trans.* 121, pp. 101–120, 1956.

BIGGS, JOHN M., H. S. SUER and J. M. LOUW. The Vibration of Simple Span Highway Bridges. *Am. Soc. Civil Engrs. Proc.* 83, pp. 1186-1–1186-31, March, 1957.

BIKERMAN, JACOB J. Drainage of Liquid from Surfaces of Different Rugosities. *J. Colloid Sci.* 11, pp. 299–307, August–October, 1956.

BJERRUM, LAURITS and O. EIDE. Stabilitet av Avstivede Utgravinger i Leire. *Teknisk Ukeblad* 103, pp. 23–33, January 12, 1956.

BJERRUM, LAURITS and C. OSTENFELD. Et Lille Geoteknisk Vejproblem Med et Interessant Jordprofil. *Ingeniören* 65, pp. 844–846, October 20, 1956.

DAILY, JAMES W. and others. Resistance Coefficients for Accelerated and Decelerated Flows Through Smooth Tubes and Orifices. *A.S.M.E. Trans.* 78, pp. 1071–1077, July, 1956.

DAILY, JAMES W. and V. E. JOHNSON, JR. Turbulence and Boundary Layer Effects on Cavitation Inception from Gas Nuclei. *A.S.M.E. Trans.* 78, pp. 1695–1706, November, 1956.

DIETZ, ALBERT G. H. Plastics in Building Today. *Rubber & Plastics Age* 37, November, 1956.

DIETZ, ALBERT G. H. Paper and Plastics in Building. *TAPPI* 39, pp. 38A–50A, December, 1956.

DIETZ, ALBERT G. H. and F. J. McGARRY. The Effects of Speed in the Mechanical Testing of Plastics. *A.S.T.M. Special Technical Publication* 185, 1956.

DIETZ, ALBERT G. H., F. J. HEGER, JR. and F. J. McGARRY. Engineering the Plastics House. *Soc. Plastic Engrs. J.* 13, pp. 38–41 ff., May, 1957.

DIETZ, ALBERT G. H., M. E. GOODY, F. J. HEGER, JR., F. J. McGARRY and R. P. WHITTIER. Engineering the Plastics "House of the Future," Part I. *Modern Plastics* 34, pp. 143–147 ff., June, 1957.

DIETZ, ALBERT G. H. Today's Newest Building Materials. *Factory Management & Maintenance* 115, pp. 114–118, June, 1957.

DIETZ, ALBERT G. H. Tension Testing of Adhesives. *A.S.T.M. Special Technical Publication* 194, 1957.

EAGLESON, PETER S. Properties of Shoaling Waves by Theory and Experiment. *Am. Geophys. Union Trans.* 37, pp. 565–572, October, 1956.

ELIASSEN, ROLF. Economics of Desalting Brackish Waters. *Texas Water and Sewage Works Assoc. J.*, March 5, 1956.

ELIASSEN, ROLF, R. T. SKRINDE, C. PEREDA and A. J. ROMEO. Effects of pH and Velocity on Corrosion of Steel Water Pipes. *Am. Water Works Assoc. J.* 48, p. 1005, August, 1956.

ELIASSEN, ROLF. Refuse Collection and Disposal. (A Chapter in *American Civil Engineering Practice, Vol. II*, edited by R. W. Abbett. (N. Y. Wiley, 1956.)

ELIASSEN, ROLF. Rapid Field Analyses Pinpoint Cabform Contamination in Reservoirs. *Water Works Eng.* 110, pp. 148–149, February, 1957.

ELIASSEN, ROLF. Design of Settling Tanks for Sewage and Wastes. *Water Eng.* 28, pp. 286–289, June, 1957.

HOUSLEY, JOHN G. and D. C. TAYLOR. Application of the Solitary Wave Theory to Shoaling Oscillatory Waves. *Am. Geophys. Union Trans.* 38, pp. 56–61, February, 1957.

LAMBE, T. WILLIAM. The Storage of Oil in an Earth Reservoir. *Boston Soc. Civil Engrs. J.* 43, pp. 179–241, July, 1956.

LAMBE, T. WILLIAM and R. T. MARTIN. Composition and Engineering Properties of Soil (V). (Preprint.) *Highway Research Board*, January, 1957.

McKINNEY, ROSS E. The Role of Chemically Combined Oxygen in Biological Systems. *Am. Soc. Civil Engrs. Sanitary Eng. Div. J.* 82, pp. 1053-1–1053-9, August, 1956.

McKINNEY, ROSS E. and A. GRAM. Protozoa and Activated Sludge. *Sewage & Ind. Wastes* 28, pp. 1219–1231, October, 1956.

McKINNEY, ROSS E. Pollution Reduction Program for the Textile Industry — A Discussion. *Sewage & Indus. Wastes* 28, pp. 1290–1293, October, 1956.

McKINNEY, ROSS E. and R. S. ENGELBRECHT. Membrane Filter Method Applied to Activated Sludge Suspended Solids Determinations. *Sewage & Indus. Wastes* 28, pp. 1321–1325, November, 1956.

McKINNEY, ROSS E. Sanitary Engineering Education: Industrial Waste Engineering. *Am. Soc. Civil Engrs. Sanitary Eng. Div. J.* 83, pp. 1223-1–1223-5, April, 1957.

McKINNEY, ROSS E. The Use of Biological Waste Treatment Systems for the Stabilization of Industrial Wastes. *Eleventh Indus. Waste Conf. Proc.* 91, pp. 465–477, June, 1957.

McKINNEY, ROSS E. Biological Flocculation. (In *Biological Treatment of Sewage and Industrial Waste, Vol. I, Aerobic Oxidation*, edited by Brother J. McCabe & W. W. Ekenfelder, Jr. N. Y. Reinhold, 1957.)

MILLER, CHARLES L. Some New Conceptions and Old Misconceptions of Photogrammetry. *Boston Soc. Civil Engrs. J.* 43, pp. 251–260, July, 1956.

MILLER, CHARLES L. The Impact of the Expanded Highway Program on Photogrammetry. *Photogrammetric Eng.* 22, pp. 834–837, December, 1956.

MILLER, CHARLES L. The Spatial Model Concept of Photogrammetry. *Photogrammetric Eng.* 23, pp. 31–35, March, 1957.

MILLER, CHARLES L. A Study of the Private Photogrammetric Mapping Activity in the United States. *Photogrammetric Eng.* 23, pp. 185–189, March, 1957.

MILLER, CHARLES L. Integrating Aerial Photogrammetry and the Electronic Computer. (In *Western Conference on Increasing Highway Engineering Productivity, Proc.* March 6, 1957.)

MILLER, CHARLES L. An Approach to Surveying Education. *Civil Eng. Bull.* 22, May, 1957.

MILLER, CHARLES L. More Photogrammetric Research Needed. *Civil Eng.* 27, p. 43, June, 1957.

MURRAY, JAMES A. Shrinkage, Activity, As Functions of Lime Burning Conditions. *Pit & Quarry* 49, pp. 122–152, May, 1957.

NAMYET, SAUL. Analog and Digital Computers in Civil Engineering. *Boston Soc. Civil Engrs. J.* 44, pp. 36–56, January, 1957.

SAWYER, CLAIR N. and R. H. BOGAN. Biochemical Degradation of Synthetic Detergents III. Relationships Between Biological Degradation and Froth Persistence. *Sewage & Indus. Wastes* 28, pp. 637–643, May, 1956.

SAWYER, CLAIR N. and D. W. RYCKMAN. Anionic Detergents and Water Supply Problems. *Am. Water Works Assoc. J.* 49, pp. 480–490, April, 1957.

SIMPSON, HOWARD. The New A.C.I. Code — Its Implications and Ramifications. *Boston Soc. Civil Engrs. J.* 44, pp. 98–116, April, 1957.

STANLEY, WILLIAM E. Economic Design Criteria for Municipal Waste Treatment Plants. (In *Fifth Southern Municipal and Industrial Waste Conf. Proc.*, pp. 128–140, April, 1956.)

SYMONS, JAMES M. and G. E. SYMONS. How to Collect, Store and Use Data. *Water & Sewage Works* 104, pp. 42–48, January, 1957.

VOSS, WALTER C. *Exterior Masonry Construction.* Washington, D. C. (National Lime Association, 1956.)

DEPARTMENT OF ECONOMICS AND SOCIAL SCIENCE

ADELMAN, MORRIS A. The Corporate Income Tax in the Long Run. *J. Political Econ.* 65, pp. 151–157, April, 1957.

ADELMAN, MORRIS A. The Price and Product in the Distributive Trades. *Am. Econ. Assoc. Proc.* 47, pp. 266–273, 1957.

ADELMAN, MORRIS A. Economic Significance of Current Mergers. *Am. Management Assoc. Financial Management Series* No. 114, pp. 82–90, 1957.

BROWN, E. CARY. Fiscal Policy in the 'Thirties: A Reappraisal. *Am. Econ. Rev.* 46, pp. 857–879, December, 1956.

DOMAR, EVSEY D. *Essays in the Theory of Economic Growth.* N. Y. Oxford Univ. Press, 1957.

HAGEN, EVERETT E. *The Economic Development of Burma.* Washington, D. C. National Planning Assoc., 1956.

HAGEN, EVERETT E. The Process of Economic Development. *Economic Development & Cultural Change* 5, pp. 193–215, April, 1957.

HOWES, DAVIS. On the Relation Between the Probability of a Word as an Association and in General Linguistic Usage. *J. Abnormal & Social Psychology* 54, pp. 75–85, January, 1957.

HOWES, DAVIS. On the Relation Between the Intelligibility and Frequency of Occurrence of English Words. *Acoustical Soc. Am. J.* 29, pp. 296–305, February, 1957.

McMANUS, MAURICE. Points Rationing and the Consumer. *Metroeconomica* 8, pp. 118–134, August, 1956.

McMANUS, MAURICE. On Hatanaka's Note on Consolidation. *Econometrica* 24, pp. 482–487, October, 1956.

McMANUS, MAURICE. Self-Contradiction in Leontief's Dynamic Model. *Yorkshire Bull. for Econ. & Social Res.* 9, April, 1957.

MALENBAUM, WILFRED. Urban Unemployment in India. *Pacific Affairs* 30, pp. 138–150, June, 1957.

MYERS, CHARLES A. and J. G. TURNBULL. Line and Staff in Industrial Relations. *Harvard Bus. Rev.* 34, pp. 113–124, July–August, 1956.

MYERS, CHARLES A. Personnel Officer in Indian Industry. *Management Topics, First Annual Number and Yearbook*, 1957.

PADELFORD, NORMAN J. Political Cooperation in the North Atlantic Community. *International Organization* 9, pp. 353–365, August, 1956.

PADELFORD, NORMAN J. A Selected Bibliography on Regionalism and Regional Arrangements. *International Organization* 10, pp. 575–603, November, 1956.

PADELFORD, NORMAN J. Cooperation in the Central American Region: The Organization of Central American States. *International Organization* 11, pp. 41–54, Winter, 1957.

PYE, LUCIAN W., G. McT. KAHIN and G. J. PAUKER. Comparative Politics of Non-Western Countries. (In Japanese.) *Americana* 2, pp. 9–30, August, 1956.

PYE, LUCIAN W. Review of *Red Shadow Over Malaya*, by M. C. A. Henniker. (London, William Blackwood & Sons, 1955.) *Pacific Affairs* 29, pp. 301–302, September, 1956.

PYE, LUCIAN W., G. McT. KAHIN and G. J. PAUKER. Comparative Politics in Non-Western Countries. *Foreign Service Institute, Department of State Training Document*, October, 1956.

PYE, LUCIAN W. *Guerrilla Communism in Malaya: Its Social and Political Meaning*. Princeton, Princeton Univ. Press, 1956.

SAMUELSON, PAUL A. and R. M. SOLOW. A Complete Capital Model Involving Heterogeneous Capital Goods. *Quarterly J. Econ.* 70, pp. 537–562, November, 1956.

SAMUELSON, PAUL A. The Economics of Eisenhower: A Symposium. *Rev. Econ. & Statistics* 38, pp. 357–385, November, 1956.

SAMUELSON, PAUL A. Economic Consequences of U. S. Election. *Financial Times*, November 13, 1956.

SAMUELSON, PAUL A. Where Next in the U. S.? *Financial Times*, January 30, 1957.

SAMUELSON, PAUL A. Leaning Against Which Economic Wind? *The Reporter* 16, pp. 14–16, March 7, 1957.

SAMUELSON, PAUL A. and S. SLICHTER. Symposium on the American Economy. *Nihon Keizai Shimbun* (Financial & Business Journal of Japan), April 19–21, 1957.

SAMUELSON, PAUL A. The Mid-1957 U. S. Economy. *Financial Times*, May 10, 1957.

SHULTZ, GEORGE P. The Massachusetts Choice of Procedures Approach to Emergency Disputes. *Indus. Labor Relations Rev.* 10, pp. 361–374, April, 1957.

SIEGEL, ABRAHAM J. and B. V. H. SCHNEIDER. *Industrial Relations in the Pacific Coast Longshore Industry*. Berkeley, Univ. California, Institute of Industrial Relations, 1956.

SIEGEL, ABRAHAM J. The Economic Environment in Human Relations Research. (A Chapter in *Research in Industrial Human Relations: A Critical Appraisal*, edited by C. M. Arensberg and others. N. Y. Harper, 1957.)

SOHMEN, EGON. Einige Bemerkungen zur Zinstheorie. *Zeit. f. Nationalokonomie* 16, pp. 324–346, December, 1956.

SOLOW, ROBERT M. Review of *The Failures of Economics, a Diagnostic Study*, by S. Schoeffler. (Cambridge, Mass. Harvard Univ. Press, 1955.) *Rev. Econ. & Statistics* 39, pp. 96–98, February, 1957.

SWETS, JOHN A. and T. G. BIRDSALL. The Human Use of Information: III. Decision-Making in Detection and Recognition Situations Involving Multiple Alternatives. *IRE Trans.* (Professional Group on Information Theory-2), pp. 138–165, September, 1956.

DEPARTMENT OF ELECTRICAL ENGINEERING

ADLER, RICHARD B. Science and Engineering Education. *J. Eng. Educ.* 47, pp. 121–128, October, 1956.

ADLER, RICHARD B. and H. HAUS. Two Invariants of Noisy Amplifiers. *I.R.E. Convention Record*, Part 2, pp. 53–67, 1956.

ADLER, RICHARD B. and L. B. ARGUIMBAU. Vacuum-Tube Circuits and Transistors. N. Y. Wiley, 1956.

ADLER, RICHARD B. Science and Engineering Education. *Am. J. Phys.* 25, pp. 109–114, February, 1957.

BAGHDADY, ELIE J. Theory of Feedback Around the Limiter. *I.R.E. Convention Record*, 1957.

BARLOW, JOHN S. An Electronic Method for Detecting Evoked Responses of the Brain and for Reproducing Their Average Waveforms. *Electroencephalography & Clinical Neurophysiology J.* 9, pp. 340–343, May, 1957.

BERANEK, LEO L. Suggestion on Reference Quantities for Power Levels. *Acoustical Soc. Am. J.* 28, pp. 725–726, July, 1956.

BERANEK, LEO L. Criteria for Office Quieting Based on Questionnaire Rating Studies. *Acoustical Soc. Am. J.* 28, pp. 833–852, September, 1956.

BERANEK, LEO L. Sound Control. (A Chapter in *American Society of Heating and Air Conditioning Engineers Guide.* N. Y. ASHAE, 1957.)

BERANEK, LEO L. Acoustical Definitions. (A Section in *American Institute of Physics Handbook*, edited by D. E. Gray & others. N. Y. McGraw-Hill, 1957.)

BERANEK, LEO L. Letter Symbols and Conversion Factors for Acoustical Quantities. (A Section in *American Institute of Physics Handbook*, edited by D. E. Gray & others. N. Y. McGraw-Hill, 1957.)

BERANEK, LEO L. Acoustic Properties of Gases. (A Section in *American Institute of Physics Handbook*, edited by D. E. Gray & others. N. Y. McGraw-Hill, 1957.)

BERANEK, LEO L. Selected References on Acoustics. (A Section in *American Institute of Physics Handbook*, edited by D. E. Gray & others. N. Y. McGraw-Hill, 1957.)

BERANEK, LEO L. Revised Criteria for Noise in Buildings. *Noise Control* 3, pp. 19–27, January, 1957.

BOFFI, LUIZ V. and V. B. HAAS. Analog Computer Representation of Alternators for Parallel Operation. *A.I.E.E. Trans.* (Communications and Electronics) 76, pp. 153–158, May, 1957.

BOOTON, RICHARD C., JR. Final Value Systems with Gaussian Inputs. *I.R.E. Trans.* (Professional Group on Information Theory-2), pp. 173–175, September, 1956.

BOSE, AMAR G. and S. D. PEZARIS. A Theorem Concerning Noise Figures. *I.R.E. Trans.* (Professional Group on Circuit Theory-3), pp. 190–196, September, 1956.

BRAZIER, MARY A. B. Electroencephalography. (A Chapter in *Progress in Neurology and Psychiatry*, edited by E. A. Spiegel. N. Y. Grune & Stratton, 1957.)

BRAZIER, MARY A. B. Rise of Neurophysiology in the 19th Century. *J. Neurophysiology* 20, pp. 212–226, March, 1957.

BROWN, GORDON S. Automation. *The Technology Review* 59, pp. 359-372, May, 1957.

BUCK, DUDLEY A. A Magnetically Controlled Gating Element. (In *Eastern Joint Computer Conference; AIEE/IRE/ACM, Trans.* December, 1956.)

BUCKLEY, ELERY F. 10,000 Rod per Microsecond. *M.I.T. Reports on Research* 8, pp. 1–2, February, 1957.

CLARK, WESLEY A. The Lincoln TX-2 Computer Development. (In *Western Joint Computer Conference; Proc.*, April, 1957.)

EDGERTON, HAROLD E. Stroboscopic Flash. (A Chapter in *Focal Encyclopaedia of Photography.* London, Focal Press Ltd., 1956.)

EDGERTON, HAROLD E. Multiflash Microsecond Flash Photography. *Research Film* 2, pp. 110–113, July, 1956.

EDGERTON, HAROLD E. Xenon Flash Tube of Small Volume. (In *Third International Congress, Department of Scientific & Industrial Research, London, Proc.*, pp. 51–56, September, 1956.)

EDGERTON, HAROLD E. and P. Y. CATHOU. Xenon Flash Tube of Small Size. *Rev. Sci. Instr.* 27, pp. 821–825, October, 1956.

EDGERTON, HAROLD E. and G. W. LeCOMPTE. Xenon Arc Transients, Electrical and Optical. *J. Appl. Phys.* 27, pp. 1427–1430, December, 1956.

ELIAS, PETER, A. FEINSTEIN and C. E. SHANNON. A Note on the Maximum Flow Through a Network. *I.R.E. Trans.* (Professional Group on Information Theory-2), pp. 117–119, December, 1956.

EPSTEIN, DAVID J. Domain-Wall Relaxation in Ferrites. (In *A.I.E.E. Second Conference on Magnetism and Magnetic Materials, Proc.*, pp. 493–503, February, 1957.)

FANO, ROBERT M. Cost of Transmission Reliability. *I.R.E. Convention Record*, Part 2, p. 48, March, 1957.

FAY, RICHARD D. Successful Method of Attack on Plane Progressive Finite Waves. *Acoustical Soc. Am. J.* 28, pp. 910–914, September, 1956.

FAY, RICHARD D. Acoustic Properties of Liquids. (A Section in *American Institute of Physics Handbook*, edited by D. E. Gray & others. N. Y. McGraw-Hill, 1957.)

FRAZIER, RICHARD H. Analysis of Pulse Pile-up Effects in a Pulse-Counting System. *Westinghouse Electric Corp.* WAPD-Tm-13, September, 1956.

GOLDSTEIN, MOISE H., JR. and N. Y-S. KIANG. Electrical Responses from the Cat's Auditory Nervous System to Certain Repetitive Stimuli. *Acoustical Soc. Am. J.* 28, p. 757, July, 1956.

GOLDSTEIN, MOISE H.. JR. Pitch Judgments for Repeated Bursts of Tone and Noise. *Acoustical Soc. Am. J.* 29, p. 184, January, 1957.

GRAY, TRUMAN S. *Electronic Technology.* (Japanese Translation.) Tokyo, Radio Engineers Educational Soc. 1955.

GRAY, TRUMAN S. *Electrónica Applicada.* (Spanish Translation.) Barcelona, Editorial Reverté, S. A. 1956.

GRAY, TRUMAN S., W. M. GRIM, JR., F. S. REPLOGLE, JR. and R. H. SPENCER. Solid-State Neutron-Flux Measuring System. *Second Nuclear Engineering & Science Conference*, Paper 57-NESC-35, 1957.

HAUS, HERMANN A. and R. B. ADLER. An Extension of the Noise Figure Definition. *I.R.E. Proc.* 45, pp. 690–691, May, 1957.

HAUS, HERMANN A. and D. L. BOBROFF. Small Signal Power Theorem for Electron Beams. *J. Appl. Phys.* 28, pp. 694–704, June, 1957.

HUFFMAN, DAVID A. The Design and Use of Hazard-Free Switching Networks. *Assoc. Computing Machinery J.* 4, pp. 47–62, January, 1957.

HUFFMAN, DAVID A. An Algebra for Periodically Time-Varying Linear Binary Sequence Transducers. (In *Harvard International Symposium on Switching Theory Proc.* April, 1957.)

JOHANNESSEN, PAUL R., W. X. JOHNSON and R. B. MARK. Magnetically Keyed, Phase-Sensitive Demodulators. *A.I.E.E. Trans.* (Communications and Electronics) 76, pp. 1–6, March, 1957.

KAISER, JAMES F., J. JURSIK and J. E. WARD. A Dual-Mode Damper-Stabilized Servo. *A.S.M.E. Trans.* 79, pp. 473–480, April, 1957.

KAISER, JAMES F., J. JURSIK and J. E. WARD. A Dual-Mode Damper-Stabilized Servo. (Abstract.) *Mech. Eng.* 78, p. 657, July, 1956.

KIANG, NELSON Y-S. and M. H. GOLDSTEIN. Responses from the Auditory Cortex to Tone Pips and Bursts of Noise: An Interpretation in Terms of the Place and Frequency Principles. (In *Twentieth International Physiological Congress, Brussels, Abstracts.* 1956.)

KUSKO, ALEXANDER and D. C. WHITE. Energy Conversion Highlights a New Curriculum. *Gen. Elec. Rev.* 59, pp. 31–34, November, 1956.

KUSKO, ALEXANDER. Thermal Considerations of Generators in High-Speed Aircraft. *A.I.E.E. Preprint* 57-463, 1957.

KYHL, ROBERT L. and H. F. WEBSTER. Breakup of Hollow Cylindrical Electron Beams. *I.R.E. Trans.* (Professional Group on Electron Devices-3), pp. 172–183, October, 1956.

LOEB, ARTHUR L. and J. B. GOODENOUGH. Anistropy in Antiferromagnetic Crystals with the Rock-salt Structure. (In *A.I.E.E. Second Conference on Magnetism and Magnetic Materials, Proc.*, pp. 55–68, February, 1957.)

MASON, SAMUEL J. Docile Behavior of Feedback Amplifiers. *I.R.E. Proc.* 44, pp. 781–788, June, 1956.

MASON, SAMUEL J. Feedback Theory — Further Properties of Signal Flow Graphs. *I.R.E. Proc.* 44, pp. 920–926, July, 1956.

MASON, SAMUEL J. Topological Analysis of Linear Nonreciprocal Networks. *I.R.E. Proc.* 45, pp. 829–838, June, 1957.

MAWARDI, OSMAN K. Creativity in the Mathematical and Physical Sciences. (In *First Creativity Conference Proc.*, pp. 19–27, October, 1956.)

MOON, PARRY H. On the Establishment of a Universal Time. *Philosophy of Sci.* 23, pp. 216–220, July, 1956.

MOON, PARRY H. A Review of *Abacs of Nomograms*, by A. Giet. Trans. by J. W. Head & H. D. Phippen. (London, Iliffe & Sons; N. Y. Philosophical Library.) *Optical Soc. Am. J.* 47, p. 109, January, 1957.

OLSEN, KENNETH H. and J. L. MITCHELL. TX-O, A Transistor Computer with A256 x 256 Memory. Part I. The TX-O Memory. Part II. TX-O Circuitry. *A.I.E.E. Special Publication* T-59, 1957.

RIAZ, MAHMOUD. Analogue Computer Representations of Synchronous Generators in Voltage-Regulation Studies. *A.I.E.E. Trans.* 75, pp. 1178–1184, December, 1956.

ROSENBLITH, WALTER A. A Probabilistic Approach to the Study of the Electrical Activity of the Auditory Nervous System. (In *Twentieth International Physiological Congress, Proc. Abstracts of Communications*, pp. 774–775, 1956.)

ROSENBLITH, WALTER A. and K. N. STEVENS. Comments on the Relations of Hearing Loss to Noise Exposure, DR, Criteria, etc. *Acoustical Soc. Am. J.* 28, pp. 716–717, July, 1956.

ROSENBLITH, WALTER A. and J. R. HUGHES. Electrophysiological Evidence for Auditory Sensitization. *Acoustical Soc. Am. J.* 29. pp. 275–280, February, 1957.

ROSENBLITH, WALTER A., J. S. BARLOW and M. A. B. BRAZIER. The Application of Autocorrelation Analysis to Electroencephalography. (In *National Biophysics Conference Proc.*, pp. 7–8, March, 1957.)

ROSENBLITH, WALTER A. Letter to the Editor. *Noise Control* 3, p. 50, May, 1957.

ROSENBLITH, WALTER A. and K. N. STEVENS. Comments on Plant Planning for Noise Control. *Noise Control* 3, p. 50, May, 1957.

ROSENBLITH, WALTER A. and others. *Guide for Conservation of Hearing in Noise.* Prepared by the Subcommittee on Noise in Industry of the Committee on Conservation of Hearing of the American Academy of Ophthalmology and Otolaryngology. 1957.

ROSENBLITH, WALTER A. and others. Guide for Conservation of Hearing in Noise. *Noise Control* 3, pp. 23–31, May, 1957.

ROSENBLITH, WALTER A. and others. Guide for Conservation of Hearing in Noise. *Ind. Med. & Surgery* 26, pp. 185–192, 1957.

SHANNON, CLAUDE E. The Zero Error Capacity of a Noisy Channel. *I.R.E. Trans.* (Professional Group on Information Theory-2), pp. 8–19, September, 1956.

SHANNON, CLAUDE E. Reliable Circuits Using Less Reliable Relays. Pt. II. *Franklin Inst. J.* 262, pp. 181–297, October, 1956.

SIEBERT, WILLIAM M. A Radar Detection Philosophy. *I.R.E. Trans.* (Professional Group on Information Theory-2), pp. 204–221, September, 1956.

SIEBERT, WILLIAM M. Statistical Theories of Radar Synthesis. (In *National Electronics Conference Proc.*, October, 1956.)

SIEBERT, WILLIAM M. Automatic Receiving Techniques Theory. (In *Raytheon Radar Symposium, Proc.* 1957.)

SIEBERT, WILLIAM M. Mathematical Statement of the Radar Data Processing Problem. (In *Raytheon Radar Symposium, Proc.* 1957.)

SMAKULA, ALEXANDER. Influence of Structure on the Optical Properties of Crystals. *Optical Soc. Am. J.* 47 p. 115, January, 1957.

SMALL, RICHARD H. Stabilizing Transistor Amplifiers. *Audio* 40, p. 47ff., December, 1956.

SMEDAL, MAGNUS I. and others. Some Problems Relating to Malignant Lymphomas. *Postgraduate Medicine* 21, pp. 508–519, May, 1957.

STEVENS, KENNETH N. and A. S. HOUSE. Studies of Formant Transitions Using a Vocal Tract Analog. *Acoustical Soc. Am. J.* 28, pp. 578–585, July, 1956.

STEVENS, KENNETH N. Synthesis of Speech by Electrical Analog Devices. *Audio Eng. Soc. J.* 4, pp. 2–8, January, 1956.

TRUMP, JOHN G. Physical Sciences and Man's Health. *The Technology Review* 58, p. 483 ff., July, 1956.

TRUMP, JOHN G., K. A. WRIGHT and OTHERS. Sterilization of Preserved Bone Grafts by High-Voltage Cathode Irradiation. *J. Bone & Joint Surgery* 38-A, pp. 862–884, July, 1956.

WEILLE, FRANCIS L. and R. S. GOHD. The Virus Theory of Nasal Polyp Etiology and Its Practical Applications. *Annals of Otology, Rhinology & Laryngology* 65, pp. 443–449, June, 1956.

WHITE, DAVID C. and A. KUSKO. A Unified Approach to the Teaching of Electromechanical Energy Conversion. *Elec. Eng.* 75, pp. 1028–1033. November, 1956.

WHITE, DAVID C. and H. H. WOODSON. A New Electromechanical Energy Conversion Laboratory. *A.I.E.E. Technical Paper* 57-603, 1957.

WIDRON, BERNARD. A Study of Rough Amplitude Quantization by Means of Nyquist Sampling Theory. *I.R.E. Trans.* (Professional Group on Circuit Theory-3), pp. 266–276, December, 1956.

WIESNER, JEROME B. New Methods of Radio Transmission. *Sci. Am.* 196, pp. 46–51, January, 1957.

WRIGHT, KENNETH A., R. C. GRANKE and J. G. TRUMP. Physical Aspects of Megavolt Electron Therapy. *Radiology* 67, pp. 553–560, October, 1956.

DEPARTMENT OF FOOD TECHNOLOGY

CAMPBELL, CAROL. Tomorrow's Trends in Food Processing and Preservation. *Forecast for Home Economists* 73, February, 1957.

FIFIELD, CHARLES W. and J. E. HOFF. Dilute Malachite Green: A Background Stain for the Millipore Filter. *Stain Technology* 32, pp. 95–96, March, 1957.

FIFIELD, CHARLES W., J. E. HOFF and B. E. PROCTOR. The Millipore Filter for Enumerating Coliform Organisms in Milk. *J. Dairy Sci.* 40, p. 588, May, 1957.

FREY, CHARLES N. Bread. (In *World Scope Encyclopedia*, Ed. 14. Lynbrook, N. Y. Universal Guild, 1956.)

FREY, CHARLES N. Antibiotics Production by Fermentation. (In *Encyclopedia of Chemistry*, edited by G. L. Clark & G. G. Hawley. N. Y. Reinhold [1957].)

FREY, CHARLES N. History and Development of Active Dry Yeast (A Chapter in *Yeast, Its Characteristics, Growth and Function in Baked Products*. U. S. Quartermaster Food and Container Institute for the Armed Forces, Chicago, 1957.)

FULD, GEORGE J. and C. G. DUNN. Automatic Pilot Plant Control in the Development of Microorganisms. *Food Technology* 11, pp. 15–18, January, 1957.

FULD, GEORGE J., B. E. PROCTOR and S. A. GOLDBLITH. Some Microbiological Aspects of Radiation Sterilization. *International J. Appl. Radiation & Isotopes* 2, pp. 35–43, April, 1957.

GOLDBLITH, SAMUEL A., B. E. PROCTOR and R. POMERANTZ. Rapid Spectrophotometric Technique for Evaluation of Vanilla Extracts. *J. Agricultural & Food Chem.* 5, pp. 292–294, April, 1957.

GOLDBLITH, SAMUEL A. From Test Tube to Table. (In *Conference on New Directions in Food Marketing Proc.* pp. 8–13, 1957.)

HARRIS, ROBERT S., K. V. THIMANN and G. F. MARRIAN. *Vitamins and Hormones*, Vol. XIV. N. Y. Academic Press, 1956.

HARRIS, ROBERT S., C. J. MALETSKOS, F. BRONNER and C. E. BENDA. Studies in Calcium Metabolism. Effect of Food Phytates on Calcium^{45} Uptake in Boys on a Moderate Calcium Breakfast. *J. Nutrition* 59, pp. 393–406, July, 1956.

HARRIS, ROBERT S. and F. BRONNER. Absorption and Metabolism of Calcium in Human Beings, Studied with Calcium^{45}. *N. Y. Acad. Sci. Annals* 64, pp. 314–325, August 18, 1956.

HARRIS, ROBERT S. So You Can't Eat Fat? *Science Digest* 40, pp. 55–57, October, 1956.

HARRIS, ROBERT S., H. LOPEZ, M. CIMADEVILLA, E. FERNANDEZ and J. M. NAVIA. Tabla Provisional de la Composicion

Nutritiva de los Alimentos Cubanos. *Colegio Medico de la Habana Boletin* 7, pp. 333–357, October, 1956.

HARRIS, ROBERT S. and others. Nutrient Composition of Cuban Foods. II. Foods of Vegetable Origin. *Food Research* 22, pp. 131–144, March–April, 1957.

KAREL, MARCUS. Protective Packaging of Frozen Foods. *Quick Frozen Foods* 19, pp. 201–204, August. 1956.

KAREL, MARCUS and B. E. PROCTOR. Cathode-Ray Irradiation of Cellophanes. *Modern Packaging* 30, pp. 141–146 ff. January, 1957.

KAREL, MARCUS, B. E. PROCTOR and A. CORNELL Flavor Permeability in Food Packaging and Its Evaluation. *Food Technology* 11, pp. 141–145, March, 1957.

NICKERSON, JOHN T. R., B. E. PROCTOR and S. A. GOLDBLITH. Ionizing Radiations in the Processing of Plant and Animal Products. *Food Technology* 10, pp. 305–311, July, 1956.

NICKERSON, JOHN T. R., S. E. CHARM, R. C. BROGLE, E. E. LOCKHART, B. E. PROCTOR and R. LINEWEAVER. Use of High-Voltage Cathode Rays to Destroy Bacteria of the Salmonella Group in Liquid and Frozen Egg White and Egg White Solids. *Food Technology* 11, pp. 159–166, March, 1957.

PAN, HUO-PING. A Simple Apparatus for Rapid Study of Paper Partition Chromatography. *Arch. Biochem. Biophysics* 64, pp. 311–314, October, 1956.

PROCTOR, BERNARD E. Operations Research — Developments in Radiation Research. (In *Activities Report, Food & Container Research and Development Work, U. S. Quartermaster Food and Container Institute for the Armed Forces*, pp. 135–140, July, 1956.)

PROCTOR, BERNARD E., S. DAVISON and A. L. BRODY. A Recording Strain Gage Denture Tenderometer for Foods. II. Studies on the Masticatory Force and Motion, and the Force-Penetration Relationship. *Food Technology* 10, pp. 327–331, July, 1956.

PROCTOR, BERNARD E., S. DAVISON and A. L. BRODY. A Recording Strain Gage Denture Tenderometer for Foods. III. Correlation with Subjective Tests and the Canco Tenderometer. *Food Technology* 10, pp. 344–346, August, 1956.

PROCTOR, BERNARD E. Food Horizons. *Food Technology* 10, pp. 393–396, September, 1956.

PROCTOR, BERNARD E. and S. A. GOLDBLITH. Preservation of Foods by Irradiation. *Am. J. Public Health* 47, pp. 439–445, April, 1957.

WERTHEIM, JOHN H., B. E. PROCTOR, and S. A. GOLDBLITH. Radiation Preservation of Milk and Milk Products. IV. Radiation-Induced Browning and Some Related Chemical Changes in Milk. *J. Dairy Sci.* 39, pp. 1236–1246, September, 1956.

DEPARTMENT OF GEOLOGY AND GEOPHYSICS

BUERGER, MARTIN J. Partial Fourier Syntheses and Their Application to the Solution of Certain Crystal Structures. *Nat. Acad. Sci. Proc.* 42, pp. 776–781, October, 1956.

BUERGER, MARTIN J. *Elementary Crystallography.* N. Y. Wiley, 1956.

BUERGER, MARTIN J. The Determination of the Crystal Structure of Pectolite, $Ca_2NaHSi_3O_9$. *Zeit. f. Crystallographie* 108, pp. 248–262, December, 1956.

BUERGER, MARTIN J., E. BARNE and T. HAHN. The Crystal Structure of Diglycine Hydrobromide. *Zeit. f. Crystallographie* 108, pp. 130–144, November, 1956.

DENNEN, WILLIAM H. Spectrographic Determination of Carbon in Sedimentary Rocks Using Direct-Current Arc Excitation. *Spectrochimica Acta* 9, pp. 89–97, 1957.

FAIRBAIRN, HAROLD W and P. M. HURLEY. Radiation Damage in Zircon and Its Relation to Ages of Paleozoic Igneous Rocks in Northern New England and Adjacent Canada. *Am. Geophys. Union, Trans.* 38, pp. 99–107, February, 1957.

HAWKES, HERBERT E. and H. BLOOM. Heavy Metals in Stream Sediment Used as Exploration Guide. *Mining Eng.* 8, pp. 1121–1127, November, 1956.

HURLEY, PATRICK M. *Geologic Age Determination by the Helium Method and Related Subjects, Final Report.* O. N. R., Geophysics Branch, June, 1957.

HURLEY, PATRICK M., G. R. WEBBER and H. W. FAIRBAIRN. Relative Ages of Eastern Massachusetts Granites by Total Lead Ratios in Zircon. *Am. J. Sci.* 254, pp. 574–583, September, 1956.

HURLEY, PATRICK M., G. J. F. MacDONALD, W. H. PINSON, J. W. WINCHESTER and H. W. FAIRBAIRN. Variations in Isotopic Abundances of Strontium, Calcium and Argon and Related Topics *U. S. Atomic Energy Commission Report*, NYO 3937, 1956.

HURLEY, PATRICK M. Test on the Possible Chondritic Composition of the Earth's Mantle and Its Abundance of Uranium, Thorium and Potassium. *Geol. Soc. Am. Bull.* 68, pp. 379–382, March, 1957.

MacDONALD, GORDON J. F. Quartz-Coesite Stability Relations at High Temperatures and Pressures. *Am. J. Sci.* 254, pp. 713–721, December, 1956.

MacDONALD, GORDON J. F. Experimental Determination of Calcite Aragonite Equilibrium Relations at Elevated Temperatures and Pressures. *Am. Mineralogist* 41, pp. 744–756, September–October, 1956.

MacDONALD, GORDON J. F., E. C. ROBERTSON and F. H. BIRCH. Experimental Determination of Jadeite Stability Relations to 25,000 Bars. *Am. J. Sci.* 255, pp. 115–137, February, 1957.

MacDONALD, GORDON J. F. Thermodynamics of Solids Under Non-Hydrostatic Stress with Geological Applications. *Am. J. Sci.* 255 pp. 266–281 April, 1957.

PARKS, ROLAND D. *Examination and Valuation of Mineral Property.* 3d Printing, Ed. 3, Rev. Reading,Mass. Addison Wesley, 1957.

SHROCK, ROBERT R. William Henry Twenhofel (1875–1957). *Am. Assoc. Petroleum Geologists Bull.* 41, pp. 978–980, May, 1957.

SHROCK, ROBERT R. Review of *The Mascall Fauna from the Miocene of Oregon*, by T. Downs. (Berkeley, Univ. Calif. Press, 1956. Univ. Calif. Publications in Geological Sciences, Vol. 31.) *U. S Quarterly Book Rev.* 12, pp. 244–245, June, 1956.

DEPARTMENT OF HUMANITIES

BARTLETT, IRVING H. History, Great Books and Liberal Education. *New England Social Studies Bull.* March, 1957.

BARTLETT, IRVING H. Bushnell, Cousin and Comprehensive Christianity. *J. Religion* 38, pp. 99–105, April, 1957.

BLUM, JOHN M. *Woodrow Wilson and the Politics of Morality*. Boston. Little, Brown, 1956.

BLUM, JOHN M. A Review of *Woodrow Wilson*, by J. A. Garraty. (N. Y. Knopf, 1956.) *Sat. Rev.* 39. pp. 12–13. September 29, 1956.

BLUM, JOHN M. Woodrow Wilson: A Study in Intellect. *Confluence* 5, pp. 367–375, Winter, 1957.

BLUM, JOHN M. T. R. Potpourii, a Review of *The Free Citizen*, edited by H. Hagedorn. (N. Y. Macmillan, 1957.) *Sat. Rev.* 40, p. 34, March 2, 1957.

BLUM, JOHN M. Humanities and Medical Education. *Tufts-New England Medical Center Bull.* 3, pp. 69–76, April–June, 1957.

BRYANT, LYNWOOD S. *The Undergraduate Thesis*. Ed. 3. Cambridge, Mass. M.I.T., 1956.

CHANDLER, ALFRED D., JR. A Review of *Management Succession*, by R. Stewart and Others. (London. Acton Society Trust, 1956.) *Explorations in Entrepreneurial History* 9, pp. 110–112, December, 1956.

CHANDLER, ALFRED D., JR. *Henry Varnum Poor — Business Editor, Analyst and Reformer*. Cambridge, Mass. Harvard Univ. Press, 1956.

CHANDLER, ALFRED D., JR. Review of *The Industrial Worker in Pennsylvania, 1800–1840*, by W. A. Sullivan. (Harrisburg, Pennsylvania Historical & Museum Commission, 1955.) *Econ. History Rev.* 9, pp. 513–514, April, 1957.

COLLINS, CARVEL. Review of *Critical Approaches to Literature*, by David Daiches. (N. Y. Prentice-Hall, 1956.) *Am. Scholar* 26, pp. 122–123, Winter, 1956–1957.

COLLINS, CARVEL. Folklore and Literary Criticism. *J. Am. Folklore*, Winter, 1956–1957.

COLLINS, CARVEL. The Pairing of *The Sound and the Fury* and *As I Lay Dying*. *Princeton Library Chronicle* 18, pp. 114–123, May, 1957.

DEUTSCH, KARL W. *Interdisciplinary Bibliography on Nationalism, 1935–53*. Cambridge, Mass. Technology Press, 1956.

DEUTSCH, KARL W. Language and Nationalism Since 1920. (In *The Most Dangerous Decades: An Introduction to the Comparative Study of Language Policy in Multi-Lingual States*, by S. S. Harrison. N. Y. Columbia Univ. Press, 1957.)

DEUTSCH, KARL W., M. LICHTERMAN and others. *Political Community and the North Atlantic Area*. Princeton, N. J. Princeton Univ. Press, 1957.

GREEN, WILLIAM C. Section on 18th Century. (In *Good Reading*, edited by Committee on College Reading. N. Y. Mentor, 1956.)

HARTLEY, E. NEAL. *Ironworks on the Saugus*. Norman, Okla. Univ. Okla. Press, 1957.

HOLLAND, NORMAN N. The Laughter of Laurence Sterne. *Hudson Rev.* 9, pp. 422–430, Autumn, 1956.

HOLLAND, NORMAN N. Cuckold or Counsellor in *Twelfth Night*, I.v.56. *Shakespeare Quarterly* 8, pp. 127–129, Winter, 1957.

HOLLAND, NORMAN N. "Do" or "Die" in *Measure for Measure*, I.iii.43. *Notes & Queries* 4 (n.s.), p. 52, February, 1957.

HOLLAND, NORMAN N. Ich am of Irlaunde. *The Explicator* 15, Note 55, June, 1957.

LEVY, ERNST. On the Proportions of the South Tower of Chartres Cathedral. (Appendix in *The Gothic Cathedral; Origins of Gothic Architecture and the Medieval Concept of Order*, by O. G. von Simson. N. Y. Pantheon, 1956.)

LOCKWOOD, THEODORE D. *Four Decades of Flying Shears*. Thomaston, Conn. Thomaston Press, 1956.

LOCKWOOD, THEODORE D. History and the Humanities. *J. Higher Education* 28, pp. 1–9, January, 1957.

MAHONEY, THOMAS H. D. Edmund Burke: a Portrait and an Appraisal. *History Today* 6, pp. 727–735, November, 1956.

MAHONEY, THOMAS H. D. Review of *The Republic of Indonesia*, by Dorothy Woodman. (N. Y. Philosophical Library, 1956.) *Historical Bull.* 35, pp. 39–40, November, 1956.

MAHONEY, THOMAS H. D. Edmund Burke, the Man They Would Not Hear. *The Irish Digest* 59, pp. 77–81, April, 1957.

REICHE, HAROLD A. T. A History of the Concepts θεοπρεπής and ἱεροπρεπής. *Harvard Studies in Clinical Philology* 62, pp. 148–151, 1957.

SCHOENWALD, RICHARD L. Review of *The Life and Work of Sidmund Freud, Volume II: Years of Maturity*, by Ernest Jones. (N. Y. Basic Books, 1955.) *Isis* 48, p. 97, March, 1957.

SCHOENWALD, RICHARD L. Review of *The Complete Works of Nathanael West*. (N. Y. Farrar, Straus & Cudahy, 1957.) *Commonweal* 66, pp. 162–163, May 10, 1957.

STAHLMAN, WILLIAM D. Review of *Science Awakening*, by B. L. van der Waerden. (Groninger, Holland, P. Noordhoff, Ltd., 1954.) *Scripta Mathematica* 22, pp. 137–139, June, 1956.

STAHLMAN, WILLIAM D. Astrology in Colonial America: An Extended Query. *William & Mary Quarterly* 13, Ser. 3, pp. 551–563, October, 1956.

STAHLMAN, WILLIAM D. Raymond Clair Archibald. *Isis* 47, pp. 244–246, 1956.

STAHLMAN, WILLIAM D. *Review of A History of Technology, Vol. II*, edited by Charles Singer *et. al.* (Oxford, Clarendon Press, 1957.) *Science* 125, pp. 822–823, April 26, 1957.

WESCOTT, ROGER W. Did the Yoruba Come from Egypt? *J. Western Region Studies* 10, pp. 10–15, June, 1957.

SCHOOL OF INDUSTRIAL MANAGEMENT

BOWMAN, EDWARD H. and R. B. FETTER. *Analysis for Production Management*. Homewood, Illinois, Richard D. Irwin, Inc., 1957.

BROWN, DOUGLAS V. Labor and the Anti-Trust Laws. (In *Am. Bar Assoc., Labor Law Section, Proc.*, pp. 23–29, August, 1955.)

BROWN, DOUGLAS V. and C. A. MYERS. The Changing Industrial Relations Philosophy of American Management. (In *Industrial Relations Research Assoc. Annual Proc.*, pp. 84–99, 1956.)

CHOW, GREGORY C. The Demand for Automobiles in the U. S. *Econometrica* 24, p. 342, July, 1956.

CHOW, GREGORY C. *Demand for Automobiles in the United States: A Study in Consumer Durables*. (A Volume in the Series of *Contributions to Economic Analysis*, edited by J. Tinbergen, P. J. Verdoorn and H. J. Witteveen.) Amsterdam, North-Holland Publ. Co., 1957.

CORBIN, DONALD A. New Proposals for Capital Gains Taxation. *Taxes* 34, pp. 663–668, October, 1956.

CORBIN, DONALD A. Analysis of Financial Statements During Inflation. *Analysts J.* 12, pp. 73–79, November, 1956.

CORBIN, DONALD A. Capital Maintenance and the Concept of Income — a Comment. *J. Political Econ.* 64, pp. 528–533, December, 1956.

CUNNINGHAM, ROSS M. How to Apply These Tools for More Effective Marketing Research. (In *Chemical Market Research Association, New Tools for Market Research Proc.*, November. 1956.)

DURAND, DAVID. Bank Stock Prices and the Bank Capital Problem. *National Bureau of Economic Research Occasional Paper* 54, 1957.

ENOS, JOHN L. The Pricing of a Super-Premium Grade of Gasoline *Am. Petroleum Institute, Marketing Research Committee, Report*, October, 1956.

FETTER, ROBERT B. Some Applications of Probability Theory to Manufacturing Problems. (In *Seventh National Conference, Am. Institute of Industrial Engineers, Proc.*, pp. 13-1, 13–18, 1956.)

FORRESTER, JAY W. Systems Technology and Industrial Dynamics. *The Technology Review* 59, pp. 417–422, ff., June, 1957.

GOETZ, BILLY E. The Usefulness of the Impossible. *Am. Assoc. Univ. Professors* 42, pp. 275–287, Summer 1956.

GOETZ BILLY E. Mathematical Models of Management Significance. *Advanced Management* 22. pp. 21–24, February, 1957.

GOODWIN, HERBERT F. How's Your Batting Average? *Supervisory Management* 1, pp. 40–42, July, 1956.

GOODWIN, HERBERT F. Work Simplification, an Effective Program of Improvement. *Advanced Management* 22, pp. 19–25, January, 1957.

GOODWIN, HERBERT F. A Progress Report on Work Simplification. (In *Eighth National Conference, Am. Institute of Industrial Engineers, Proc.*, pp. 203–212, May, 1957.)

GORDON, MYRON J. and E. SHAPIRO. Capital Equipment Analysis: the Required Rate of Profit. *Management Science* 3, pp. 102–110, October, 1956.

GORDON, MYRON J. and W. J. TAYLOR. The Condition for Lot Size Production. *Am. Statistical Assoc. J.* 51, pp. 627–636, December, 1956.

GREGORY, ROBERT H. Reviews of *An Introduction to Automatic Computers; A Systems Approach for Business*, by N. Chapin (Chicago, Technology Center, 1955) and *Data Processing by Electronics: A Basic Guide for the Understanding and Use of a New Technique*, by Haskins & Sells, *firm accountants*. (N. Y. Haskins & Sells, 1955.) *Accounting Rev.* 31, pp. 339–340, April, 1956.

GREGORY, ROBERT H. Review of *Electronic Data Processing in Industry: A Case Book of Management Experience*, by Am. Management Assoc. *Accounting Research* 7, pp. 295–298, July, 1956.

GREGORY, ROBERT H. Analyzing and Appraising Office Operations. *J. Machine Accounting* 7, pp. 8–10, October, 1956.

GREGORY, ROBERT H. and T. V. V. ATWATER, JR. Cost and Value of Management Information as Functions of Age. *Accounting Research* 8, pp. 42–70, January, 1957.

HILL, THOMAS M. and W. T. JEROME. Accounting in the Executive Program. *Accounting Rev.* 31, pp. 411–417, July, 1956.

JACK, ANDREW B. The Channels of Distribution for an Innovation: The Sewing-Machine Industry in America, 1860–1865. *Explorations in Entrepreneurial History* 9, pp. 113–141, February, 1957.

JOHNSON, HOWARD W. The Measurement of Motivation by Attitude Surveys. (In *Tenth Annual Conference on the Administration of Research, Proc.*, 1957.)

JOHNSON, HOWARD W. Where Management Development Belongs. *Nation's Business* 45, pp. 36–37, ff., June, 1957.

McGREGOR, DOUGLAS M. An Uneasy Look at Performance Appraisal. *Harvard Business Rev.* 35, pp. 89–94, May–June, 1957.

MAFFEI, RICHARD B. Mathematical Models, Values of Parameters and the Sensitivity Analysis of Management-Decision Rules. *J. Marketing* 21, pp. 419–427, April, 1957.

MAFFEI, RICHARD B. Review of *Operations Research for Management*, Vol. II, edited by J. F. McCloskey & J. M. Coppinger. (Baltimore, Johns Hopkins Press, 1956.) *Am. Scientist* 45, pp. 208A–212A, June, 1957.

MAFFEI, RICHARD B. Review of *Introduction to Operations Research*, by C. W. Churchman, R. L. Ackoff and E. L. Arnoff. (N. Y. Wiley, 1957.) *Am. Scientist* 45, pp. 212A–214A, June, 1957.

MOORE, LEO B. Standards Outlook — Standards Library. *The Magazine of Standards* 27, p. 223, July, 1956.

MOORE, LEO B. Standards Outlook — Standards Information. *The Magazine of Standards* 27, p. 255, August, 1956.

MOORE, LEO B. Standards Outlook — Standards Enforcement. *The Magazine of Standards* 27, p. 287, September, 1956.

MOORE, LEO B. Standards Outlook — Financing Standards Activity. *The Magazine of Standards* 27, p. 319, October 1956.

MOORE, LEO B. Standards Outlook — Standards Personnel. *The Magazine of Standards* 27, p. 351, November, 1956.

MOORE, LEO B. Standards Outlook — Engineering Manpower. *The Magazine of Standards* 27, p. 383, December, 1956.

MOORE, LEO B. Report on Progress in the Standards Field. A Review of *National Standards in a Modern Economy*, edited by D. Reck. (N. Y. Harper, 1956.) *Standards Eng.* 8. p. 3, December, 1956.

MOORE, LEO B. Standards Outlook — Standards Films. *The Magazine of Standards* 28, p. 27, January, 1957.

MOORE, LEO B. Standards Outlook — Standards Reading. *The Magazine of Standards* 28, p. 59, February, 1957.

MOORE, LEO B. Standards Outlook — Standards Agreement *The Magazine of Standards* 28, p. 91, March, 1957.

MOORE, LEO B. Standards Outlook — The Standards Pattern. *The Magazine of Standards* 28, p. 123, April, 1957.

MOORE, LEO B. Standards Outlook — Standards by Design. *The Magazine of Standards* 28, p. 155, May, 1957.

MOORE, LEO B. Standards Outlook — Community Challenge. *The Magazine of Standards* 28, p. 187, June, 1957.

RUBENSTEIN, ALBERT H. Setting Criteria for R and D. *Harvard Bus. Rev.* 35, pp. 95–104, January–February, 1957.

RUBENSTEIN, ALBERT H. Guides to R and D. *Harvard Bus. Rev.* 35, pp. 133–146, May–June, 1957.

RUBENSTEIN, ALBERT H. Liaison Relations in Research and Development. *I.R.E. Trans.* (Professional Group on Engineering Management-4) pp. 72–78, June, 1957.

SCHELL, ERWIN H. *Technique of Executive Control.* Ed. 8. N. Y. McGraw-Hill, 1957.

SCHELL, ERWIN H. A Dialogue on Executive Development. *Advanced Management* 22, pp. 5–12, March, 1957.

SHAPIRO, ELI. Financing Future Expansion. (In *The Next Five Years in Management*, by M.I.T. School of Industrial Management.) (Cambridge, Mass. M.I.T., 1956.)

SHAPIRO, ELI and D. MEISELMAN. The Financing of Consumer Credit Institutions. (In *Conference on Consumer Instalment Credit Regulation*, Part II, Vol. I, pp. 298–323, 1957.)

SHAPIRO, ELI. The Market for Corporate Securities: A Progress Report. *J. Finance* 12, pp. 136–147, May, 1957.

SHAPIRO, ELI. Discussion. *J. Finance* 12, pp. 283–288, May, 1957.

SHAPIRO, ELI. Capital Budgeting in the Next Ten Years. *Business Scope* 1 (Blue Report No. 1), May 18, 1957.

SHAPIRO, ELI. Financial Forces in Industrial Growth. *The Technology Review* 59, pp. 412–416, ff., June, 1957.

SHILLINGLAW, GORDON. Profit Analysis for Abandonment Decisions. *J. Business, Univ. Chicago* 30, pp. 17–29, January, 1957.

SHILLINGLAW, GORDON. Guides to Internal Profit Measurement. *Harvard Bus. Rev.* 35, pp. 82–94, March–April, 1957.

WAGNER, HARVEY M. The Two Phase Method for the Simplex Tableau. *Operations Res.* 4, pp. 443–447, August, 1956.

WAGNER, HARVEY M. An Eclectic Approach to the Pure Theory of Consumer Behavior. *Econometrica* 24, pp. 451–466, October, 1956.

WAGNER, HARVEY M. The Run-off Election Paradox. *Labor Law J.* 8, pp. 116–117, February, 1957.

WAGNER, HARVEY M. A Lemma for Automatic Programming on the I. B. M. 650. *Mathematical Tables & Aids to Computation* 11, pp. 85–90, April, 1957.

WAGNER, HARVEY M. A Unified Treatment of Bargaining Theory. *Southern Econ. J.* 24, pp. 380–397, April, 1957.

WAGNER, HARVEY M. A Linear Programming Solution to Dynamic Leontief Type Models. *Management Sci.* 3, pp. 200–216, April, 1957.

WAGNER, HARVEY M. A Comparison of the Original and Revised Simplex Methods. *Operations Res.* 5, pp. 308–317, June, 1957.

WAGNER, HARVEY M. Dynamic Problems in the Theory of the Firm. (A Chapter in *Theory of Inventory Management*, by T. M. Whitin.) (Princeton. Princeton Univ. Press, 1957.)

WHITIN, THOMSON M. *Theory of Inventory Management.* Princeton. Princeton Univ. Press, 1957.

DEPARTMENT OF MATHEMATICS

BAILY, WALTER L., JR. The Decomposition Theorem for V-Manifolds. *Am. J. Math.* 78, pp. 862–888, October, 1956.

BAILY, WALTER L., JR. On the Imbedding of V-Manifolds in Projective Space. *Am. J. Math.* 79, pp. 403–430, April, 1957.

FRANKLIN, PHILIP. The Euclidean Algorithm. *Am. Math. Monthly* 63, pp. 663–664, November, 1956.

IWASAWA, KENKICHI. A Note on Class Numbers of Algebraic Number Fields. *Hamburg Univ. Abh. Math. Seminar* 20, pp. 257–258, 1956.

IWASAWA, KENKICHI. A Note on the Group of Units of an Algebraic Number Field. *J. Math. Pures et Appliquées* 35, pp. 189–192, 1956.

KNOWLES, JAMES K. and E. REISSNER, A Derivation of the Equations of Shell Theory for General Orthogonal Coordinates. *J. Math. & Physics* 35, pp. 351–358, January, 1957.

LEVINSON, NORMAN. On Closure Problems and the Zeros of the Riemann Zeta Function. *Am. Math. Soc. Proc.* 7, pp. 838–845, October, 1956.

LIN, CHIA-CHIAO. Stability of Laminar Flows. *Appl. Mech. Rev.* 10, pp. 1–3, January, 1957.

LIN, CHIA-CHIAO. On Uniformly Valid Asymptotic Solutions of the Orr-Sommerfeld Equation. (In *Ninth International Congress of Applied Mechanics, Proc.* Vol. 1, pp. 136–148, 1957.)

REISSNER, ERIC and J. L. LUBKIN. Stress Distribution and Design Data for Adhesive Lap Joints Between Circular Tubes. *A.S.M.E. Trans.* 78, pp. 1213–1221, August, 1956.

REISSNER, ERIC. A Note on Membrane and Banding Stresses in Spherical Shells. *Soc. Indus. Appl. Math. J.* 4, pp. 230–240, December, 1956.

REISSNER, ERIC and M. B. SLEDD. Bounds on Influence Coefficients for Circular Cylindrical Shells. *J. Math. & Physics* 36, pp. 1–19, April, 1957.

ROGERS, HARTLEY, JR. A General Education Course in Pure Mathematics. *Am. Math. Monthly* 63, pp. 460–465, August–September, 1956.

ROGERS, HARTLEY, JR. Certain Logical Reduction and Decision Problems. *Annals Math.* 64, pp. 264–284, September, 1956.

ROGERS, HARTLEY, JR. A Note on the Law of Large Numbers. *Am. Math. Soc. Proc.* 8, pp. 518–520, June, 1957.

ULAM, STANISLAW M. Infinite Models in Physics. (A Chapter in *Symposia in Applied Mathematics Proc., Vol. 7.* Edited by L. A. MacColl. N. Y. McGraw-Hill, 1957.)

WHITEHEAD, GEORGE W. Homotopy Groups of Joins and Unions. *Am. Math. Soc. Trans.* 83, pp. 55–69, September, 1956.

WIENER, NORBERT. Analysis of the Child Prodigy. *N. Y. Times Mag.*, pp. 15 ff., June 2, 1957.

DEPARTMENT OF MECHANICAL ENGINEERING

ADAMS, DOUGLAS P., E. R. SCHWARZ and S. BACKER. Relationship Between Structural Geometry of Textile Fabric and Its Physical Properties. Nomographic Solution of Geometric Relationships. *Textile Res. J.* 26, pp. 653–665, September, 1956.

ADAMS, DOUGLAS P. Alignment Diagrams from Network Charts by Graphics. *Mech. Eng.* 78, pp. 1013–1015, November, 1956.

ADAMS, DOUGLAS P. Nomograms. A Review of *Abacs or Nomograms*, by A. Giet. (London, Iliffe, 1956.) *Mech. Eng.* 79, p. 99, January, 1957.

ADAMS, DOUGLAS P. More General Dualities. *Mech. Eng.* 79, pp. 494–495, May, 1957.

BUCKINGHAM, EARLE and T. W. KHIRALLA. Design of Gear Drives for Extreme Conditions. *Am. Gear Manufacturers Assoc. Technical Paper* 109.10, June, 1957.

CHADDOCK, JACK B. Film Condensation of Vapor in a Horizontal Tube. *Refrig. Eng.* 65, pp. 36–41, April, 1957.

COLLINS, S. C. Hydrogen-Helium Liquefier. (In *Cryogenic Engineering Conference, Proc.*, September, 1956.)

COLLINS, S. C., F. D. EZEKIEL, O. W. SEPP and J. W. RIZIKA. The Strength of Certain Stainless and Carbon Steels at Low Temperatures. *A.S.T.M. Proc.* 56, p. 687, 1956.

COOK, NATHAN H. A Differential Torsion Testing Machine. *Soc. Exper. Stress Analysis Proc.* 14, pp. 155–158, 1957.

CRANDALL, STEPHEN H. *Engineering Analysis, a Survey of Numerical Procedures.* N. Y. McGraw-Hill, 1956.

CRANDALL, STEPHEN H. and W. G. STRANG. An Improvement of the Holzer Table Based on a Suggestion of Ray Leigh's. *J. Appl. Mech.* 24, pp. 228–230, June, 1957.

EZEKIEL, FREDDIE D. A Proposal for a Steam Rate Flowmeter. (In *National District Heating Association Proc.*, 1955.)

EZEKIEL, FREDDIE D. Effect of an End Chamber on the Surge Frequency in a Hydraulic Conduit. *A.S.M.E. Paper* No. 56-A-158D, 1956.

EZEKIEL, FREDDIE D. Discussion of *On the Dynamics of Pneumatic Transmission Lines* by C. P. Rohmann and E. C. Grogan. *A.S.M.E. Trans.* 79, p. 869, May, 1957.

FAY, JAMES A., F. R. RIDDELL and N. H. KEMP. Stagnation Point Heat Transfer in Dissociated Air Flow. *Jet Propulsion* 27, pp. 672–674, June, 1957.

GOODMAN, THOMAS P. A Technique for Approximate Evaluation of Correlation Coefficients. *J. Appl. Physics* 27, pp. 773–775, July, 1956.

GOODMAN, THOMAS P. Teaching and Psychodynamics. *J. Eng. Educ.* 47, pp. 334–335, December, 1956.

GOODMAN, THOMAS P. Determination of the Characteristics of Multi-Input and Nonlinear Systems from Normal Operating Records. *A.S.M.E. Trans.* 79, pp. 567–575, April, 1957.

GRIFFITH, PETER. Bubble Growth Rates in Boiling. *A.S.M.E. Paper* No. 57-HT-2, 1957.

GRIFFITH, PETER. The Correlation of Nucleate Boiling Burnout Data. *A.S.M.E. Paper* No. HTD-57-23, 1957.

HILLSLEY, RICHARD H. Analyzing Control Systems Graphically. *Control Eng.* 3, pp. 154–161, September, 1956.

KAYE, JOSEPH. Review of Industrial Applications of Heat Transfer to Electronics. *I.R.E. Proc.* 44, pp. 977–991, August, 1956.

KAYE, JOSEPH and G. N. HATSOPOULOS. A Novel Method of Obtaining an Isothermal Surface for Steady-State and Transient Conditions. *A.S.M.E. Preprint* No. 56-SA-13, November, 1956.

KAYE, JOSEPH and S. W. GOUSE, JR. Thermal Analysis of a Small D. C. Motor — Part I: Dimensional Analysis of Combined Thermal and Electrical Processes. *A.I.E.E. Trans.* (Power Apparatus & Systems) 76, pp. 1463–1467, February, 1957.

KAYE, JOSEPH, S. W. GOUSE, JR. and E. C. ELGAR. Thermal Analysis of a Small D. C. Motor — Part II: Experimental Study of Steady-State Temperature Distribution in a D-C Motor with Correlations Based on Dimensional Analysis. *A.I.E.E. Trans.* (Power Apparatus & Systems) 76, pp. 1468–1486, February, 1957.

KEENAN, JOSEPH H. and H. E. WEBER. Head Loss in Flow Through a Cyclone Dust Separator or Vortex Chamber. *J. Appl. Mech.* 24, pp. 16–21, March, 1957.

MANN, ROBERT W. Fuels and Prime Movers for Rotating Auxiliary Power Units. (In *Symposium on Auxiliary Power for Guided Missiles Proc.* February, 1957.)

MAYER, JOHN E., JR. and M. C. SHAW. Grinding Temperatures. *Lubrication Eng.* 13, pp. 21–27, January, 1957.

MONTGOMERY, STEPHEN R. and J. J. BRAUN. Investigation of Rotating Stall in a Single Stage Axial Compressor. *N.A.C.A. Technical Note* 3823, January, 1957.

MURRAY, WILLIAM M. and P. K. STEIN. *Strain Gage Techniques.* Cambridge, M.I.T. 1956.

RABINOWICZ, ERNEST. The Equilibrium Distribution of Transfer Fragments. *Lubrication Eng.* 12, pp. 401–404, November–December, 1956.

RABINOWICZ, ERNEST. Direction of the Friction Force. *Nature* 179, p. 1073, May 25, 1957.

REICHENBACH, GEORGE S. Experimental Measurement of Metal Cutting Temperature Distributions. *A.S.M.E. Paper* 57-SA-53, 1957.

ROHSENOW, WARREN M., J. H. WEBBER and A. T. LING. Effect of Vapor Velocity on Laminar and Turbulent Film Condensation. *A.S.M.E. Trans.* 78, pp. 1637–1644, November, 1956.

ROHSENOW, WARREN M. Heat Transfer and Temperature Distribution in Laminar Film Condensation. *A.S.M.E. Trans.* 78, pp. 1645–1648, November, 1956.

ROHSENOW, WARREN M. Effect of Turbine-Blade Cooling on Efficiency of a Simple Gas-Turbine Power Plant. *A.S.M.E. Trans.* 78, pp. 1787–1794, November, 1956.

ROHSENOW, WARREN M., J. C. BURKE and B. L. BUTEAU. Analysis of Effect of Blade Cooling on Gas-Turbine Performance. *A.S.M.E. Trans.* 78, pp. 1795–1806, November, 1956.

SCHWARZ, EDWARD R. The Power of Purpose. *Am. Dyestuff Reporter* 45, p. 857, November 19, 1956.

SCHWARZ, EDWARD R. Safety in an Ivory Tower and Vice Versa. *Safety Monographs for Universities & Colleges* 6, pp. 32–36, 1956.

SHANK, MAURICE E. and W. R. CLOUGH. Flow and Fracture of Nodular Cast Iron. *A.S.M.E. Paper* 56-A-110, 1956.

SHANK, MAURICE E. and W. R. CLOUGH. The Deformation and Rupture of Gray Cast Iron. *Am. Soc. Metals. Trans.* 49, pp. 241–262, 1957.

SHANK, MAURICE E., editor. *Control of Steel Construction to Avoid Brittle Failure.* N. Y. Welding Research Council, 1957.

SHAPIRO, ASCHER H. and A. J. ERICKSON. On the Changing Size Spectrum of Particle Clouds Undergoing Evaporation, Combustion or Acceleration. *A.S.M.E. Trans.* 79, pp. 775–788, May, 1957.

SHAW, MILTON C. Ultrasonic Grinding. *Microtecnic* 10, pp. 257–265, 1956.

SHAW, MILTON C. and I. FINNIE. The Friction Process in Metal Cutting. *A.S.M.E. Trans.* 78, pp. 1649–1657, November, 1956.

SHAW, MILTON C. and P. A. SMITH. A Comparison of Workpiece Finishes Produced by Ceramic and Carbide Tools. *Am. Soc. Tool Engrs. Technical Paper* No. 20, 1957.

SHAW, MILTON C. Betrachtungen zur Verwendung von Keramischen Werkzeugen. *Industrie-Anzeiger* 79, p. 282, March 8, 1957.

SHAW, MILTON C. and P. A. SMITH. Finishes Produced by Ceramics and Carbides. *Tool Eng.* 38, pp. 97–102, April, 1957.

STENNING, ALAN H., S. R. MONTGOMERY and A. R. KRIEREL. Stall Propagation in Axial Flow Compressors. *N.A.C.A. Technical Note* 3580, June, 1956.

TAYLOR, C. FAYETTE and T-Y TOONG. Heat Transfer in Internal-Combustion Engines. *A.S.M.E. Paper* 57-HT-17, 1957.

TOONG, TAU-YI and J. KAYE. Theoretical Solutions for a Steady. Laminar Flow of a Compressible Fluid in the Entrance Region of a Tube. (In *Ninth International Congress on Theoretical and Applied Mechanics Proc*, 1956.)

TOONG, TAU-YI and J. KAYE. Discussion on *Heat Transfer in Pipe Flow at High Speeds*, by J. E. Bialokoz & O. A. Saunders. *Instn. Mech. Engrs. Proc.* 170, pp. 401–406, 1956.

TOONG, TAU-YI. Ignition and Combustion in a Laminar Boundary Layer Over a Hot Surface. (In *Sixth Symposium International on Combustion*, 1957.)

MEDICAL DEPARTMENT

COBB, STANLEY. Awareness, Attention and Physiology of the Brain Stem. (A Chapter in *Experimental Psychopathology*, edited by P. H. Hoch & J. Zubin. N. Y. Grune & Stratton, 1957.)

COBB, STANLEY. Physiological Observations on Disturbances of the Cerebral Circulation. (A Chapter in *Handbuch des Speziellen Pathologischen Anatomie*. Berlin, Springer, 1957.)

HARDY, HARRIET L. Differential Diagnosis Between Beryllium Poisoning and Sarcoidosis. *Am. Rev. Tuberculosis & Pulmonary Diseases* 74, p. 885, December, 1956.

HARRIS, HERBERT I. and F. P. HEALD. Psychotherapy of Adolescents and Psychiatrist at Combined Clinic and Inpatient Hospital Level. (A Chapter in *Psychotherapy of the Adolescent*, edited by B. H. Balser. N. Y. International Univ. Press, Inc., 1957.)

HARRIS, HERBERT I. Review of *The Practice of Dynamic Psychiatry*, by J. H. Masserman. (Phila. Saunders, 1955.) *Contemporary Psychology* 2, p. 12, January, 1957.

HARRIS, HERBERT I. Telephone Anxiety. *Am. Psychoanalytic Assoc. J.* 5, pp. 342–347, April, 1957.

HERM, ROBERT J. A Case of Severe Membranous Conjunctivitis. *Archives of Ophthalmology* 57, pp. 740–743, May, 1957.

HORWOOD, MURRAY P. and J. WELSH. Health and Social Welfare in Burma. *Human Relations Area Files* 1, pp. 454–543, July, 1956.

HORWOOD, MURRAY P. *Sanitary Code for Eating and Drinking Establishments and for Prepared Food Vending Vehicles.* Boston, Health Dept., 1957.

HORWOOD, MURRAY P. *Equipment and Supplies for Sanitation Laboratories.* Wash., D. C. U. S. Public Health Service, 1957.

HORWOOD, MURRAY P. Tribute to Professor Charles Edward Amory Winslow. *Mass. Public Health Assoc. Proc.* 18, p. 7, April, 1957.

MALETSKOS, CONSTANTINE J. and others. The Artificial Kidney and Ion Exchange Resins as Possible Methods of Removing Radio Elements from the Body. *Radiology* 68 pp. 255–256, February 1957.

MALETSKOS, CONSTANTINE J. and others. Radioactive Calcium Tracer Studies in Bone Grafts. *J. Bone & Joint Surgery* 39A, pp. 561–577, June, 1957.

MEANS, JAMES H. The Span of the Doctor's Responsibility. *King's College Hospital Gazette* (London) 35, pp. 141–149, Autumn, 1956.

MEANS, JAMES H. By Way of the Thyroid. *St. Bartholomew's Hospital J.* (London) 61, pp. 101–105, April, 1957.

TILLEY, ROBERT F. Contact Dermatitis from Chlorpromazine Hydrochloride. *New England J. Medicine* 255, pp. 1046–1047, November 29, 1956.

VILES, FREDERICK J., JR. Design and Uses of Laboratory Hoods. *College & University Business* 22, pp. 41–46, June, 1957.

DEPARTMENT OF METALLURGY

ABRAHAMSON, ERNEST P., II and N. J. GRANT. Beta Chromium. *J. Metals* 8, pp. 975–977, August, 1956.

ABRAHAMSON, ERNEST P., II and N. J. GRANT. Some Structures and Properties of Chromium-Nickel-Nitrogen Ternary Alloys. (A Chapter in *Ductile Chromium and Its Alloys.* Cleveland, Am. Soc. Metals, 1957.)

ABRAHAMSON, ERNEST P., II and N. J. GRANT. The Chromium-Nickel-Nitrogen Ternary Diagram. (A Chapter in *Ductile Chromium and Its Alloys.* Cleveland, Am. Soc. Metals, 1957.)

ADAMS, CLYDE M., JR., H. F. TAYLOR, D. V. RAGONE and J. K. SPRINKLE. Gas Porosity in Oxygen-Free Copper Castings. *Am. Foundrymen's Soc. Trans.* 64, pp. 611–615, 1956.

ADAMS, CLYDE M., JR., H. F. TAYLOR and D. V. RAGONE. Some Factors Affecting Fluidity of Metals. *Am. Foundrymen's Soc. Trans.* 64, pp. 640–652, 1956.

ADAMS, CLYDE M., JR., H. F. TAYLOR and D. V. RAGONE. A New Method for Determining the Effect of Solidification Range on Fluidity. *Am. Foundrymen's Soc. Trans.* 64, pp. 653–657, 1956.

ADAMS, CLYDE M., JR., H. F. TAYLOR and W. D. WALTHER Mechanism for Pore Formation in Solidifying Metals. *Am. Foundrymen's Soc. Trans.* 64, pp. 658–664, 1956.

AVERBACH, BENJAMIN L. and P. S. RUDMAN. The Effect of Cold Work on Local Order. *Acta Metallurgica* 4, pp. 382–384, July, 1956.

AVERBACH, BENJAMIN L. and F. H. HERBSTEIN. The Structure of Lithium-Magnesium Solid Solutions. Part I. Measurements on the Bragg Reflections. *Acta Metallurgica* 4, pp. 407–413, July, 1956.

AVERBACH, BENJAMIN L. and F. H. HERBSTEIN. The Structure of Lithium-Magnesium Solid Solutions. Part II. Measurements of Diffuse X-Ray Scattering. *Acta Metallurgica* 4, pp. 414–420, July, 1956.

AVERBACH, BENJAMIN L., M. B. BEVER, M. F. COMERFORD and J. S. LEACH. X-Ray and Calorimetric Investigations of Cold Working and Annealing of a Gold-Silver Alloy. *Acta Metallurgica* 4, pp. 477–484, September, 1956.

AVERBACH, BENJAMIN L., S. A. KULIN and A. D. KURTZ. Effects of Growth Rate on Crystal Perfection and Lifetime in Germanium. *J. Appl. Physics* 27, p. 1287, October, 1956.

AVERBACH, BENJAMIN L., M. COHEN and F. E. WERNER. The Matrix Phase in Lower Bainite and Tempered Martensite. *J. Metals* 8, p. 1484, October, 1956.

AVERBACH, BENJAMIN L., M. COHEN and J. E. REYNOLDS. Self-Diffusion and Interdiffusion in Gold-Nickel Alloys. *Acta Metallurgica* 5, pp. 29–38, January, 1957.

AVERBACH, BENJAMIN L. and P. S. RUDMAN. X-Ray Determinations of Order and Atomic Sizes in Co-Pt Solid Solutions. *Acta Metallurgica* 5, p. 65, February, 1957.

BACKOFEN, WALTER A., E. F. ERBIN and E. R. MARSHALL. Martensitic Transformation in the Machining of Austenitic Stainless Steel. *Am. Soc. Metals Trans.* 49, pp. 686–705, 1957.

BACKOFEN, WALTER A. and D. S. FIELDS, JR. Determination of Strain-Hardening Characteristics by Torsion Testing. *A.S.T.M. Preprint* 84, 1957.

BEVER, MICHAEL B. and P. GREENFIELD. The Evolution of the Energy Stored by a Gold-Silver Alloy Cold-Worked at -195° and at Room Temperature. *Acta Metallurgica* 4, pp. 433–439, July, 1956.

BEVER, MICHAEL B. Review of *Theoretische Metallkunde*, by Ulrich Dehlinger. (Berlin, Springer-Verlag, 1955.) *Am. Chem. Soc. J.* 75, p. 3551, July 20, 1956.

BEVER, MICHAEL B. and D. JAFFE. Solidification of Aluminum-Zinc Alloys. *Am. Inst. Mining, Metallurgical & Petroleum Engrs. Trans.* 206, pp. 972–975, August, 1956.

BEVER, MICHAEL B. and P. GREENFIELD. The Effect of Composition on the Stored Energy of Cold Work and the Deformation Behavior of Gold-Silver Alloys. *Acta Metallurgica* 5, pp. 125–130, March, 1957.

BEVER, MICHAEL B. On the Thermodynamics and Kinetics of Recovery. (A Chapter in *Creep and Recovery*. Cleveland, Am. Soc. Metals, 1957.)

BROWN, JAMES H. and A. M. GAUDIN. Intergranular Comminution. (In *Am. Iron & Steel Inst. Tech. Committee Activities. Addresses Presented at Regional Technical Meeting*, pp. 485–492, 1956.

BRUNNER, HANS and N. J. GRANT. Calculation of the Contribution Made by Grain-Boundary Sliding to Total Tensile Elongation. *Inst. of Metals J.* 85, pp. 77–80, October, 1956.

CAMPBELL, JOHN C. and P. M. POWER. A Metallographic and Mineralogical Study of a Basic Open Hearth Heat. *Canadian Mining & Metallurgical Bull.* 49, pp. 793–802, November, 1956.

CHIPMAN, JOHN and H. A. WRIEDT. Oxygen in Liquid Iron-Nickel Alloys. *Am. Inst. Mining & Met. Engrs. Trans.* 206, pp. 1195–1199, 1956.

CHIPMAN, JOHN. Note on the Producer Gas Equilibrium and the Entropy of Graphite. *J. Phys. Chem.* 60, pp. 1467–1468, October, 1956.

CHIPMAN, JOHN, T. B. KING, N. J. GRANT and J. H. WALSH. Hydrogen in Steelmaking Slags. *Am. Inst. Mining & Met. Engrs. Trans.* 206, pp. 1568–1576, November, 1956.

CHIPMAN, JOHN and F. C. LANGENBERG. Determination of the 1600° and 1700° C Liquidus in the CaO.2 Al_2O_3 and Al_2O_3 Stability Fields of the CaO-Al_2O_3-SiO_2 System. *Am. Ceramic Soc. J.* 39, pp. 432–433, December, 1956.

CHIPMAN, JOHN and G. R. ST. PIERRE. Sulfur Equilibria Between Gases and Slags Containing Iron Oxide. *Am. Inst. Mining & Met. Engrs. Trans.* 206, pp. 1474–1483, October, 1956.

CHIPMAN, JOHN and A. RIST. L'Activité du Carbone Dissous dans le Fer Liquide. *Revue de Métallurgie* 53, pp. 796–807, October, 1956.

CHIPMAN, JOHN, N. J. GRANT and H. EPSTEIN. Hydrogen in Steelmaking Practice. *Am. Inst. Mining & Met. Engrs. Trans.* 209, pp. 597–608, April, 1957.

CHIPMAN, JOHN and H. TOWERS. Diffusion of Calcium and Silicon in a Lime-Alumina-Silica Slag. *Am. Inst. Mining & Met. Engrs. Trans.* 209, pp. 769–773, June, 1957.

CUFF, FRANK B., JR., N. J. GRANT and F. C. MONKMAN. Computation of Ms for Stainless Steels. *Metal Progress* 71, pp. 94–96, April, 1957.

ELLIOTT, JOHN F. The Carbon-Oxygen Equilibria in Liquid Iron. (In *M.I.T. Conference on Physical Chemistry of Iron and Steel Making, Proc.*, 1956.)

ELLIOTT, JOHN F. Physical Chemistry of Iron and Steelmaking. (In *Am. Iron & Steel Inst. Tech. Committee Activities. Addresses Presented at Regional Technical Meeting*, 1956.)

FLEISCHER, ROBERT and others. Effect of Orientation on the Plastic Deformation of Aluminum Single Crystals and Bicrystals. *J. Metals* 9, pp. 136–140, January, 1957.

FLEMINGS, MERTON C., JR., C. M. ADAMS, E. E. HUCKE and H. F. TAYLOR. Metal Solidification in a Flowing Stream. *Am. Foundrymen's Soc. Trans.* 64, pp. 636–639, 1956.

FUERSTENAU, MAURICE C. and D. W. FUERSTENAU. Ionic Size in Flotation Collection of Alkali Halides. *Mining Eng.* 8, pp. 302–307, March, 1956.

GAUDIN, ANTOINE M. *Flotation.* (New Second Edition.) N. Y. McGraw-Hill, 1957.

GRANT, NICHOLAS J., J. CHIPMAN, H. L. BISHOP, JR. and H. N. LANDER. Equilibria of Sulfur and Oxygen Between Liquid Iron and Open Hearth Type Slags. *J. Metals* 8, pp. 862–868, July, 1956.

GRANT, NICHOLAS J. Recent Developments in the Art of Precision Casting. *Metal Progress* 70, pp. 113–117, September, 1956.

GRANT, NICHOLAS J. and H. C. CHANG. Some Observations on the Structure of Grain Boundary Fracture Surfaces. *J. Metals* 8, pp. 1241–1247, October, 1956.

GRANT, NICHOLAS J. and P. MANGANARO. Examination and Evaluation of the Glascast Investment Process. (In *Investment Casting Institute Proc.* 413, November, 1956.)

GRANT, NICHOLAS J. and F. C. MONKMAN. An Empirical Relationship Between Rupture Life and Minimum Creep Rate in Creep Rupture Tests. *A.S.T.M. Preprint* 72, 1956.

GRANT, NICHOLAS J. Vacuum Melting — Past and Future. (In *Vacuum Melting Symposium*, Chicago, Investment Casting Institute, 1956.)

GRANT, NICHOLAS J. and P. MANGANARO. Ceramic Investment Shells Give High Quality Castings. *Tool Engr.* 38, pp. 109–113, February, 1957.

GRANT, NICHOLAS J. and O. PRESTON. Dispersed Hard Particle Strengthening of Metals. *J. Metals* 9, pp. 349–357, March, 1957.

GRANT, NICHOLAS J. and G. D. GEMMELL. Effects of Solid Solution Alloying on Creep Deformation of Aluminum. *J. Metals* 9, pp. 417–423, April, 1957.

GRANT, NICHOLAS J. and A. CHAUDHURI. Creep and Fracture. (A Chapter in *Creep and Recovery*. Cleveland, Am. Soc. Metals, 1957.)

KING, THOMAS B., N. J. GRANT and S. RAMACHANDRAN. Rate and Mechanism of the Sulfur Transfer Reaction. *J. Metals* 8, pp. 1549–1558, November, 1956.

KING, THOMAS B. Gas Problems in Solidification of Steel. (In *Am. Inst. Mining & Met. Engrs. Electric Furnace Steel Conference Proc.* 14, pp. 159–173, 1956.)

KINGERY, W. DAVID and R. L. COBLE. Effect of Porosity on Physical Properties of Sintered Alumina. *Am. Ceramic Soc. J.* 39, pp. 377–385, November, 1956.

KINGERY, W. DAVID. Corrosion of Refractories by Liquid Melts. (In *Symposium on High Temperature — A Tool for the Future, Proc.* pp. 126–132, 1956.)

KOROS, PETER J. and J. CHIPMAN. Activity Coefficient of Cu in Liquid Fe, Fe-C, and Fe-C-Si Alloys at 1600° C. *Am. Inst. Mining & Met. Engrs. Trans.* 206, pp. 1102–1104, August, 1956.

LUNSFORD, JOHN L. and N. J. GRANT. Relative High Temperature Properties of the Hexagonal-Close-Packed and Body-Centered-Cubic Structures in Iodide Titanium. *Am. Soc. Metals Trans.* 49, pp. 328–338, 1957.

UHLIG, HERBERT H. Initial Oxidation Rate of Metals and the Logarithmic Equation. *Acta Metallurgica* 4, pp. 541–554, September, 1956.

UHLIG, HERBERT H. In Favor of Thinking Creatively. *Electrochem. Soc. J.* 103, pp. 191C–193C, September, 1956.

UHLIG, HERBERT H. Robert Martin Burns. *Electrochem. Soc. J.* 104, p. 7C, January, 1957.

UHLIG, HERBERT H. and T. L. O'CONNOR. Absolute Areas of Some Metallic Surfaces. *J. Phys. Chem.* 61, pp. 402–405, April, 1957.

VAN ROOYEN, GERRITT T. and W. A. BACKOFEN. Friction in Cold Rolling. *Iron & Steel Inst. J.* 186, pp. 235–244, June, 1957.

WAGNER, CARL. The Thermodynamic Evaluation of Alloy-Slag Equilibria. *Z. Physik. Chem.* 8, pp. 342–351, June, 1956.

WAGNER, CARL. Oxidation of Alloys Involving Noble Metals. *Electrochem. Soc. J.* 103, pp. 571–580, October, 1956.

WAGNER, CARL. Formation of Composite Scales Consisting of Oxides of Different Metals. *Electrochem. Soc. J.* 103, pp. 627–633, November, 1956.

WAGNER, CARL. Current Distribution in Galvanic Cells Involving Natural Convection. *Electrochem. Soc. J.* 104, pp. 129–131, February, 1957.

WAGNER, CARL and A. G. VERDUCH. Contributions to the Thermodynamics of the Systems PbS–Sb_2–S_3, Cu_2S–Sb_2S_3, Ag_2S–Sb_2S_3 and and Ag–Sb. *J. Phys. Chem.* 61, pp. 558–562, May, 1957.

WAGNER, CARL and K. KIUKKOLA. Galvanic Cells for the Determination of the Standard Molar Free Energy of Formation of Metal Halides, Oxides, and Sulfides at Elevated Temperatures. *Electrochem. Soc. J.* 104, pp. 308–316, May, 1957.

WAGNER, CARL and K. KIUKKOLA. Measurements on Galvanic Cells Involving Solid Electrolytes. *Electrochem. Soc. J.* 104, pp. 370–387, June, 1957.

WAGNER, CARL and J. B. WAGNER. Electrical Conductivity Measurements on Cuprous Halides. *J. Chem. Phys.* 26, pp. 1597–1601, June, 1957.

WAGNER, CARL and J. B. WAGNER. Investigations on Cuprous Sulfide. *J. Chem. Phys.* 26, pp. 1602–1606, June, 1957.

WAGNER, CARL and G. LORENZ. Investigations on Cuprous Selenide and Copper Tellurides. *J. Chem. Phys.* 26, pp. 1607–1608, June, 1957.

WAGNER, CARL and H. KOBAYASKI. Investigations on the Reduction of Silver Sulfide and Cuprous Sulfide by Hydrogen. *J. Chem. Phys.* 26, pp. 1609–1614, June, 1957.

DEPARTMENT OF METEOROLOGY

PHILLIPS, NORMAN A. A Coordinate System Having Some Special Advantages for Numerical Forecasting. *J. Meteorology* 14, pp. 184–185, April, 1957.

SALTZMAN, BARRY and R. M. WHITE. On Conversions Between Potential and Kinetic Energy in the Atmosphere. *Tellus* 8, pp. 357–363, August, 1956.

STARR, VICTOR P. The General Circulation of the Atmosphere. *Sci. Am.* 195, pp. 40–45, December, 1956.

DEPARTMENT OF MODERN LANGUAGES

BOTTIGLIA, WILLIAM F., Editor. *Reports of the Working Committees of the 1957 Northeast Conference on the Teaching of Foreign Languages.* Cambridge, Mass., 1957.

CHOMSKY, NOAM A., M. HALLE and F. LUKOFF. On Accent and Juncture in English. (A Chapter in *For Roman Jakobson, Essays on the Occasion of His Sixtieth Birthday*, compiled by M. Halle and others. The Hague, Mouton, 1956.

CHOMSKY, NOAM A. Three Models for the Description of Language. *I.R.E. Trans.* (Professional Group on Information Theory-2) pp. 113–124, November, 1956.

CHOMSKY, NOAM A. *Syntactic Structures.* The Hague, Mouton, 1957.

DYCK, MARTIN. *The Relation of Novalis to Mathematics.* Ann Arbor, Mich., University Microfilms, 1956.

DYCK, MARTIN. Novalis als Philosoph. *Comparative Literature* 8, pp. 264–268, Summer, 1956.

HALLE, MORRIS, H. G. LUNT, H. McLEAN and C. H. VAN SCHOONEVELD, compilers. *For Roman Jakobson, Essays on the Occasion of His Sixtieth Birthday.* The Hague, Mouton, 1956.

HALLE, MORRIS, G. W. HUGHES and J-P. A. RADLEY. Acoustic Properties of Stop Consonants. *Acoustical Soc. Am. J.* 29, pp. 107–116, January, 1957.

LOCKE, WILLIAM N. and V. H. YNGVE, editors. *M T: Mechanical Translation,* 1956–1957.

LOCKE, WILLIAM N. *Scientific French.* N. Y. Wiley, 1957.

YNGVE, VICTOR H. Sentence for Sentence Translation. *M T: Mechanical Translation* 2, pp. 29–37, November, 1955.

YNGVE, VICTOR H. The Translation of Languages by Machine. (A Chapter in *Information Theory,* edited by C. Cherry. London, Butterworths, 1956.)

YNGVE, VICTOR H. The Outlook for Mechanical Translation. *Le Linquiste* 4, pp. 5–7, 1956.

YNGVE, VICTOR H. Gap Analysis and Syntax. *I.R.E. Trans.* (Professional Group on Information Theory-2) pp. 106–112, September, 1956.

YNGVE, VICTOR H. The Outlook for Mechanical Translation. *Babel* 2, pp. 99–101, October, 1956.

YNGVE, VICTOR H. Terminology in the Light of Research on Mechanical Translation. *Babel* 2, pp. 128–132, October, 1956.

YNGVE, VICTOR H. Mechanical Translation Research at M.I.T. *M T: Mechanical Translation* 3, pp. 44–45, November, 1956.

YNGVE, VICTOR H. The Technical Feasibility of Translating Languages by Machine. *Electrical Eng.* 75, pp. 994–999, November, 1956.

YNGVE, VICTOR H. The Technical Feasibility of Translating Languages by Machine. *A.I.E.E. Trans.* (Communications and Electronics) 76, pp. 792–797, January, 1957.

DEPARTMENT OF NAVAL ARCHITECTURE AND MARINE ENGINEERING

ABKOWITZ, MARTIN A. and D. L. PASTER. Analytical Methods for Estimating the Hydrodynamic Stability and Control Derivatives in Pitch, Yaw and Roll. *U.S. Naval Underwater Ordnance Station, Technical Memorandum 20.*

ABKOWITZ, MARTIN. Correlation of Model Tests in Waves. (In *Am. Towing Tank Conference, Proc.* September, 1956.)

ABKOWITZ, MARTIN and W. R. PORTER. An Integrating Gyro for Measuring the Pitch Angle of Ship Model in Waves. (In *Am. Towing Tank Conference, Proc.* September, 1956.)

ABKOWITZ, MARTIN A. Sea Keeping Considerations in Design and Research. (In *Soc. Naval Arch. & Marine Engrs. N.E. Section Proc.* January, 1957.)

ALLMENDINGER, E. EUGENE. *Naval Architecture and Marine Engineering.* Cambridge, M.I.T., 1957.

TROOST, LAURENS. The Pitch Distribution of Wake-Adapted Marine Propellers. *Soc. Naval Arch. & Marine Engrs. Trans.* 64, pp. 357–374, 1956.

DEPARTMENT OF PHYSICS

ALLIS, WILLIAM P. Motions of Ions and Electrons. (A Section in *Handbuch der Physik*, edited by S. Flügge. Vol. 21. Berlin, Springer-Verlag, 1956.)

BITTER, FRANCIS. *Currents, Fields and Particles.* Cambridge, Mass. Wiley & Technology Press, 1956.

BITTER, FRANCIS and J. F. WAYMOUTH. Electroluminescence in Zinc Sulfide. *Phys. Rev.* 103, pp. 1584–1585, September 1, 1956.

BITTER, FRANCIS, J. F. WAYMOUTH, W. C. GUNGLE and C. W. JEROME. Very High Output Fluorescent Lamps. *Sylvania Technologist* 9, pp. 102–110, October, 1956.

BITTER, FRANCIS and J. D. BJORKEN. Field Homogeneity and Pole Distribution. *Rev. Sci. Instr.* 27, pp. 1005–1016, December, 1956.

BRENNER, ALFRED E. and R. W. WILLIAMS. Cross-Section Measurement Near 50 Bev. *Phys. Rev.* 106, pp. 1020–1025, June 1, 1957.

BROWN, HOWARD H., JR. and F. BITTER. Microinhomogeneities in Magnetic Fields. *Rev. Sci. Instr.* 27, pp. 1009–1012, December, 1956.

BROWN, SANBORN C. Breakdown in Gases: Alternating and High-Frequency Fields. (A Section in *Handbuch der Physik*, edited by S. Flügge. Vol. 22. Berlin, Springer-Verlag, 1956.)

BROWN, SANBORN C., W. P. ALLIS and R. J. FRIAUF. Properties of Nonmetallic Conductors. (A Section in *American Institute of Physics Handbook*, edited by D. E. Gray and others. N. Y. McGraw-Hill, 1957.)

BROWN, SANBORN C. and W. P. ALLIS. Motions of Electons and Ions in Gases. (A Section in *American Institute of Physics Handbook*, edited by D. E. Gray and others. N. Y. McGraw-Hill, 1957.)

BROWN, SANBORN C. and A. L. GILARDINI. Microwave Conductivity of an Ionized Decaying Plasma at Low Pressures. *Phys. Rev.* 105, pp. 25–30, January 1, 1957.

BROWN, SANBORN C. and A. L. GILARDINI. Microwave Determination of the Probability of Collision of Electrons in Neon. *Phys. Rev.* 105, pp. 31–34, January 1, 1957.

BROWN, SANBORN C. Apparatus for Educational Institutions. *Physics Today* 10, p. 27, March, 1957.

BROWN, SANBORN C. and D. J. ROSE. Microwave Gas Discharge Breakdown in Air, Nitrogen and Oxygen. *J. Appl. Phys.* 28, pp. 561–563 May, 1957.

BUECHNER, WILLIAM W. Determination of Nuclear Reaction Energies by Deflection Measurements. (In *Progress in Nuclear Physics* edited by O. R. Frisch, Vol. 5. London, Pergamon Press, 1956.)

BUECHNER, WILLIAM W., G. L. SQUIRES and C. K. BOCKELMAN. Measurement of Energy Levels in F^{19} and O^{16}. *Phys. Rev.* 104, p. 413, October 15, 1956.

BUECHNER, WILLIAM W., C. K. BOCKELMAN and A. LEVEQUE. Energy Levels of Be^{9}. *Phys. Rev.* 104, p. 456, October 15, 1956.

BUECHNER, WILLIAM W. and C. P. BROWNE. Broad-Range Magnetic Spectrograph. *Rev. Sci. Instr.* 27, p. 899, November, 1956.

BUECHNER, WILLIAM W. Nuclear Masses and Their Determination (In *Max-Planck Institut für Chemie, Conference on Nuclear Masses Proc.* 1957.)

BUECHNER, WILLIAM W. and A. SPERDUTO. Energy Levels in Na^{23} and Ne^{20}. *Phys. Rev.* 106, pp. 1008–1011, June 1, 1957.

CALDWELL, DAVID O. and Y. PAL. Photometric Ionization Measurements in a Multiplate Cloud Chamber. *Rev. Sci. Instr.* 27, pp. 633–638, August, 1956.

CALDWELL, DAVID O., H. BLUMENFELD, E. BOLDT, H. S. BRIDGE, Y. PAL and C. P. LEAVITT. Relative Production of Unstable Particles in Iron by Proton and π-Mesons. *Am. Phys. Soc. Bull.* 2, Ser. 2, p. 19, January 30, 1957.

CALDWELL, DAVID O., H. BLUMENFELD, E. BOLDT, H. S. BRIDGE and Y. PAL. Neutral Decay Mode of the θ°. *Am. Phys. Soc. Bull.* 2, Ser. 2, p. 236, April 25, 1957.

ENGE, HARALD A. Characteristics for Half-Wave Rectifier Circuits. *Electronic Eng.* 28, pp. 401–406, September, 1956.

ENGE, HARALD A. and A. GRAUE. Numerical Calculation of Noncoulomb Stripping Cross Sections. *Rev. Sci. Instr.* 27, p. 1078, December, 1956.

ENGE, HARALD A., M. A. WAHLIG and A. AANDERAA. α-Particle Thickness Gauge. *Rev. Sci. Instr.* 28, p. 145, February, 1957.

FESHBACH, HERMAN and J. R. LAMARSH. Direct Interaction in Neutron Inelastic Scattering. *Phys. Rev.* 104, pp. 1633–1639, December 15, 1956.

FRIEDMAN, MARVIN H., S. D. DRELL and F. ZACHARIASEN. Theory of S-Wave Pion Scattering and Photoproduction at Low Energies. *Phys. Rev.* 104, pp. 236–248, October 1, 1956.

FRIEDMAN, MARVIN H. On the μ-Meson Decay and the Two Component Neutrim. *Phys. Rev.* 106, pp. 387–388, April 15, 1957.

GOMES, LUIZ C. and L. R. B. ELTON. Scattering of Nucleons by Nuclei in the 30 Mev Region. *Phys. Rev.* 105, pp. 1027–1033, February 1, 1957.

HUNTING, C. EUGENE and N. S. WALL. Reactions $C^{12}(\alpha, P)N^{15}$ & $(B^{10}\alpha, P)\ C^{13}$ at 30.5 Mev. *Am. Phys. Soc. Bull.* 2, Ser. 2, pp. 181–182, April 25, 1957.

INGARD, KARL U. and D. C. PRIDMORE-BROWN. Tentative Method for Calculation of the Sound Field About a Source Over Ground Considering Diffraction and Scattering into Shadow Zones. *N.A.C.A. Technical* Note 3779, September, 1956.

INGARD, KARL U. and G. L. LAMB, JR. The Effect of a Reflecting Plane on the Power Output of Sound Sources. *Acoustical Soc. Am. J.* 29, pp. 743–744, June, 1957.

JANUSZ, THEODORE P., R. R. HEIKES and W. D. JOHNSTON. Reinvestigation of Reported Ferro-Magnetism in Li_x Ni(i–x) 0. *J. Chem. Phys.* 26, pp. 973–974, April, 1957.

KING, JOHN G. and J. R. ZACHARIAS. Some New Applications and Techniques of Molecular Beams. (In *Advances in Electronics and Electron Physics*, edited by L. Marton. Vol. 8. N. Y. Academic Press, 1956.)

LOW, FRANCIS E. Pi-Mesodynamics. *Rev. Modern Phys.* 29, pp. 216–222, April, 1957.

LOW, FRANCIS E., G. F. CHEW, M. L. GOLDBERGER and Y. NAMBU. Application of Dispersion Relations to Low-Energy Meson-Nucleon Scattering. *Phys. Rev.* 106, pp. 1337–1344, June 15, 1957.

LOW, FRANCIS E., G. F. CHEW, M. L. GOLDBERGER and Y. NAMBU. Relativistic Dispersion Relation Approach to Photomeson Production. *Phys. Rev.* 106, pp. 1345–1355, June 15, 1957.

LUEDERS, GERHART C. F. and B. ZUMINO. Some Consequences of TCP-Invariance. *Phys. Rev.* 106, pp. 385–386, April 15, 1957.

MATTUCK, RICHARD D. Recent Attempts to Determine the Thickness and Refractive Index of Unimolecular Films. *Optical Soc. Am. J.* 46, pp. 615–620, August, 1956.

MATTUCK, RICHARD D. Stepped Interference Reflector for Determining the Optical Constants of Nonabsorbing Unimolecular Films. I. Theory. *Optical Soc. Am. J.* 46, pp. 621–628, August, 1956.

MATTUCK, RICHARD D., R. D. PETTI and J. B. BATEMAN. Stepped Interference Reflector for Determining the Optical Constants of Nonabsorbing Unimolecular Films. II. Experimental. *Optical Soc. Am. J.* 46, pp. 782–789, October, 1956.

NETTEL, STEPHEN J. Periodic Sampling Logarithmic Amplifier. *Rev. Sci. Instr.* 28, pp. 37–40, January, 1957.

NOTTINGHAM, WAYNE B. Thermionic Emission. (A Section in *Handbuch der Physik*, edited by S. Flügge. Vol. 21. Berlin, Springer-Verlag, 1956.)

PARIS, CORNELIS H., P. M. ENDT, A. SPERDUTO and W. W. BUECHNER. Nuclear Levels in S^{32}, S^{34}, Cl^{35}, and Cl^{37}. *Phys. Rev.* 101, p. 961, August 15, 1956.

PARIS, CORNELIS H., P. M. ENDT, W. W. BUECHNER, C. M. BRAAMS and A. SPERDUTO. Atomic Masses in the S — Ti Region from Precision Q-Value Measurements. *Phys. Rev.* 105, p. 1002, February 1, 1957.

PARIS, CORNELIS H. and P. M. ENDT. Nuclear Levels in Si^{28} and P^{31}. *Phys. Rev.* 106, p. 764, May 15, 1957.

RODBERG, LEONARD S. Pion Production in Pion-Nucleon Collisions. *Phys. Rev.* 106, pp. 1090–1099, June 1, 1957.

ROSSI, BRUNO B. *Optics*. Reading, Mass. Addison-Wesley, 1957.

SCHLUTER, ROBERT A., M. WIDGOFF, A. SHAPIRO, D. RITSON, A. PEVSNER and V. HENRI. Scattering of K^+ Particles. *Phys. Rev.* 104, p. 811, November 1, 1956.

SLATER, JOHN C. Barrier Theory of the Photoconductivity of Lead Sulfide. *Phys. Rev.* 103, pp. 1631–1644, September 15, 1956.

STRANDBERG, MALCOM W. P. Quantum Mechanical Amplifiers. *I.R.E. Proc.* 45, pp. 92–93, January, 1957.

STRANDBERG, MALCOM W. P. Inherent Noise of Quantum Mechanical Amplifiers. *Phys. Rev.* 106, pp. 617–620, May 15, 1957.

TISZA, LASZLO and I. MANNING. Fluctuations and Irreversible Thermodynamics. *Phys. Rev.* 105, pp. 1695–1705, March 15, 1957.

WANIEK, RALPH W. and H. P. FURTH. High-Field Longitudinal Magnetoresistance of Germanium. *Phys. Rev.* 104, pp. 343–345, October 15, 1956.

WANIEK, RALPH W., H. P. FURTH and M. A. LEVINE. Mechanical and Thermal Limitations to the Production of High Magnetic Fields. *Am. Phys. Soc. Bull.* 2, Ser. 2, p. 7, January, 1957.

WANIEK, RALPH W., H. P. FURTH and M. A. LEVINE. Force-Free Magnetic Field Configurations. *Am. Phys. Soc. Bull.* 2, Ser. 2, p. 237, April, 1957.

WARREN, BERTRAM E. and B. BORIE. X-ray Study of the Change in Cu_3Au near 600° C. *J. Appl. Phys.* 27, pp. 1562–1563, December 1, 1956.

WARREN, BERTRAM E. and A. AUTHIER. Variation of Extinction with X-ray Wave Length. *J. Appl. Phys.* 27, p. 1382, November 1, 1956.

WARREN, BERTRAM E. and G. E. BACON. X-ray Diffraction Studies of Neutron Irradiated Graphite. *Acta Crystallographica* 9, pp. 1029–1035, December 1, 1956.

WHITNEY, WILLIAM M. Absorption of Sound in Liquid Helium II. *Phys. Rev.* 105, pp. 38–41, January 1, 1957.

ZACHARIAS, JERROLD R. Structure of Physical Science. *Science* 125, pp. 427–428, March 8, 1957.

LIBRARY

BARTLETT, ELEANOR L. This Works for Us — Indexing Scholarship Announcements. *Special Libraries* 48, p. 215, May–June, 1957.

BARTLETT, ELEANOR L., compiler. Publications from the Institute. (In *M.I.T. Bulletin, President's Report Issue*, pp. 345–418, November, 1956.)

ROBIE, BURTON A. Declare your Library's Assets! *Library J.* 81, pp. 2514–2515, November 1, 1956.

ROBIE, BURTON A. More Poetry. *N. Y. Times Magazine*, p. 6, December 9, 1956.

ROBIE, BURTON A. For 1929. (In *National Poetry Anthology, 1956–1957.* Los Angeles, National Poetry Assoc., 1957.)

SHILLABER, CAROLINE, compiler. *Tropical Housing and Planning. Monthly Information Bulletin.* Athens, Greece, Doxiadis Associates, 1957.

ADMINISTRATION

BURCHARD, JOHN E. Architecture for the Good Life. *Am. Inst. Architects J.* 26, pp. 47–54, August; pp. 115–122, September; pp. 144–151, October, 1956.

BURCHARD, JOHN E. To Begin to Live. *The Technology Review* 59, pp. 33–35, ff., November, 1956.

BURCHARD, JOHN E. The City on the Hill. *Quarterly Rev. Michigan Alumnus* 63, pp. 120–129, Winter, 1957.

BURCHARD, JOHN E. Architecture for the Nuclear Age. *Am. Inst. Architects Bull.* 11, pp. 7–10, January–February, 1957.

BURCHARD, JOHN E. The Shape of an Architecture. *Arch. Record* 121, pp. 183–189, May, 1957.

BURCHARD, JOHN E. and A. BUSH-BROWN. The Architect, More Needed than Pitied. *Harper's Magazine* 214, pp. 36–40, May, 1957.

BURCHARD, JOHN E. and A. BUSH-BROWN. 100 Years of American Architecture. *N. Y. Times Magazine*, pp. 26–27, ff., May 12, 1957.

BURCHARD, JOHN E. Hopeful Start on a Long Journey: A New Century Beckons. *Arch. Record* 121, pp. 8A–8D, June, 1957.

DUDLEY, BEVERLY. Commencement and Reunion. *The Technology Review* 58, pp. 488–492, July, 1956.

DUDLEY, BEVERLY. Nobel Prize in Physics. *The Technology Review* 59, p. 83, December, 1956.

DUDLEY, BEVERLY. For Youths of Exceptional Promise. *The Technology Review* 59, p. 97, December, 1956.

DUDLEY, BEVERLY. Half Century of Electronics. *The Technology Review* 59, pp. 138–139, January, 1957.

DUDLEY, BEVERLY. Record Event. *The Technology Review* 59, p. 145, January, 1957.

DUDLEY, BEVERLY. The Social Beaver. *The Technology Review* 59, p. 147, January, 1957.

DUDLEY, BEVERLY. Discussion Wanted. *The Technology Review* 59, pp. 189–190, February, 1957.

DUDLEY, BEVERLY. 75 Years of *The Tech*. *The Technology Review* 59, p. 192, February, 1957.

DUDLEY, BEVERLY. School of Industrial Management Holds Convocation. *The Technology Review* 59, pp. 403–408, June, 1957.

HARRISON, GEORGE R. *What Man May Be — The Human Side of Science*. N. Y. William Morrow & Co., 1956.

HARRISON, GEORGE R. How the Brain Works. *Atlantic Monthly* 198, pp. 58–63, September, 1956.

HARRISON GEORGE R., N. STURGIS, S. C. BAKER and G. W. STROKE. Ruling of Large Diffraction Gratings with Interferometric Control. *Optical Soc. Am. J.* 47, pp. 15–22, January, 1957.

KILLIAN, JAMES R., JR. Message in M.I.T.'s *Social Beaver*. Cambridge, Mass. Technology Christian Assoc., July, 1956.

KILLIAN, JAMES R., JR. What Should Our Schools Accomplish? *Educational Rev.* (Madras, India) 62, p. 144, August, 1956.

KILLIAN, JAMES R., JR. From Classroom to Plant. *Engineers' Job Directory*, August, 1956.

KILLIAN, JAMES R., JR. Are High-School Standards Too Low? *Ladies' Home J.*, September, 1956.

KILLIAN, JAMES R., JR. America's Technical Education Requirements. *Aviation Age* 26, pp. 20–25, October, 1956.

KILLIAN, JAMES R., JR. Industry and Our Universities. *Industry* 22, pp. 13–16, November, 1956.

KILLIAN, JAMES R., JR. President's Annual Report. *The Technology Review* 59, p. 29, November, 1956.

KILLIAN, JAMES R., JR. New Requirements on Education Imposed by Advancing Technology. *Elec. Eng.* 75, pp. 1061–1063, December, 1956.

KILLIAN, JAMES R., JR. Scientific and Engineering Manpower. *The Technology Review* 59, pp. 152–153, January, 1957.

KILLIAN, JAMES R., JR. Scientific and Engineering Manpower. *Tech. Eng. News* 38, pp. 19, ff., January, 1957.

KILLIAN, JAMES R., JR. What Should Our Schools Accomplish? *Educational Horizons* 35, pp. 74–78, Spring, 1957.

KILLIAN, JAMES R., JR. Technology Shapes Our Future. *The Technology Review* 59, pp. 299–301, ff., April, 1957.

KILLIAN, JAMES R., JR. Invisible Crisis in Engineering and Science. *N. Y. Times Magazine*, pp. 26, ff., April 7, 1957.

KILLIAN, JAMES R., JR. Augmenting our Scientific and Engineering Manpower Resources. *School & Soc.* 85, pp. 213–217, June 22, 1957.

LITTLE, ELBERT P. and N. H. BLACK. *An Introductory Course in College Physics.* Ed. 4, Cambridge, Mass. Macmillan, 1956.

MATTILL, JOHN I. The 64th Annual Meeting (of A.S.E.E.). *J. Eng. Educ.* 47, pp. 13–22, September, 1956.

SODERBERG, C. RICHARD. Mechanical Properties in Relation to Design Requirements. *Metallurgical Rev.* 1, pp. 31–63, 1956.

STRATTON, JULIUS A. Science in the Secondary Schools. *The Technology Review* 59, pp. 355–372, May, 1957.

THRESHER, B. ALDEN. Some Principles of Selective Admission. *College & University* 31, pp. 495–499, Summer, 1956.

THRESHER, B. ALDEN. A Review of *Background for a National Scholarship Policy*, by E. D. West. (Washington, D. C. Am. Council on Education, 1956.) *College & University* 32, pp. 85–87, Fall, 1956.

THRESHER, B. ALDEN. A Review of *Encouraging Scientific Talent; a Study of America's Able Students Who are Lost to College and of Ways of Attracting Them to College and Science Careers*, by C. C. Cole. (N. Y. College Entrance Examination Board, 1956.) *College & University* 32, pp. 357–359, Spring, 1957.

CENTER FOR INTERNATIONAL STUDIES

BALDWIN, GEORGE B. Public Enterprise in Indian Industry. *Pacific Affairs* 30, pp. 3–21, March, 1957.

BATOR, FRANCIS M. On Capital Productivity, Input Allocation and Growth. *Quarterly J. Econ.* 71, pp. 86–106, February, 1957.

BATOR, FRANCIS M. The Simple Analytics of Welfare Maximization. *Am. Econ. Rev.* 47, pp. 22–59, March, 1957.

BLOOMFIELD, LINCOLN P. How the U. S. Government is Organized to Participate in the U. N. System. *U. S. State Dept. Bull.* 35, pp. 435–444, September 17, 1956.

DEXTER, LEWIS A. Role Relationships and Conceptions of Neutrality in Interviewing. *Am. J. Sociology* 62, pp. 153–157, September, 1956.

HIGGINS, BENJAMIN H. Indonesia's Development Plans and Problems. *Econ. Res. J.* 3, pp. 78–92, September, 1956.

HIGGINS, BENJAMIN H., W. C. HOLLINGER and others. Stanvac in Indonesia. *National Planning Assoc. United States Business Performance Abroad. Case Study* 6, 1957.

HIGGINS, BENJAMIN H. The Incremental Capital Output Ratio as a Tool for Development Planning. *Ekonomi dan Keuangan Indonesia* 1, pp. 1–13, January, 1957.

HIGGINS, BENJAMIN H. *Final Report to the Government of the Philippines on Planning Economic Development.* N. Y. United Nations, 1957.

HIGGINS, BENJAMIN H. Prospects for an International Economy. *World Politics* 9, pp. 458–471, April, 1957.

HOLLINGER, WILLIAM C. The National Income of Indonesia, 1951–1952: A Critical Commentary on the Neumark Estimates (1). *Ekonomi dan Keuangan Indonesia* 12, 1956.

HOLLINGER, WILLIAM C. Social Accounting in Underdeveloped Areas. *Ekonomi dan Keuangan Indonesia* 10, 1956.

KAUTSKY, JOHN H. *Moscow and the Communist Party of India.* N. Y. Wiley and Technology Press, 1956.

KEESING, FELIX and M. KEESING. *Elite Communication in Samoa: A Study of Leadership.* Stanford, Calif. Stanford Univ. Press, 1956.

LENNEBERG, ERIC H. A Probabilistic Approach to Language Learning. *Behavioral Sci.* 2, pp. 1–12, January, 1957.

LERNER, DANIEL and R. ARON. *France Defeats EDC.* N. Y. F. A. Praeger, 1957.

LERNER, DANIEL and R. ARON. *La Querelle de la CED.* Paris. Colin, 1956.

LERNER, DANIEL. Franco-German Relations: Politics, Public and the Press. *J. Internat. Affairs* 10, pp. 138–152, 1956.

LERNER, DANIEL. The "Hard-Headed" Frenchman. *Encounter,* pp. 1–6, March, 1957.

LERNER, DANIEL. Interviewing Frenchmen. *Am. J. Sociology* 52, pp. 187–194, September, 1956.

LERNER, DANIEL. The Outlook. *Public Opinion Quarterly* 21, pp. 199–206, Spring, 1957.

MALENBAUM, WILFRED. Urban Unemployment in India. *Pacific Affairs* 30, pp. 138–150, June, 1957.

MILLIKAN, MAX F. How Much Trade — How Much Aid? *Foreign Policy Assoc. Headline Series* 121, December, 1956.

MILLIKAN, MAX F. and CENTER FOR INTERNATIONAL STUDIES STAFF. *Objectives of the United States Economic Assistance Programs, Study No. 1. Prepared at the Request of the Special Committee to Study the Foreign Aid Program, U. S. Senate.* Washington, D. C. G. P. O. January, 1957.

MILLIKAN, MAX F. and W. W. ROSTOW. *A Proposal: Key to an Effective Foreign Policy.* N. Y. Harper, 1957.

PERLMUTTER, HOWARD V. and R. MAYNTZ. Einige Versuchsergebnisse zum Problem der Vorstellungsbildung und Interpretation von Kommunikationen: 1. Der Einflus von Nationalitätsidentifikation und Berufsdefinition auf die Vorstellungsbildung. *Kölner Zeit. f. Soziologie und Sozialpsychologie* 8, pp. 292–320, 1956.

PERLMUTTER, HOWARD V. and R. MAYNTZ. Einige Versuchsergebnisse zum Problem der Vorstellungsbildung und Interpretation von Kommunikationen: 2. Die Interpretation von Kommunikationen unter dem Einflus der Nationalitätsidentifikation und Berufsdefinition ihres Verfassers. *Kölner Zeit. f. Soziologie und Sozialpsychologie* 8, pp. 450–476, 1956.

PERLMUTTER, HOWARD V. Some Relationships between Xenophilic Attitudes and Authoritarianism Among Americans Abroad. *Psychological Reports* 3, pp. 79–87, 1957.

PERLMUTTER, HOWARD V. and D. SHAPIRO. Stereotypes About Americans and Europeans Who Make Specific Statements. *Psychological Reports* 3, pp. 131–137, 1957.

POOL, ITHIEL D. A Critique of the XXth Anniversary Issue. *Public Opinion Quarterly* 21, pp. 190–198, Spring, 1957.

ROSEN, GEORGE. The Plan for Industry. *Econ. Weekly,* September 1, 1956.

ROSEN, GEORGE. Capital: Output Ratios in Indian Industry. *Indian Econ. J.* 4, pp. 107–121, October, 1956.

ROSEN, GEORGE. Capital: Output Ratios in Indian Industry. *Econ. Trends*, December, 1956.

ROSEN, GEORGE. Subcontracting in Engineering Industries. *Econ. Weekly* (Bombay, India) 8, pp. 1369–1374, November 24, 1956.

ROSTOW, WALT W. The Challenge Facing the United States. *Naval War College Rev.* 9, November, 1956.

ROSTOW, WALT W. Can We Beat the Russians at Their Own Game? *Air Force* 39, pp. 60–68, November, 1956.

ROSTOW, WALT W. The Fallacy of the Fertile Gondolas. *Harvard Alumni Bull.* 59, pp. 633, ff., May 25, 1957.

DIVISION OF DEFENSE LABORATORIES

BAKER, RICHARD H. Boosting Transistor Switching Speed. *Electronics* 30, pp. 190–193, March 1, 1957.

BARON, JUDSON R. The Binary-Mixture Boundary Layer Associated with Mass Transfer. (In *Ninth International Congress on Theoretical and Applied Mechanics Proc.*, 1956.)

BOLINDER, E. FOLKE. Graphical Methods for Transforming Impedances Through Lossless Networks by the Cayley-Klein Diagram. *Acta Polytechnica, Electrical Engineering Series* 7 (Whole No. 202), 1956.

BOLINDER, E. FOLKE. Study of the Exponential Line by the Isometric Circle Method and Hyperbolic Geometry. *Acta Polytechnica, Electrical Engineering Series* 7 (Whole No. 214), 1957.

BOLINDER, E. FOLKE. Impedance and Polarization-Ratio Transformations by a Graphical Method Using the Isometric Circles. *I.R.E. Trans.* (Professional Group on Microwave Theory and Techniques-4), pp. 176–180, July, 1956.

BOLINDER, E. FOLKE. Maximum Efficiency of Four-Terminal Networks. *I.R.E. Proc.* 44, p. 941, July, 1956.

BOLINDER, E. FOLKE. Survey of Some Properties of Linear Networks. *Royal Inst. Technology (Stockholm). Div. of Radio Eng., Transistor Group Report* 32, October, 1956.

BOLINDER, E. FOLKE. Graphical Method of Determining the Efficiency of Two-Port Networks. *I.R.E. Proc.* 45, p. 361, March, 1957.

BOLINDER, E. FOLKE. The Classical Electromagnetic Equations Expressed as Complex Four-Dimensional Quantities. *Franklin Inst. J.* 263, pp. 213–223, March, 1957.

BOLINDER, E. FOLKE. Impedance Transformations by Extension of the Isometric Circle Method to the Three-Dimensional Hyperbolic Space. *J. Math. and Phys.* 36, pp. 49–61, April, 1957.

BRIDGE, HERBERT S., H. C. DeSTAEBLER, JR., B. ROSSI, B. V. SREEKANTAN and D. O. CALDWELL. Results on S Events; Remarks on Range-Energy Relations. *Nuovo Cimento (Suppl.)* 4, pp. 552–556, 1956.

BROWN, RICHARD H. The Solution of a Certain Two-Person Zero-Sum Game. *Operations Research* 5, pp. 63–67, February, 1957.

BUCHSBAUM, SOLOMON J. and S. C. BROWN. Microwave Measurements of High Electron Densities. *Phys. Rev.* 102, pp. 196–199, April 15, 1957.

BUTTON, KENNETH J. and B. LAX. Theory of Ferrites in Rectangular Waveguide. *I.R.E. Trans.* (Professional Group on Antennas & Propagation-4), pp. 531–537, July, 1956.

COVERT, EUGENE E. and F. H. DURGIN. A Note on Transient Aerodynamic Heating. *J. Aero. Sci.* 23, pp. 699–700, July, 1956.

CRAMER, HARRISON E. and F. A. RECORD. Field Studies of Atmospheric Diffusion and the Structure of Turbulence. *Am. Industrial Hygiene Assoc. Quarterly J.* 18, pp. 126–131, June, 1957.

DAVIS, CHARLES F. and M. W. P. STRANDBERG. The Paramagnetic Resonance Spectrum of Ammonium Chromium Alum. *Phys. Rev.* 105, pp. 447–455, January 15, 1957.

DOBBIE, JAMES M. Expectancy of Multiple Vehicular Breakdowns in a Tunnel. *Operations Research* 4, pp. 609–614, October, 1956.

DOBBIE, JAMES M. Comments on Edie's Letter on Vehicular Breakdowns. *Operations Research* 4, pp. 740–742, December, 1956.

FONER, SIMON and H. H. KOLM. Coil for Pulsed Megagauss Fields. *Rev. Sci. Instr.* 27, pp. 547–548, July, 1956.

FONER, SIMON. Vibrating Sample Magnetometer. *Rev. Sci. Instr.* 27, p. 548, July, 1956.

FONER, SIMON and H. H. KOLM. The Production and Use of High Intensity Pulsed Magnetic Fields. (In *A.I.E.E. Second Conference on Magnetism and Magnetic Materials Proc.*, pp. 586–599, February, 1957.)

FONER, SIMON and J. O. ARTMAN. Magnetization Processes in Single-Crystal Cobalt Ferrite with "Sticky" Walls. *Am. Phys. Soc. Bull.* 2, Series 2, pp. 22, January 30, 1957.

FONER, SIMON. Antiferromagnetic Resonance Using Pulsed Magnetic Fields and Millimeter Wavelength Radiation. *Am. Phys. Soc. Bull.* 2, Series 2, p. 128, March 21, 1957.

FONER, SIMON. Application of the Vibrating Sample Magnetometer to Weakly Magnetic Materials. *Am. Phys. Soc. Bull.* 2, Series 2, p. 237, April 25, 1957.

GANO, JOSEPH J. Power Generation and Distribution at Air Defence Computing Centers. *Elec. Eng.* 75, pp. 1098–1102, December, 1956.

GOLD, LOUIS. Relativistic Magnetron and the Effective Mass Anisotropy. *J. Electronics* 2, pp. 17–32, July, 1956.

GOLD, LOUIS and L. M. ROTH. Galvanomagnetic Theory for Electrons in Germanium and Silicon: Magnetoresistance in the High-Field Saturation Limit. *Phys. Rev.* 103, pp. 61–66, July 1, 1956.

GOLD, LOUIS. Secular Solution of Cyclotron Resonances for Electrons in Germanium. *J. Electronics* 2, pp. 131–133, September, 1956.

GOLD, LOUIS, W. M. BULLIS and R. CAMPBELL. Theory of Cyclotron Absorption in Many-Valley Semiconductors. *Phys. Rev.* 103, pp. 1250–1252, September 1, 1956.

GOLD, LOUIS. Rayleigh Wave Propagation on Anisotropic (Cubic) Media. *Phys. Rev.* 104, pp. 1532–1536, December 15, 1956.

GOLD, LOUIS. Anisotropy of the Hot Electron Problem in Semiconductors with Spheroidal Energy Surfaces. *Phys. Rev.* 104, pp. 1580–1584, December 15, 1956.

GOLD, LOUIS. Density of States for Warped Spherical Energy Surfaces: Zeroth Approximation for Holes in Germanium and Silicon. *J. Electronics* 2, pp. 323–329, January, 1957.

GOLD, LOUIS. Domain Treatment of Order-Disorder Theory. *Am. Phys. Soc. Bull.* 2, Series 2, p. 58, January, 1957.

GOLD, LOUIS. Role of Magnetic Field in Hot Electron Behavior of Germanium. *Am. Phys. Soc. Bull.* 2, Series 2, p. 170, April 25, 1957.

GOODENOUGH, JOHN B. Summary of Losses in Magnetic Materials. (In *A.I.E.E. Second Conference on Magnetism and Magnetic Materials Proc.*, pp. 368–385, February, 1957.)

GREEN, PAUL E., JR. The Output Signal-to-Noise Ratio of Correlation Detectors. *I.R.E. Trans.* (Professional Group on Information Theory-3), pp. 10–18, March, 1957.

HARRIS, WILLIAM P. A Revised Law of Comparative Judgment. *Psychometrika* 22, pp. 189–198, June, 1957.

HELLER, GERALD S. Ferrites as Microwave Circuit Elements. *I. R. E. Proc.* 44, pp. 180–187, October, 1956.

HONIG, JOHN G. and C. R. SINGLETERRY. The Physical-Chemical Behavior of Oil-Dispersible Soap Solutions. II. Alkali and Alkaline Earth Phenylstearates in Benzene. *J. Phys. Chem.* 60, pp. 1108–1114, August, 1956.

HONIG, JOHN G. and C. R. SINGLETERRY. The Physical-Chemical Behavior of Oil-Dispersible Soap Solutions. III. Colloid Structure in Dilute Arylstearate-Benzene Systems. *J. Phys. Chem.* 60, pp. 1114–1119, August, 1956.

HOUSE, ARTHUR S., G. FAIRBANKS and J. MELROSE. Auditory Detection of the Presence and Absence of Signals in Noise. *Acoustical Soc. Am. J.* 28, pp. 614–616, July, 1956.

HOUSE, ARTHUR S. and K. N. STEVENS. Analog Studies of the Nasalization of Vowels. *J. Speech Hearing Disorders* 21, pp. 218–232, June, 1956.

HOUSE, ARTHUR S. and J. L. FLANAGAN. Development and Testing of a Formant-Coding Speech Compression System. *Acoustical Soc. Am. J.* 28, pp. 1099–1106, November, 1956.

HOUSE, ARTHUR S. Analog Studies of Nasal Consonants. *J. Speech Hearing Disorders* 22, pp. 190–204, June, 1957.

HURTIG, CARL R. Directly Coupled Amplifiers. (In *Handbook of Semiconductor Electronics*, edited by L. P. Hunter. N. Y. McGraw-Hill, 1956.)

HURTIG, CARL R. Sensory Aid Defines Lights and Marks. *Electronics* 30, pp. 162–163, February 1, 1957.

ISRAEL, DAVID R. and H. SHERMAN. Common or Uncommon Systems: Air Traffic Control and Air Defense. *Aero. Eng. Rev.* 16, pp. 85–88, May, 1957.

JACOBS, JOHN F., R. P. MAYER and others. Logical Design of the Digital Computer for the SAGE System. *IBM J. Res. & Development* 1, pp. 76–83, January, 1957.

JACOBS, JOHN F., R. P. MAYER and others. The Logical Design of a Digital Computer for a Large-Scale Real-Time Application. *A.I.E.E. Trans.* (Communications and Electronics) 76, pp. 71–75, March, 1957.

JONES, CLARENCE W. Broad Band Duplexers. *I.R.E. Trans.* (Professional Group on Microwave Theory & Techniques-5), pp. 4–12, January, 1957.

KAFALAS, JAMES A., P. H. ROBINSON and M. GREEN. The Interaction of Oxygen with Clean Germanium Surfaces. (In *Semiconductor Surface Physics*, edited by R. H. Kingston. Phila. Univ. Penn. Press, 1957.)

KAUFMAN, LAWRENCE P. and M. COHEN. The Martensitic Transformation in the Iron-Nickel System. *Am. Inst. Mining & Met. Engrs. Trans.* 206, pp. 1393–1401, October, 1956.

KAUFMAN, LAWRENCE P. and M. COHEN. Thermodynamics and Kinetics of Martensitic Transformations. (In *Progress in Metal Physics*, edited by B. Chalmers. Vol. 7. London. Pergamon Press, 1957.)

KEYES, ROBERT J., S. ZWERDLING, S. FONER, H. H. KOLM and B. LAX. Infrared Cyclotron Resonance in Bi, InSb and InAs with High Pulsed Magnetic Fields. *Phys. Rev.* 104, pp. 1804–1805, December 15, 1956.

KINGSTON, ROBERT H. and A. L. McWHORTER. Relaxation Time of Surface States on Germanium. *Phys. Rev.* 103, pp. 534–540, August 1, 1956.

KINGSTON, ROBERT H., Editor. *Semiconductor Surface Physics.* Phila. Univ. Penn. Press, 1957.

KOLM, HENRY H. Rotating Electrometer for Comparative Work Function Measurements. *Rev. Sci. Instr.* 27, pp. 1046–1048, December 1, 1956.

KUO, HSIAO L. On Quasi-Nondivergent Prognostic Equations and Their Integration. *Tellus* 8, pp. 373–383, August, 1956.

KUO, HSIAO L. Forced and Free Axially-Symmetric Convection Produced by Differential Heating in a Rotating Fluid. *J. Meteor* 13, pp. 521–528, December, 1956.

KUO, HSIAO L. Forced and Free Meridional Circulations in the Atmosphere. *J. Meteor* 13, pp. 561–568, December, 1956.

LAX, BENJAMIN, K. J. BUTTON, H. J. ZEIGER and L. ROTH. Analysis of Cyclotron Absorption in Bismuth. *Phys. Rev.* 102, pp. 715–721, May 1, 1956.

LAX, BENJAMIN and H. J. ZEIGER. Possible Interpretation of Cyclotron Resonance Absorption in Graphite. *Phys. Rev.* 105, p. 1466, March 1, 1957.

LEMENT, BERNARD S. and M. COHEN. A Dislocation-Attraction Model for the First State of Tempering. *Acta Metallurgica* 4, pp. 469–476, September, 1956.

LEVIN, JACOB J. Singular Perturbations of Nonlinear Systems of Differential Equations Related to Conditional Stability. *Duke Math. J.* 24, pp. 609–620, December, 1956.

MADAM, MAHENDRA P., S. C. BROWN, E. I. GORDON and S. J. BUCHSBAUM. Determination of the Coefficient of Diffusion and Frequency of Ionization in Microwave Discharges. *Phys. Rev.* 106, pp. 839–843, June 1, 1957.

MARILL, THOMAS. The Psychological Refractory Phase. *British J. Psychology* 4, pp. 93–97, May, 1957.

MAYER, ALEX AND F. S. HOLT. A Design Procedure for Dielectric Microwave Lenses of Large Aperture Ratio and Large Scanning Angle. *I.R.E. Trans.* (Professional Group on Antennas & Propagation-5), pp. 25–30, January, 1957.

MORROW, WALTER E., JR., C. L. MACK, JR., B. E. NICHOLS and J. LEONHARD. Single-Sideband Techniques in UHF Long-Range Communications. *I.R.E. Proc.* 44, pp. 1854–1873, December, 1956.

NAVARRO, JOSE and H. F. TAYLOR. Inorganic Binders Solve Shell Molding Problems. *Am. Foundrymen's Soc. Trans.* 64, pp. 625–635, 1956.

NICELY, PATRICIA E. and G. A. MILLER. Some Effects of Unequal Spatial Distribution on the Detectability of Radar Targets. *J. Exper. Psychology* 53, pp. 195–198, March, 1957.

PAN, HUO-PING. A Simple Apparatus for Rapid Study of Paper Partition Chromatography. *Arch. Biochem. & Biophys.* 64, pp. 311–314, October, 1956.

PARK, EDWARD C., JR. A Simple Differential Pulse Height Analyser. *J. Sci. Instr.* 33, pp. 257–260, July, 1956.

PASCALAR, HERBERT G. Strip Line Hybrid Junction. *I.R.E. Trans.* (Professional Group on Microwave Theory & Technique-5), pp. 23–30, January, 1957.

PASTAN, HARVEY L., A. J. NAVOY, G. J. AROUCHON and L. J. BERMAN. Cruise Control Techniques and Instrumentation for Gas Turbine Powered Aircraft. *W.A.D.C. Technical Report* 56-349, 1956.

PRATT, GEORGE W., JR. and H. H. KOLM. Long Time Work Function Changes Induced by Light and Electrostatic Fields. (A Chapter in *Semiconductor Surface Physics*, edited by R. H. Kingston. Phila. Univ. Penn. Press, 1957.)

PRATT, GEORGE W., JR. Exchange and Superexchange Coupling in Magnetic Materials. *Am. Phys. Soc. Bull.* 2, Ser. 2, p. 8, January 30, 1957.

PRATT, GEORGE W., JR. A Molecular Field Theory for Dilute Alloys and the Rare Earth Metals. *Am. Phys. Soc. Bull.* 2, Ser. 2, p. 118 March 21, 1957.

PRATT, GEORGE W., JR. Exchange and Superexchange Coupling Between Conduction Electrons and d-Electrons in Magnetic Materials. *Phys. Rev.* 106, pp. 53–66, April 1, 1957.

PRICE, ROBERT. Optimum Detection of Random Signals in Noise, with Application to Scatter-Multipath Communication, I. *I.R.E. Trans.* (Professional Group on Information Theory-2), pp. 125–135, December, 1956.

PRICE, ROBERT and P. E. GREEN, JR. Measurement of Ionospheric Path-Phase for Oblique Incidence. *Nature* 179, pp. 372–373, February 16, 1957.

RICHARDSON, ALBERT S. Non-Linear Oscillation of All-Movable Stabilizer at Supersonic Speed. *J. Aero. Sci. Preprint 685*, January, 1957.

RICHARDSON, ALBERT S. Bending-Torsion Flutter Sensitivity in Incompressible and Supersonic Flow. (In *Midwest Conference on Fluid and Solid Mechanics Proc.*, April, 1957.)

RICHARDSON, ALBERT S. On the Prediction of Gust and Buffet Response of Wings and Airfoils. *J. Aero. Sci.* 24, pp. 385–386, May, 1957.

RICHARDSON, ALBERT S. and R. J. HAKKINEN. Theoretical and Experimental Investigation of Random Gust Loads. Part I. Aerodynamic Transfer Function of a Simple Wing Configuration in Incompressible Flow. *N.A.C.A. Technical Note 3878*, May, 1957.

RICHARDSON, ALBERT S. Theoretical and Experimental Investigation of Random Gust Loads. Part II. Theoretical Formulation of Atmospheric Gust Response Problem. *N.A.C.A. Technical Note 3879*, May, 1957.

RITSON, DAVID M., D. DAVIS, R. A. SCHLUTER and others. The Energy Dependence of the K^+ Meson Interaction Cross-Section. *Am. Phys. Soc. Bull.* 2, Ser. 2, p. 20, January 30, 1957.

ROBINSON, PAUL H., A. J. ROSENBERG and H. C. GATOS. On the Preparation and Regeneration of Clean Germanium Surfaces. *J. Appl. Phys.* 27, p. 962, August, 1956.

RUBIN, EUGENE S. and E. M. KERWIN, JR. Some Experiments in Unsteady Aerodynamics Leading to the Development of an Acoustic Drag Coefficient. (In *Ninth International Congress on Theoretical and Applied Mechanics Proc.*, 1957.)

RUETENIK, J. RAY and L. V. DIVONE. Interferometric Measurements of the Laminar Boundary Layer on a Shock Tube Wall. *Am. Phys. Soc. Bull.* 2, Ser. 2, pp. 47–48, January 30, 1957.

SEIFERT, WILLIAM W. The Generation of Functions of Two Independent Variables. (In *Journees Internationales de Calcul Analogique Actes Proc.*, 1956.)

SEIFERT, WILLIAM W. The Role of Computing Machines in the Analysis of Complex Systems. (In *Journees Internationales de Calcul Analogique Actes Proc.*, 1956.)

SEIFERT, WILLIAM W. The Analysis of Hydraulic Servosystems. (In *National Conference on Industrial Hydraulics Proc.* 10, pp. 126–140, 1956.)

SHULMAN, YECHIEL. Stability of a Flexible Helicopter Rotor Blade in Forward Flight. *J. Aero. Sci.* 23, pp. 663–670, July, 1956.

SIEGEL, ARNOLD. Automatic Programming of Numerically-Controlled Machine Tools. *Control Eng.* 3, pp. 65–70, October, 1956.

SKOLNIK, MERRILL I. Radar Horizon and Propagation Loss. *I.R.E. Proc.* 45, pp. 697–698, May, 1957.

SMITH, DONALD O. Magnetization Reversal in Thin Films. *Phys. Rev.* 104, pp. 1280–1281, December, 1956.

SMITH, DONALD O. Magnetic Relaxation in Thin Films. (In *A.I.E.E. Second Conference on Magnetism and Magnetic Materials Proc.*, pp. 625–636, February, 1957.)

SMITH, J. E. KEITH, P. J. RUNKEL and T. M. NEWCOMB. Estimating Interaction Effects Among Overlapping Pairs. *Psychological Bull.* 54, pp. 152–158, March, 1957.

TAYLOR, NORMAN H. Session on Rapid-Access Storage, Including the Use of Magnetic Cores for Storage and Switching. *Instn. Elec. Engrs. (London) Proc.* 103, pp. 289–294, 1956.

TAYLOR, NORMAN H. Designing for Reliability. *I.R.E. Proc.* 45, pp. 811–822, June, 1957.

TREMBLY, GRAY C. An Essay on Buckwheat Cakes. *Preston County News* 1, p. 2, September 19, 1956.

WALDRON, ROBERT D. and R. M. BADGER. Spectra of Urea and Thiourea in the 3μ Region. *J. Chem. Phys.* 26, pp. 255–256, February, 1957.

WALDRON, ROBERT D. Infrared Spectra of HDO in Water and Ionic Solutions. *J. Chem. Phys.* 26, pp. 809–814, April, 1957.

WARSCHAUER, DOUGLAS M. and W. PAUL. The Unsupported Area High Pressure Seal. *Rev. Sci. Instr.* 28, p. 62, January, 1957.

WATTENBERG, ALBERT, R. WEINSTEIN, A. C. ODIAN, P. C. STEIN and H. WILSON. Momentum of Nucleons in Various Nuclei from the High Energy Photo-Effect. *Phys. Rev.* 104, pp. 1710–1716, December 15, 1956.

WATTENBERG, ALBERT. Nuclear Reactions at High Energies. (A Section in *Handbuch der Physik*, edited by S. Flügge. Berlin. Springer-Verlag, 1957.)

WHITE, BENJAMIN W. and E. SALTZ. Measurement of Reproducibility. *Psychological Bull.* 54, pp. 81–99, March, 1957.

WITMER, EMMETT A., N. P. HOBBS and J. C. LORIA. Resumé of the Effects of Very High Yield Atomic Explosions on Aircraft Structures — Explosion Characteristics, Structural and Aeroelastic Blast Effects and Thermal Radiation Effects. *W.A.D.C. Technical Report* 54-386, August, 1956.

ZEIGER, HERBERT J., B. LAX and R. N. DEXTER. Cyclotron Resonance Experiments in Silicon and Germanium. *Phys. Rev.* 104, pp. 637–644, November 1, 1956.

ZEIGER, HERBERT J., B. LAX and R. N. DEXTER. Classical Boltzmann Theory of Cyclotron Resonance for Warped Surfaces. *Phys. Rev.* 105, pp. 495–501, January 15, 1957.

ZIERLER, NEAL. On a Class of Binary Sequences. *Am. Math. Soc. Proc.* 7, pp. 675–681, August, 1956.

ZWERDLING, SOLOMON, R. J. KEYES, S. FONER, H. H. KOLM and B. LAX. Magneto-Band Effects in InAs and InSb in d-c and High Pulsed Magnetic Fields. *Phys. Rev.* 104, pp. 1805–1807, December 15, 1956.

ZWERDLING, SOLOMON and B. LAX. Oscillatory Magneto-Absorption of the Direct Transition in Germanium. *Am. Phys. Soc. Bull.* 2, Ser. 2, p. 141, March 21, 1957.

ZWERDLING, SOLOMON, L. M. ROTH and B. LAX. Theory of the Oscillatory Magneto-Absorption in Semiconductors. *Am. Phys. Soc. Bull.* 2, Ser. 2, p. 141, March 21, 1957.

ZWERDLING, SOLOMON and B. LAX. Oscillatory Magneto-Absorption of the Direct Transition in Germanium. *Phys. Rev.* 106, pp. 51–52, April 1, 1957.

PUBLICATIONS OF THE DEPARTMENTS AND LABORATORIES, JULY 1, 1956–JUNE 30, 1957[1]

DEPARTMENT OF AERONAUTICAL ENGINEERING

AEROELASTIC AND STRUCTURES LABORATORY

The Temperature Response of Thick Plates Exposed to Radiant Heat Pulses, by J. C. Loria and L. A. Schmit. WADC TR 56–149, July 15, 1956.

Transient Aerodynamics of Two-Dimensional Airfoils. Part I — Interferometric Measurements of Two-Dimensional Airflow Development about a Symmetrical Double-Wedge Airfoil in Shock-Initiated Subsonic Flow, by J. R. Ruetenik and E. A. Witmer. WADC TR 54–368, Part I, August, 1956.

Shock Tube Flow Investigations. Part I — An Exploratory Study of the Generation of Blast-Type Profiles in the Shock Tube by the Reflection Method, by R. C. K. Lee, J. R. Ruetenik, and E. A. Witmer. WADC TR 54–383, Part I, August 1, 1956.

Indicial Downwash and its Structural Effect on the Horizontal Tail, by N. P. Hobbs. WADC TR 56–164, August, 1956.

The Influence of Aerodynamic Heating on the Structural Design of High-Speed Aircraft. Part IV — An Application of Minimum Complementary Energy Principle to the Thermal Stress Analysis of Thin Plates and Stiffened-Sheet Structures Subjected to Aerodynamic Heating, by J. W. Mar and M. M. Chen. ASRL, NOas 56–333-d, October, 1956.

Experimental Studies on the Postfailure Response of a Simple Structural Model Subjected to Static and Dynamic Loading, by R. D'Amato. WADC TR 56–161, November 15, 1956.

A Parametric Investigation of the Effects of Aerodynamic Coupling and Damping on the Dynamic Response of Lifting Surfaces, by K. R. Wetmore. WADC TR 57–52, April, 1957.

A Study of the Feasibility of Experimental Determination of Aerodynamic Forces for Use in Flutter Calculations. Part I — Direct and Inferential Determination of Unsteady Aerodynamic Forces, by E. Mollø-Christensen and J. R. Martuccelli. ASRL, Boeing Airplane Company, June 1957.

[1] Copies of all the reports listed here have been deposited in the M.I.T. Library (Special Collections), where they may be consulted. Microfilm or photo-print copies may be obtained through the Microreproduction Service, Charles Hayden Memorial Library. Inquiries or orders should include all the information printed for each title and should specifically name the sponsoring laboratory. This compilation has been prepared under the direction of Miss Eleanor Bartlett, Special Collections and Gifts Librarian.

A Study of the Feasibility of Experimental Determination of Aerodynamic Forces for Use in Flutter Calculations. Part II — Determination of Unsteady Aerodynamic Forces from Steady State Measurements, by E. Mollø-Christensen. ASRL, Boeing Airplane Company, June, 1957.

A Study of the Feasibility of Experimental Determination of Aerodynamic Forces for Use in Flutter Calculations. Part III — Summary and Conclusions, by E. Mollø-Christensen and J. R. Martuccelli. ASRL, Boeing Airplane Company, June, 1957.

Measurement of Aerodynamic Loading on Oscillating Airfoils in Supersonic Flow, by E. Mollø-Christensen and J. R. Martuccelli. ASRL, NOas 56–556-d, June, 1957.

Experimental and Theoretical Research on Flutter of Low-Aspect-Ratio Wings, by H. Ashley, M. Chen, and P. T. Hsu. ASRL, Noas 55–771-c, June, 1957.

AEROPHYSICS RESEARCH GROUP

A Theoretical Investigation of Shock Oscillations in One-Dimensional Flows with and without Pressure Gradients, by H. B. Schechter. Aerophysics Research Group, Massachusetts Institute of Technology, WADC TN 57–37, February, 1957.

Description of the MIT Optimalizing Cruise Control System, by H. L. Pastan. Aerophysics Research Group, Massachusetts Institute of Technology, Report ARG MR-2, February 1, 1957.

INSTRUMENTATION LABORATORY

Programming Manual for SLIC 650 Routine, by C. Block and L. Teng. R-93, November, 1956.

Handbook on the Assembly and Testing of MIT 20IG Integrating Gyro Unit, by L. Grohe, J. Hogg, and A. Lattanzi. R-101, December, 1956.

Bibliography of Components Used in Gyroscopic Instruments. R-106, November, 1956.

Design Basis for Cascade-Type Positional Servomechanisms, by S. Lees and T. Blaschke. R-124, October, 1956.

Programming Manual for BALITAC 650 Routine, by R. Battin. R-126, August, 1956.

A Special Purpose D-C Integrator, by G. Sloan. R-127, November, 1956.

Interpreting Dynamic Measurements of Physical Systems — Parts I and II, by S. Lees. R-128, February, 1957.

Non-Dimensional Performance Characteristics of a Family of Gyro-Wheel-Drive Hysteresis Motors, by W. Denhard and D. Whipple. R-129, January, 1957.

The Properties of Metals and Alloys of Particular Interest in Precision Instrument Construction, by L. M. Schetky. R-137, January, 1957.

NAVAL SUPERSONIC LABORATORY

The Quantitative Measurement of Gas Density by Means of Schlieren Interference, by E. Temple. TR 132, August, 1956.

Papers on Heat Transfers and Unsteady Aerodynamics (Presented at the IX International Congress of Applied Mechanics, Brussels, Belgium, September 5–13, 1956), by J. A. F. Hill, M. Finston, J. R. Baron, E. S. Rubin, and E. M. Kerwin, Jr. TR 179, September, 1956.

On a Boundary Condition for the Calculation of the Internal Temperature Rise Due to Aerodynamic Heating, by E. E. Covert. TR 202, February, 1957.

The Heterogeneous, Laminar, Boundary Layer, by J. R. Baron. TR 236, August, 1957.

DEPARTMENT OF CHEMICAL ENGINEERING

FUELS RESEARCH LABORATORY

Skin Simulants with Depth Magnification, by N. Y. Chen and W. P. Jensen. DSR 7666. TR 5 March 15, 1957.

Mechanism of Initiation of Fire by Irradiation of Combustible Surfaces, by N. Y. Chen and W. P. Jensen. DIC 6797, Quarterly Status Reports: Number 11, November 9, 1956. DSR 7666, Number 12, January 17, 1957; Number 13, April 15, 1957; and Number 14, August 20, 1957.

Simulated High Altitude Combustion Research, by C. A. Homsy, W. P. Jensen, P. M. Raymond, and A. C. Tobey. DIC 7361, Quarterly Progress Reports: Number 5, September 28, 1956; Number 6, January 11, 1957; Number 7, April 25, 1957; and Number 8, July 8, 1957.

HYDROGEN PEROXIDE RESEARCH

Some Aspects of the Stabilization of Concentrated Solutions of Hydrogen Peroxide, by W. C. Schumb. TR 50, February 15, 1957.

Kinetics of Decomposition of Calcium Carbonate and Barium Carbonate, by C. N. Satterfield and F. Feakes. TR 51, March 15, 1957.

Translation into English of a portion of *Perekis Vodoroda I Perekisnie Soedineniya, (Hydrogen Peroxide and the Peroxide Compounds)*, by G. E. Halpern. TR 52, April 1, 1957.

DEPARTMENT OF CIVIL AND SANITARY ENGINEERING

HYDRODYNAMICS LABORATORY

Water Test Results for an Experimental 'Ten-Inch' Swing Check Valve, by R. E. Nece. TN 1, July, 1956.

Effects of Unsteadiness on Resistance and Energy Dissipation, by J. W. Daily and J. M. Jordaan. TR 22, December, 1956.

The Damping of the Solitary Wave from Boundary Shear Measurements, by A. T. Ippen and M. M. Mitchell. TR 23, June, 1957.

Experimental and Analytical Studies of Wave Forces on Offshore Drilling Structures. Part II: Bouyancy Components for Floating Platforms, by D. R. F. Harleman, W. C. Shapiro, and T. A. Marlow, II. TR 24, June, 1957.

Hydraulic Model Study of Protective Works for Fleet Berthing Facilities in Coddington Cove, Narragansett Bay, R. I., by P. S. Eagleson, T. A. Marlow, II, C. T. Luke, and F. J. Turpin. TR 25, June, 1957.

JOINT HIGHWAY RESEARCH PROJECT

Bridge Vibration — Progress Report No. 2 — A Theoretical and Experimental Investigation of the Vibration of Simple-Span Highway Bridges, by J. M. Biggs, H. S. Suer, and S. M. Louw. July, 1956.

Borrow Pit Computation Programmed for the IBM 650, by P. O. Roberts, Jr. and V. J. Roggeveen. November, 1956.

Westboro Subsealing Experiment, by E. Tons and A. J. Bone. December, 1956.

Field Testing of Materials for Sealing Cracks and Joints in Bituminous Concrete Resurfacings, by E. Tons and V. J. Roggeveen. Preprint of paper presented at the 36th Annual Meeting, Highway Research Board, January, 1957. Washington, D. C.

A Laboratory Study of Welded Wire Fabric Reinforcement in Bituminous Concrete Resurfacing, by G. A. Bicher, R. L. Harris, and V. J. Roggeveen. Preprint of paper presented at the Annual Meeting, Association of Asphalt Paving Technologists, February, 1957. Atlanta, Georgia.

DEPARTMENT OF ELECTRICAL ENGINEERING

LABORATORY FOR INSULATION RESEARCH

A Wide-Band High-Pressure Dielectric Cell, by M. G. Vallauri and P. W. Forsbergh, Jr. TR 110, October, 1956.

A System for Electrical Measurements on Small Crystals under High Pressures by P. W. Forsbergh, Jr. and G. J. Wolga. TR 111, October, 1956.

Electric Breakdown and Conduction Through Mylar Films, by Y. Inuishi and D. A. Powers. TR 112, December, 1956.

High-Temperature Dialectric Measurements on Radome Ceramics in the Microwave Region, by W. B. Westphal. TR 113, January, 1957.

A 50-kMc Dielectrometer, by N. E. Dye. TR 114, January, 1957.

Investigation of the Ferrite Region of the Phase Diagram Fe-Co-O, by J. Smiltens. TR 115, January, 1957.

The Standard Free Energy of Oxidation of Magnetite to Hematite at Temperatures Above 1000° C., by J. Smiltens. TR 116, January, 1957.

Crystal Structure Refinement by Least Squares with the IBM 650, by L. R. Lavine and J. R. Steinberg. TR 117, February, 1957.

An X-Ray Method for Determining Cation Distribution in Ferrites, by L. P. Skolnick, S. Kondo, and L. R. Lavine. TR 118, February, 1957.

Tables of Dielectric Materials, Volume V, Laboratory for Insulation Research. TR 119, April, 1957.

Studies on the Lower Oxides of Titanium, by A. D. Pearson. TR 120, June, 1957.

SERVOMECHANISMS LABORATORY

Cooling and Materials Investigation for Aircraft Generators, by A. Kusko. WADC TR 56–305, June, 1956.

Dynamic Representation for Magnetic Amplifiers, by T. M. Brown, Jr. WADC TN 56–293, August, 1956.

Analog-Digital Conversion Techniques, Summer Course Notes. Staff. August, 1956.

Analog Computer Representations of Aircraft Parallel Alternating-Current Generating Systems, by L. V. Boffi, M. Riaz, and P. E. Smith, Jr. WADC TN 56–384, September, 1956.

Study of Aircraft Alternating Current Electric Power Generating Systems, by V. B. Haas, Jr., D. C. White, and P. E. Smith, Jr. WADC TR 56–471, September, 1956.

Digital Computer Studies, by R. R. Brown, J. B. Dennis and C. Kingsley, Jr. WADC TR 56–471, September, 1956.

Design of Systems Using Digital Computers, by R. R. Brown, J. B. Dennis, and C. Kingsley, Jr. WADC TN 56–383, November, 1956.

Comparison of Lead Network, Tachometer, and Damper Stabilization in Instrument Servos, by G. Biernson. 7138–TM–10, December, 1956.

The Cryotron as a Storage Element, by J. O. Morin. 7138–R–15, Astia No. AD–113699, December, 1956.

Automatic Programming of Numerically Controlled Machine Tools, by D. T. Ross and H. E. Pople, Jr. Interim Engineering Reports 6873–IR–1 and 6873–IR–2 for period June 26, 1956, to December 31, 1956.

Automatic Programming of Numerically Controlled Machine Tools, by Project Staff. Interim Engineering Report 6873–IR–3 for period January 1, 1957, to March 31, 1957.

An Automatic Converter to Prepare Analog Data for Digital Computation, by F. R. Cronin. 7138–R–19, January 15, 1957.

Bibliography on Numerical Control of Machine Tools, compiled by A. K. Susskind, February 1, 1957.

Summary Report Correlation Computer Design Study, by J. F. Kaiser. Special report for the Communications Biophysics Group of the Research Laboratory of Electronics, March 27, 1957.

An Outline of Subject Matter for Industrial Training Programs in Numerical Control of Machine Tools. March, 1957.

DEPARTMENT OF MECHANICAL ENGINEERING

DYNAMIC ANALYSIS AND CONTROL LABORATORY

Control-Systems Engineering, by W. W. Seifert and members of the Dynamic Analysis and Control Laboratory. Notes for Massachusetts Institute of Technology Special Summer Program 2.769, August, 1956. Part I, *Mathematical Theory of Control-Systems Engineering*. Part II, *Illustrative Examples*.

Static and Dynamic Characteristics of Compensated Gas Bearings, by H. H. Richardson. DACL–RM–7401–1, April 2, 1957.

Techniques of Time-Domain Synthesis for Control Systems, by C. W. Steeg. DACL–TR–100, April 30, 1957.

Random-Signal Analysis of Linear and Nonlinear Sampled-Data Systems, by N. W. Trembath. DACL–TR–108, June 28, 1957.

DEPARTMENT OF METEOROLOGY

Contributions to the Study of Atmospheric Ozone, by D. W. Martin. Sci. Rpt. No. 6 AF 19(604)–1000, September 15, 1956.

Topics concerning the Mechanics of the General Circulation, by V. P. Starr, B. Saltzman, and R. M. White. Sci. Rpt. No. 8 AFCRC TN 57–271, February 1, 1957.

Further Studies of Thermal Convection, by H. Kuo. Sci. Rpt. No. 7 AF 19(604)–1000, February 1, 1957.

Radar Measurement of Gustiness, by R. R. Rogers. Res. Rpt. No. 29, DA–36–039 SC–71136, February, 1957.

Static Stability and Atmospheric Energy, by E. N. Lorenz. Sci. Rpt. No. 9, AF 19(604)–1000, April 30, 1957.

Mean Temperature from 1000 MB to 500 MB as a Predictor of Precipitation Type, by A. J. Wagner. Sci. Rpt. No. 2 AF 19(604)–1305, May, 1957.

A Statistical-Dynamic Approach to Numerical Weather Prediction, by W. D. Sellers. Sci. Rpt. No. 2, AF 19(604)–1566, June, 1957.

Empirical Orthogonal Functions Applied to Thirty-Day Forecasting, by D. L. Gilman. Sci. Rpt. No. 1, AF 19(604)–1283, June 30, 1957.

DEPARTMENT OF PHYSICS

SOLID-STATE AND MOLECULAR THEORY GROUP

Electron-Lattice Interactions in Polar Crystals, by T. D. Schultz. TR 9, August 20, 1956.

Quarterly Progress Reports Numbers 21, 22, 23, and 24, July 15 and October 15, 1956, and January 15 and April 15, 1957.

CENTER FOR INTERNATIONAL STUDIES

The Social Context of Economic Change: An Indonesian Case Study, by C. Geertz. July, 1956.

Industrial Production of Soviet Germany, by W. F. Stolper and K. W. Roskamp. August, 1956.

India Project Progress of Work in India, September 1, 1955–August 31, 1956, by W. Malenbaum. October, 1956.

The Nonmonetized Sector of Rural India, by W. Malenbaum. October, 1956.

Subcontracting in the Small and Medium Size Engineering Industries of Bombay City, by G. Rosen. October, 1956.

Disguised Unemployment and Under-Employment in Agriculture, by P. N. Rosenstein-Rodan. October, 1956.

The Relation between Political and Economic Development, by W. W. Rostow. October, 1956.

The Rotating Credit Association: An Instrument for Development, by C. Geertz. November, 1956.

Who Does the Planning? by W. Malenbaum. November, 1956.

A Note on Changing American Values as Seen in Contemporary Popular Literature, by H. Kangieser. January, 1957.

Unemployment among the University Educated: A Pilot Inquiry in India, by D. N. Majumdar. January, 1957.

World Population and National Income, 1953, by E. E. Hagen. February, 1957.

Lessons from the Malayan Struggle against Communism, by L. W. Pye. February, 1957.

Entrepreneurship in the Batik Industry of Indonesia, by E. D. Hawkins. March, 1957.

Notes on the Theory of the "Big Push," by P. N. Rosenstein-Rodan. March, 1957.

Some Personal Reflections on Recent Changes in the United States, by D. W. Brogan. April, 1957.

Foreign Aid and the Cold War, by B. Higgins. April, 1957. (Paper prepared for League for Industrial Democracy.)

The Policy Implications of Social Change in Non-Western Societies, by L. W. Pye. April, 1957.

International Financing of Exports of Machinery to Underdeveloped Countries, by P. N. Rosenstein-Rodan. April, 1957. (Paper prepared for the Congress of Cultural Freedom, Tokyo.)

Notes on Congress and the National Interest: 1945–1951, by R. W. Hatch. May, 1957.

The Indian Merchant, by H. B. Lamb. May, 1957. (Paper prepared for the Association of Asian Studies.)

The Prediction of Attitudes of Foreign Travelers, by I. de Sola Pool. May, 1957. (Paper delivered at A.A.P.O.R. meeting, May, 1957.)

Imaginary Communication as a Problem in Public Communication: Progress Report, by I. de Sola Pool and I. Shulman. June, 1957.

Two Studies in the Italian Light Mechanical Industry, by S. H. Wellisz.

LABORATORY FOR NUCLEAR SCIENCE

Preparation of Large Plastic Scintillators, by G. W. Clark, F. Scherb, and W. B. Smith. TR 69, September 15, 1956.

LINCOLN LABORATORY

Symmetrical Back-Clamped Transistor Switching Circuits, by R. H. Baker, R. E. McMahon, F. L. McNamara, A. C. Parker, V. J. Sferrino, and H. A. Ullman. TR 120, May 5, 1956.

The Suggested Role of Stratified Elevated Layers in Transhorizon Short-Wave Radio Propagation, by J. R. Bauer. TR 124, September 24, 1956.

On Meteor Echoes from Underdense Trails at Very High Frequencies, by M. Loewenthal. TR 132, December 13, 1956.

Transistor Core Memory, by R. E. McMahon and F. L. McNamara. TR 133, November 13, 1956.

Preliminary Report on Ground-Wave-Radar Sea Clutter, by C. A. Stutt, S. J. Fricker, R. P. Ingalls, and M. L. Stone. TR 134, September 21, 1956.

Topics in the Design of Antennas for Scatter, by J. Granlund. TR 135, November 23, 1956.

Classical Boltzmann Theory of Cyclotron Resonance, by H. J. Zeiger, B. Lax, and R. N. Dexter. TR 136, October 4, 1956.

Punch-Thru Diode (Operation as a Narrow-Base Diode), by R. H. Rediker and D. E. Sawyer. TR 137, November 27, 1956.

Circular Polarization for the AN/CPN-18 Antenna, by F. L. Niemann and J. P. Curtis. TR 138, January 7, 1957.

Logical Design of CG24 (A General-Purpose Computer), by G. P. Dinneen, J. A. Dumanian, I. L. Lebow, I. S. Reed, and P. B. Sebring. TR 139, April 15, 1957.

Symbolic Design Techniques Applied to a Generalized Computer, by I. S. Reed. TR 141, January 3, 1957.

High-Power RF Switch, by L. J. Ricardi. TR 142, December 10, 1956.

Electromagnetic Propagation Effects in Ferromagnetic Resonance, by M. H. Seavey and P. E. Tannenwald. TR 143, January 16, 1957.

Analysis of Wet-Snow Precipitation along the Eastern North American Coastline, by J. M. Austin and S. L. Hensel. TR 144, January 25, 1957.

Some Studies on Group III–V Intermetallic Compounds, by C. R. Kolm. TR 150, February 20, 1957.

Proposal for Improving Tropospheric Propagation, by L. J. Eyges. TR 151, March 1, 1957.

Hahn Decompositions and Hypothesis Tests, by I. S. Reed, E. J. Kelly, and D. H. Lyons. TR 152, March 4, 1957.

A Fixed-Gap UHF TR Tube, by C. W. Jones, C. E. Muehe, and S. J. Miller. TR 155, March 29, 1957.

Transistorized Matched Filter for Pulsed Sinusoids, by P. L. Fleck, Jr. TR 156, April 12, 1957.

A Proposal for an Evolving Air Traffic Control System, by D. R. Israel and H. Sherman. Technical Memorandum No. 64, September 17, 1956.

RESEARCH LABORATORY OF ELECTRONICS

Properties and Tables of the Extended Airy-Hardy Integrals, by M. V. Cerrillo and W. H. Kautz. RLE TR 144, November 15, 1951.

Fluctuations and Irreversible Thermodynamics, by L. Tisza and I. Manning. RLE TR 235, March 15, 1957.

The Paramagnetic Resonance Spectrum of Ammonium Chromium Alum, by C. F. Davis, Jr. and M. W. P. Strandberg. RLE TR 242, December 9, 1955.

Basic Data of Electrical Discharges, by S. C. Brown and W. P. Allis. Edition 3. RLE TR 283, September 1, 1956.

Motions of Ions and Electrons, by W. P. Allis. RLE TR 299, June 13, 1956.

Measurement of Second-order Probability Distributions of Pictures by Digital Means, by J. C. Stoddard. RLE TR 302, July 13, 1955.

Recording Magnetic-resonance Spectrometer, by M. W. P. Strandberg, M. Tinkham, I. H. Solt, and C. F. Davis, Jr. RLE TR 304, May 10, 1955.

Network Synthesis for a Prescribed Impulse Response, by R. A. Pucel. RLE TR 305. November 2, 1955.

Analysis of Signals and Noise in Longitudinal Electron Beams, by H. A. Haus. RLE TR 306, August 18, 1955.

A Theory of Non-linear Systems, by A. G. Bose. RLE TR 309, May 15, 1956.

The Synthesis of Voltage Transfer Functions, by P. M. Lewis, II. RLE TR 314, June 7, 1956.

Piecewise-linear Network Theory, by T. E. Stern. RLE TR 315, June 15, 1956.

Detection Theory and Psychophysics, by T. Marill. RLE TR 319, October 30, 1956.

Thermionic Emission, by W. B. Nottingham. RLE TR 321, December 10, 1956.

Quarterly Progress Reports for July 15 and October 15, 1956, and January 15 and April 15, 1957.