MASSACHUSETTS INSTITUTE OF TECHNOLOGY *bulletin*

PRESIDENT'S REPORT ISSUE

Volume 91, Number 3, November, 1955

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 Station, Boston, Massachusetts, in March, May, June, September, October, and November*

Issues of the Bulletin include
the REPORT OF THE TREASURER,
the ANNUAL REPORT,
the ADMINISTRATIVE REPORT,
the SUMMER SESSION CATALOGUE,
the GENERAL CATALOGUE,
and THE UNDERGRADUATE CATALOGUE.

Published under the auspices of the M.I.T. Office of Publications

Massachusetts Institute of Technology Bulletion

PRESIDENT'S REPORT ISSUE

Volume 91, Number 3 · November, 1955

Photographs (NOT OTHERWISE CREDITED) BY THE M.I.T. PHOTOGRAPHIC SERVICE.
Editorial service and design BY THE M.I.T. OFFICE OF PUBLICATIONS.
Plates and printing BY THE M.I.T. PHOTOGRAPHIC SERVICE.
Binding BY ROBERT BURLEN AND SON, BOSTON.

CONTENTS

Report of the President

To the Members of the Corporation:

I have the honor to present, in accordance with the by-laws of the Corporation, this annual report on the state of the Massachusetts Institute of Technology. This year the report is divided into two parts. Part 1 is devoted to a discussion of the nation's manpower requirements and the Institute's response to these requirements. Part 2 is a review of Institute affairs since the last annual meeting of the Corporation.

1. MEETING THE NATION'S SCIENTIFIC MANPOWER NEEDS

The theme of this section is summed up by saying that the strategical planning of our manpower resources in the United States calls at this juncture for a major drive to enhance the excellence and increase the creativity of scientific and engineering education even beyond their present fine performance. The strength and progress of our society depend less upon numbers and more upon an advancing quality of professional accomplishment. Technological competition among nations and among industries is increasing, and the safety and welfare of both may depend upon their capacity to compete. Our dynamic society anticipates and requires new jobs, an upgrading of old jobs, a still higher standard of living, better health, and stronger defense. The fulfillment of these needs requires a new order of excellence and creativity in the nation's professional work. While the preparation for this new order of excellence begins in the secondary schools, our professional schools have the major responsibility in setting and underwriting these new standards of professional accomplishment.

The qualitative aspects of manpower scarcity.

While the United States has experienced shortages of professional talent in the past, notably of physicians, we have not in many years experienced so great or persistent an imbalance between supply and demand as we now have in science and engineering. The sustained scarcity of professional manpower in these fields, having been widely proclaimed, is now generally recognized, and its handicap to the nation is becoming understood.

Not so well recognized and understood or stressed is the qualitative nature of the shortage. We have a shortage

of young engineers competent to handle new, advanced technologies. We have a shortage of research scientists and engineers (the demand for whom has been doubling every decade). We have an acute shortage of scientists whose creative and conceptualizing powers are exceptional. We have, in summary, a shortage more of basically educated, versatile young talent than of mere numbers of scientists and engineers. There is indeed a shortage of numbers in many but not all fields of science and engineering; we could better cope with such a shortage did we not also have an even more severe shortage of quality, depth, adaptability, and up-to-dateness.

As our advancing technology becomes more complex and sophisticated, it requires scientists and engineers — and managers — of more advanced education and analytical powers. There are areas of technology so new and rapidly advancing that only men with self-acquired fundamental and versatile understanding or with recent education in the new technologies are able to master or to keep pace with them. There are many areas of technology that are now closed books to those engineers lacking creative powers or to those whose training or analytical abilities never carried them beyond the superficial methods of handbook engineering. The qualitative nature of this scarcity is reflected in the placement offices where industry seeks new men. Employers are not just looking for "bodies" with degrees; they are looking with a critical eye for competence — competence that is up-to-date and versatile enough to meet the needs of their advancing technology. The companies dependent upon "high" technology are pressing the colleges for men with a more fundamental, integrated education in science, engineering, and the humanities rather than for men specialized in some field of technology at the expense of fundamentals. Employers want

more scientists and engineers, but they don't feel they are meeting their needs by employing inferior or narrowly educated ones. They want men — particularly young engineers — with the power to deal with the technologies of tomorrow and not of yesterday.

Similarly in the basic sciences our most pressing needs are for those scientists who have the imagination and trained creative power to make the discoveries and generate the new concepts which advance science. We hear much about the need for more basic research and funds to support it. These needs are great, but greater still is the need for more scientists who have the trained talent, the motivation, and the conceptualizing power to make basic research really basic. In stressing the need — which has always been present — of exceptional talent, I do not minimize the critical shortage of the rank and file of good competent scientists. Flag officers are not enough to provide a strong scientific attack force, but the really acute shortage now is in the flag officer group.

Factors influencing quality.

The quality of American science and engineering depends upon many factors. It depends upon those attitudes in our society which tend to place a high value on accomplishment in these fields and which thus affect the motivations and the recognition so vital to achievement in any field. It depends upon whether our society values and rewards creative intelligence. Above all, it depends upon the success of our society in identifying, encouraging, and providing special educational opportunity for its exceptionally talented young people.

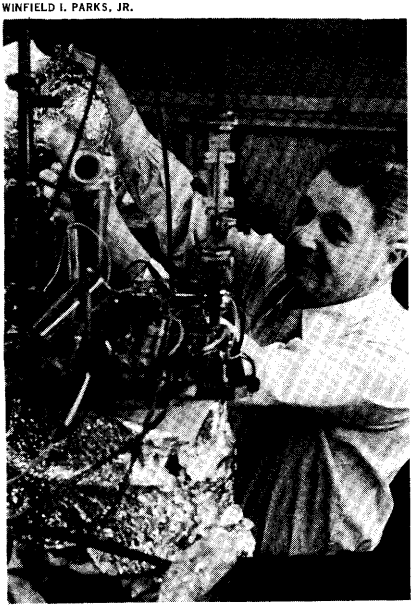
BENJAMIN J. DIVER

A powerful new method of analyzing the sequence of brain waves.

"... scientists who have the trained talent, the motivation, and the conceptualizing power to make basic research really basic."

An "atomic clock," accurate to one second in nearly 300 years.

WINFIELD I. PARKS, JR.



RADIOACTIVITY CENTER

This suds-like structure is the calcium in bone — greatly magnified — after the organic materials surrounding it have been boiled away. Studies of this pure calcium structure in the M.I.T. Radioactivity Center are leading to new methods of detecting radioactivity in the human body.

We hear impressive reports of Russian success in marshalling these favorable factors to advance their technology. Russians attending the Geneva Conference on the Peaceful Uses of the Atom reported that their institutes of technology are accepting only one out of about 25 applicants.

In recent years the United States rounded out a public system of mass education which is magnificent in its accomplishment as a means for mass education. We must maintain this system in a state of vigor, and we must make sure that we provide the means for it to meet the swelling numbers that result from our rapid growth in population. But we must do more. We must make sure that it has built into it the methods, the ideals, and the people who will spot the able youngsters and will give them special handling so that they have a maximum opportunity to make their contribution to our society. All too frequently the youngster of exceptional intellectual ability is the underprivileged youngster in our schools.

One-third of the top 2 per cent of the graduates of our high schools are not going to college. Some are not motivated; some do not have the means. As one of the major moves to augment the quality of our science and other professional work, we must provide the motivation and the means for more of this missing third to get a college education.

The quality of American science and engineering depends also upon the strengthening of science teaching in the secondary schools, and institutions such as M.I.T. cannot side-step a responsibility to help. Last June the teachers' colleges and other institutions producing teachers in the nation graduated less than 250 teachers of physics for our secondary schools, and half of these were attracted by industry and government away from teaching. At present rates of education, we will train only half the number of science teachers we will need to stay where we are during the next five years. We have a shortage of science teachers, first, as a result of their being attracted into other more remunerative fields — mainly industry — and, second, as a result of the inadequate status and emphasis given to science in the secondary schools. In remarking this, I hasten to make clear that I do not feel that the teaching of science should be given such overriding attention and privilege in our public schools that other fields are weakened and the curriculum distorted. This is not the way to solve the problem; but I do think the evidence is clear that in the secondary schools science teaching has suffered more than teaching in any other field. If we are to make headway in educating more teachers of science and in improving the teaching of science, the schools of science and engineering must do more than they have so far done to help in encouraging and preparing more of their students to go into secondary school teaching.

GEORGE N. STEINBERG '56

The Massachusetts Science Fair, to which M.I.T. is host each year in cooperation with the Boston Globe, is an important stimulus to high school students' interest in science.

The quality of American scientists and engineers depends upon our willingness and success in building a more differentiated system of higher education, with institutions specialized more and more in accord with the degree of intellectual performance expected of their students. It depends, for example, on increasingly strong graduate schools of science and engineering and on undergraduate schools associated with these graduate schools where standards of admission are very high and where the educational environment is as benign to scholarship and discovery as that to be found anywhere in any field of learning. There are qualities of maturity, of disinterested scholarship, of freedom, and of intellectual stimulus which mark such an environment and which are necessary for scientific work of the highest order and for the maturing of first-rate scientists and engineers.

Toward a more attractive environment.

One of the major threats to scientific and engineering education is the higher compensation and other attractions offered to scientists and engineers by industry and other employers. This problem is less acute in science, since the university is (and must continue to be) a natural habitat for creative scientists. Engineering education, however, has been more vulnerable to this competition. This is particularly true of those engineering schools limited to undergraduate programs; but all of engineering education has been under pressure because its young and imaginative teachers — especially those in the advancing, growing fields of technology — are sought after by industry to a greater degree than any other group in our educational institutions.

If engineering education is to meet this challenge and prevent the spreading scarcity of quality in engineering schools that has weakened science teaching in the high schools, it must find ways to make engineering schools a more attractive environment for top-flight engineers.

One of the surest ways of accomplishing this is to create and maintain strong graduate schools of engineering. In those engineering institutions where strong graduate schools exist and where there is a fruitful alliance with basic science, an environment attractive to first-rate engineers has been achieved — but not, of course, a competitive scale of compensation. The urgent need now in American engineering education is for more research and graduate study in order to create the environment for attracting first-rate, imaginative teachers. The engineering profession can no longer depend primarily upon a system of undergraduate professional education. The development of more advanced study is the path that can lead again to creativeness and imaginativeness in

teaching — that boldness and fecundity in pioneering new educational ideas that have characterized engineering education in the past and that it now seems to have lost. It is not that our national resource of engineering education is less strong than it used to be. It is rather that the demands placed by our society on engineering education are greater. The challenge of this responsibility and of our advancing technology steadily creates new opportunities and new requirements for engineering education and creates the need for a new order of professional excellence. We have a small number of engineering institutions — and M.I.T. is one of these — where this awareness of the engineer's new importance in our society exists, and where there is an atmosphere of creativity, of growth in ideas, and of high professional excellence that are commensurate with the responsibility and potential of engineering in our society. These institutions, however strong, cannot relax for a minute if they are to keep ahead of our society's advancing technological opportunities and if they are to educate engineers of the breadth, scope, and power now needed.

These factors I have touched upon all have a bearing on the manpower shortage, both of numbers and of quality, in science and engineering. We must move on a broad front if we are to eliminate the shortages, and if we can give first priority to maintaining and augmenting quality we shall be better able to deal with numbers. This is especially true now that we face a vast increase in numbers seeking admission to our colleges and ultimately to the professions. We should also keep in mind the possibility that a drop in business activity or in the volume of defense development or production could reduce the demand for run-of-the-mill engineers and scientists, and jobs — temporarily — might be hard to come

by. Such changes would not, except temporarily, reduce the demand for the superior men; excellence will never be in oversupply for very long.

As we undertake to augment our supply of top-quality scientists and engineers, we should do so in terms of our own national needs and outlook. We need to concentrate more on the quality of our own science and technology and less on engaging in a technological race with the Russians and other nations. The last thing we should do is to engage in an academic numbers race with the Russians. We need, instead, to concentrate on those qualitative aims which will keep our science and engineering always ahead. The only sound policy is for the professions of science and engineering in the United States to seek in their own indigenous way to serve the growing needs of our society. This policy and objective, if followed, will require them to set quality and creativeness at the highest achievable level.

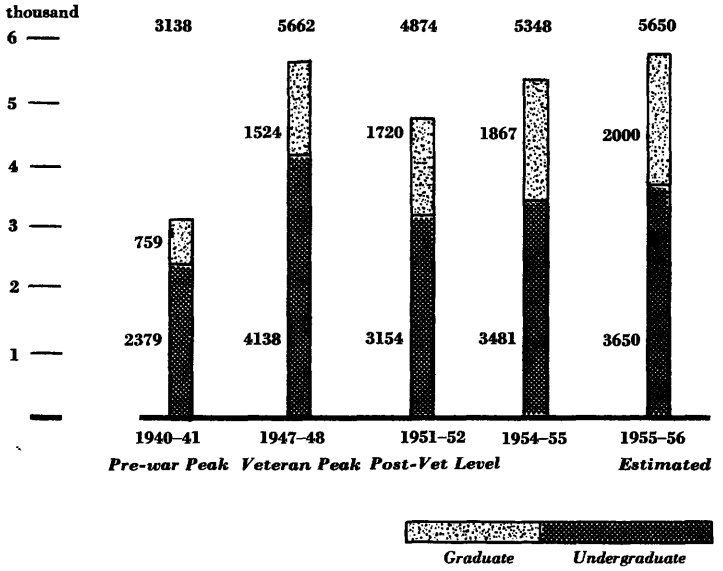
M.I.T.'s response and responsibility.

These general observations on the importance of stressing excellence in dealing with the current shortage of scientists and engineers are a prologue to my discussion of M.I.T.'s specific response and responsibility in the face of these shortages and in the face of the greatly increased numbers of qualified youth who soon will be seeking a college education. It is not enough to reiterate our traditional and established role of stressing excellence. In the last 90 years far-seeing and generous people of the United States have provided the resources to create under private control at M.I.T. the nation's largest foundation for the specific support of an institute of technology; through the achievements of its Corporation, Faculty, students, and alumni this foundation has been built

into an institution of unexcelled quality and of world renown. As a consequence, the current governing bodies of the Institute have a grave trustee responsibility to manage this foundation for the best interest of the nation, to be responsive to the nation's special needs, and to use its position of leadership to promote steady progress in education and in the professional fields it covers. Because of this special position and trusteeship, M.I.T. has special responsibilities, over and beyond its own self-interest, in meeting the problem of numbers.

What has been M.I.T.'s response so far? We have moved in the following six ways to accept our share of responsibility:

First, and most notably, we have already accepted since World War II (and taking the last normal year before the war as a base) an increase in enrollment of 80 per cent. Here is the record:

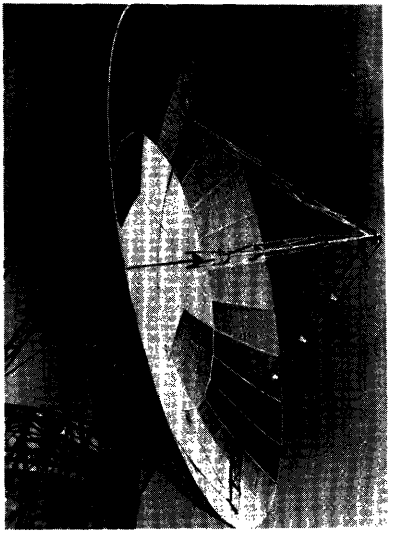


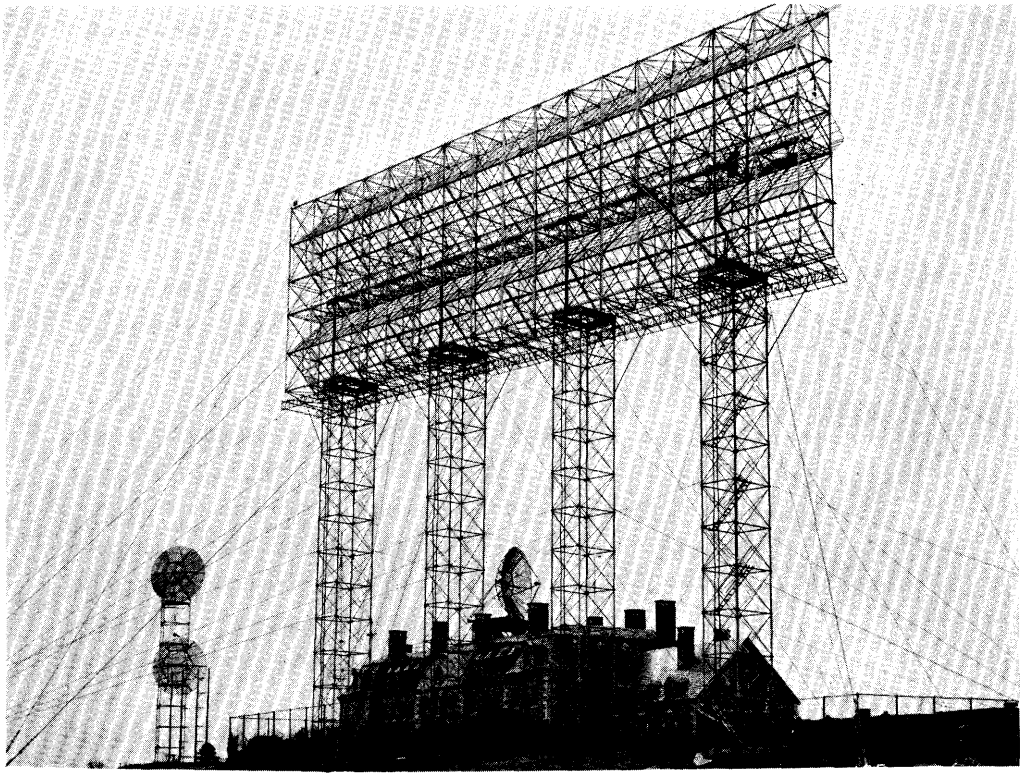
As the Development Committee of the Corporation well knows, the fiscal needs created by an 80 per cent increase in our student body have required strenuous efforts to raise new funds for the necessary buildings and endowment. While we have enlarged our facilities approximately in proportion to the increase in enrollment, we still have an acute shortage of space and numerous specialized building needs, arising out of the greater facility requirements imposed by our more modern and advanced concept of education and by new research responsibilities imposed by current national needs. Expressed in numbers of dollars, we have also increased our endowment in proportion to the increase in enrollment, but we have not at the same time increased it enough to offset the reduced purchasing power of the dollar. Few other private institutions have undertaken within a decade so bold and so large an increase in program: 2,600 additional students, new buildings totaling $18,878,000, and additional permanent funds totaling $28,733,000 book value.

The second way M.I.T. has responded has been to take special measures to reduce its student mortality and thus to minimize human wastage. By better selection in the first place and then by systematic efforts to ease the adjustment of incoming students to college life, we have made progress in reducing mortality, in decreasing frustration and emotional difficulties, and in improving morale. The Faculty who are members of the Freshman Advisory Council have contributed importantly to these objectives. To cite one small but human accomplishment, every freshman out of a class of nearly 1000 had the opportunity to dine with a member of the Faculty before classes started last month, and this adviser had come to know his freshmen well.

The third way M.I.T. has shared in meeting the national need has been by initiating new programs to meet new needs, both in research and in teaching. Since the war we have added a graduate course in nuclear engineering and augmented our program in nuclear science. We have organized a School of Industrial Management, established as a formal entity the School of Humanities and Social Studies, and added the Center for International Studies. To recognize new areas of importance and new technologies and to increase opportunities for both graduate and undergraduate study, we have organized new laboratories and programs such as the Research Laboratory of Electronics; the Combustion, Acoustics, Nuclear Science, Gas Turbine, Servomechanisms, Dynamic Analysis and Control, Instrumentation, Cryogenic, Insulation Research, Hydrodynamics, and Aero-Elastic Laboratories; the Supersonic Wind Tunnel and the Towing Tank. There has been an unremitting effort to open up new educational areas within our jurisdiction and thus to educate men and women competent to meet industry's rapidly changing technological needs.

LINCOLN LABORATORY





LINCOLN LABORATORY

M.I.T.'s Lincoln Laboratory and Research Laboratory of Electronics, working jointly with the Bell Telephone Laboratories, are responsible for two radically new and extremely important methods for radio wave transmission — both depending upon reflection of high-frequency radio waves from the troposphere and ionosphere. The billboard antenna in front of the great house at the Round Hill Field Station transmits high-frequency signals directly to Cedar Rapids, Iowa; the 60-foot dish antenna at Ipswich, Massachusetts, sends signals to Fort Monmouth, New Jersey. By opening a vast number of new communication channels, these transmission methods make a major contribution to the nation's continental defense plans.

The fourth way we have sought to provide new competence and to increase knowledge of advancing science and technology has been our extensive program of adult education. Last year we held 12 conferences for representatives of the industrial companies in our Industrial Liaison Program, and this past summer our Summer Session, with 32 special conferences, advanced courses, and seminars, drew 1,800 from industry, government, and educational institutions. This kind of special adult education is becoming a major part of the Institute's educational mission.

The fifth way M.I.T. has sought to help in meeting our national manpower needs has been its attempt to strengthen and invigorate science teaching in the secondary schools. Jointly with the Harvard Graduate School of Education we have established a five-year program designed to prepare students of science and engineering for teaching in secondary schools. So far the enrollment in this course is very small, but it shows signs of growing. Last month the Executive Committee authorized special scholarships to encourage students to enter this course.

Six years ago we obtained the help of the Westinghouse Educational Foundation in establishing a summer program for secondary school teachers of science. The Foundation offers Fellowships which cover tuition and living costs for the teachers, and M.I.T. and its Faculty contribute the supervision and teaching. The purpose of this program is to increase the knowledge of science teachers about science; it is only incidentally concerned with pedagogy. This past summer the limit on the number of teachers awarded fellowships was increased from 50 to 80, and this higher enrollment is guaranteed for three years.

In addition to this program, we have inaugurated a program of internships for science teachers in our research laboratories; this past summer nine secondary school teachers held appointments as research assistants at the Institute. We hope to increase the number of such appointments, since this program — like the Westinghouse summer course — has met with a most enthusiastic response.

The sixth way we have moved to assure national leadership has been in the direction of augmenting our capital resources and increasing our current income. Last spring the Corporation voted to raise the tuition at M.I.T. from $900 to $1100 per academic year, effective with the opening of the Summer Session in 1956. This decision was reached reluctantly but with a deep conviction, first, that it was an essential move to assure M.I.T.'s strength and its capacity to accept new responsibilities and, second, that it was also in accord with a growing national attitude that the privately controlled institutions must meet their financial problems squarely and creatively.

The private institutions must not deny themselves the remedies available to other organizations in our society in a period of rising costs and high taxes. They must reject and replace the sorry subsidy of balancing their budgets by underpaying their faculties. They must aggressively seek increased gifts and grants from a greater number of sources and at the same time improve their budgets by removing the deadwood from their curricula and the dead hand of archaic methods from their management. These are the conditions of survival and the requirements of leadership. To meet them, the private colleges must revise obsolete financial policies. They must ask parents, who are able, to pay a higher portion of the costs of their young people's education and they must at the

same time increase institutional assistance for students who need help.

They must move in the direction of asking those who can to pay and those who can't to be generously helped. Too many young people of ample means are being subsidized in college, while too many of limited means are being inadequately helped. This condition arises for two reasons: first, a tuition policy that does not adequately take into consideration the ability to pay and, second, a scholarship policy that gives aid to those who do not need it.

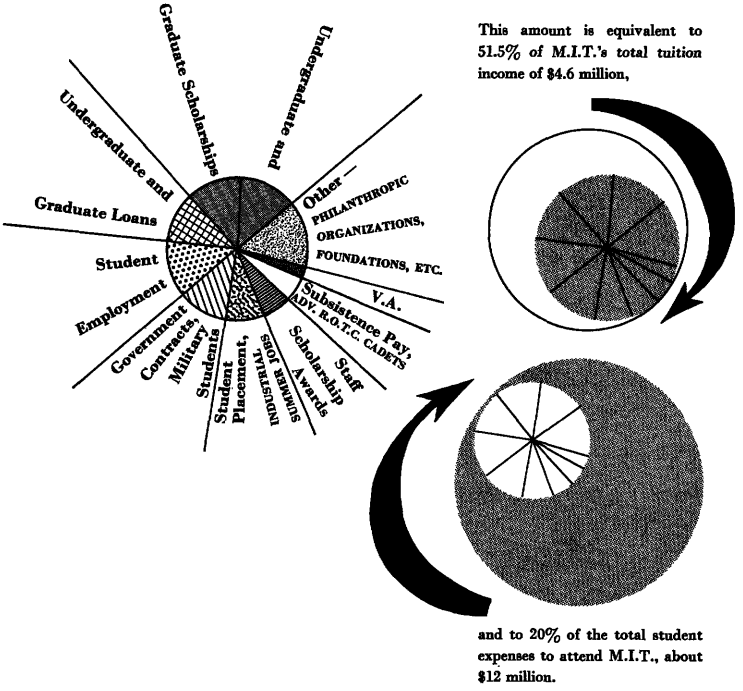
The misuse of scholarship funds — for recruiting young men and women of talent without due regard to their needs for financial aid — remains a powerful factor in continuing to promote confusion in the minds of the public as to the true purpose of scholarship assistance and the high purposes of education. It is encouraging that this year almost 100 colleges and universities have joined in a common program aimed at a solution of this problem. Prizes and other forms of recognition for intellectual achievement are important, but under present conditions scholarships must be limited to those able students who need financial aid to go to college. These views in regard to the financial policies of private colleges have motivated M.I.T. to increase both tuition and scholarships beginning in 1956.

When the new tuition goes into effect, we expect to extend scholarship aid to more students at M.I.T. and to increase the average award per student as well. While further gifts are urgently needed to provide scholarships, it is indeed encouraging to have the increase in scholarships at the Institute coming from industry and from personal gifts and bequests. These scholarship funds, augmented by additions from unrestricted funds, will make available an increase of

better than 50 per cent in the funds for undergraduate scholarships — in contrast to the 22 per cent increase in tuition.

Financial Aid for M.I.T. Students

Aid from these many sources totals $2.35 million.



Along with an increase in tuition and student aid, we seek an increase in gifts and grants. Under the direction of Alfred P. Sloan, Jr., and Marshall B. Dalton, we have a large campaign for the Karl Taylor Compton Laboratories under way. In addition, we are moving to extend the annual giving concept of the Alumni Fund to other groups. We are maintaining at a very gratifying level the Industrial Liaison Program of corporation grants. We are conducting a bequest program. In every possible way, we are seeking to broaden the base of the Institute's support. Last year, for example, our gifts and grants came from 31 foundations, 170 companies, and 12,000 individuals and other givers. Thus we average over a thousand gifts a month, small as the average gift may be. From this great variety of sources, M.I.T. received during the last fiscal year $6,650,000 — $2,000,000 more than was received the year before.

This total we announce with gratitude and gladness, but our report would not be complete without a footnote to remind us that the dollar "ain't what she used to be." What was $1,000,000 twenty or even ten years ago represents in purchasing power only about $500,000 today.

In addition to these six principal efforts, we have moved in other ways to help in meeting the needs of the country for increased numbers and better quality in science and engineering. We have increased scholarship assistance available to entering students. The Admissions Office has greatly increased the number of secondary schools visited, with 40 members of the Faculty volunteering to make visits. Members of the administration and Faculty have been campaigning widely to make the facts and the needs known about the shortage and to seek out and encourage high quality youth. Not unrelated to this effort has been the work undertaken by

the Center for International Studies with a grant from the Carnegie Corporation to study the quality of Soviet scientific and engineering education.

Further responsibilities and responses.

Having already accepted a large increase in enrollment and undertaken the new activities which I have described, what other responsibilities does M.I.T. face in helping to meet the current and impending pressure for numbers? To help the governing bodies of the Institute answer this question wisely, I have appointed a strong committee of the Faculty Council, under the chairmanship of Professor Gordon S. Brown, to study factors affecting our enrollment policy. Without attempting to anticipate the conclusions of this committee, I wish to point out some of the contradictions inherent in the enrollment problem.

First, there are a number of fields in which enrollment nationally and at M.I.T. is far lower than placement opportunities warrant and in which we have the facilities and staff to handle a larger enrollment if more students elected to study in these fields. These fields include geology, chemistry, meteorology, aeronautical engineering, city planning, biology, food technology, and civil engineering. There are other fields, such as mathematics, in which the nation needs more graduates and in which we would relish more enrollment even though increased numbers of students would require more staff and space.

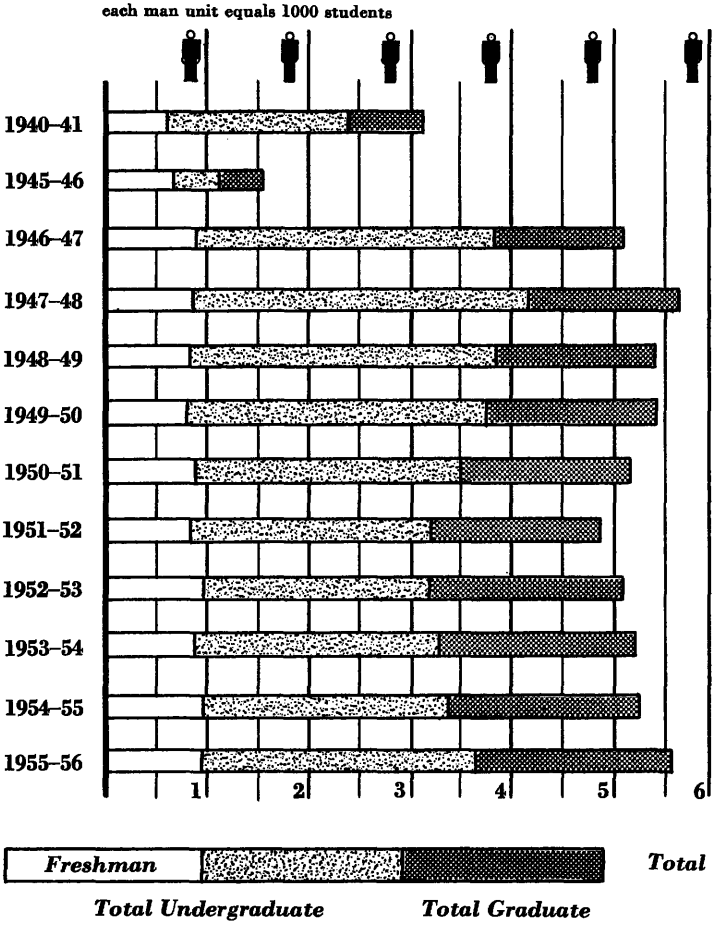
In contrast to these fields, we have courses, such as electrical engineering and physics, which attract a number of students embarrassingly large as measured by the demands on our staff and facilities (but not large measured by demand for graduates). For example, about one-quarter of the members

of this year's sophomore class have indicated a wish to elect electrical engineering. If we could avoid this over-concentration in a few courses and achieve a better distribution among the 21 courses of study at the Institute, we could accept some increases in enrollment without requiring new staff and capital and with advantage all-round. One of the questions before the Brown Committee is whether the Institute should again impose a quota system on our courses of study in order to prevent unequal distribution of students. It is a harsh procedure to admit students to the Institute and subsequently deny them admission to the course of their choice.

A second policy question arises out of the bottleneck encountered in the first two years of our undergraduate program. We are limited by the capacity of our class and lecture rooms and of our physics and chemistry laboratories. Increased enrollment in the first two years must be accompanied either by expansion of classroom and laboratory facilities or by lower standards of education. Can we, perhaps, encourage more college transfers into the upper two years, and thus accept an increase where, in general, we have space and staff to care for them?

A third consideration is that we must — with the exceptions noted — accompany an enrollment increase with a proportional increase in endowment and in plant. And competition for new funds will inevitably develop between the capital costs required for increased numbers of students and the capital urgently needed to increase faculty salaries and to finance the other expenditures we need to make in order to improve the attractiveness of our environment for both students and staff. Here, sharply juxtaposed, are conflicting demands of quantity and quality.

The Growth of Enrollment at M.I.T.



A fourth consideration has to do with the question, "What is the optimum size for M.I.T.?" There are no easy, objective answers to this question, but many of us feel that any further large increase will require drastic reorganization of the Institute and could become incompatible with the excellence which is and must be our hallmark.

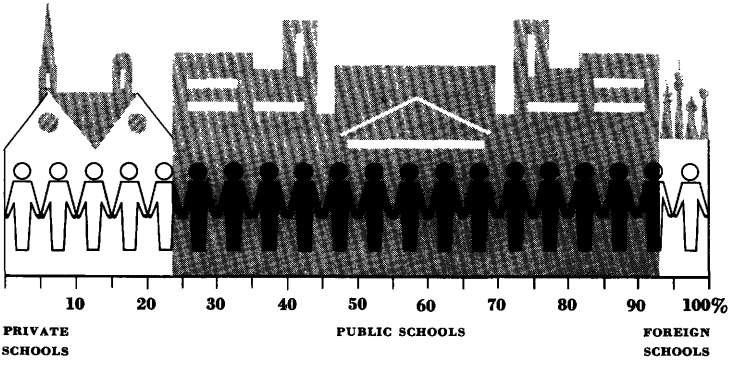
Other factors affecting our enrollment policy have to do with the relative size of the graduate and undergraduate schools. Again our enrollment is exceeding the capacity of our student residences, and we have severe limitations of land area for additional dormitories, academic buildings, and playing fields.

The opportunity for a new level of excellence.

Whatever may be our response to pressures for increasing enrollment, it is of overriding importance for us to realize that the first order of business is the maintenance — and more, the further elevation — of the quality of our educational and research programs.

This is our first responsibility in helping to meet the shortages of quality in science and engineering. In my judgment we have a special opportunity and responsibility at this juncture to exert our leadership by pushing on to a higher plateau of excellence and by persisting in the constant educational "retooling" required by the rapid advance of science and engineering.

Educational Backgrounds at M.I.T.



Three-fourths of the 1954 Freshmen prepared in public schools.

To urge increased excellence at this time may seem like supererogation — like urging the minstrel to black himself all over. We now have a superb Faculty — the strongest group, taken in the aggregate, assembled in any institute of technology. We have a superb student body, and our new freshman class is probably the most highly selected we have ever admitted. There is ample evidence of the excellence of our students. Nearly 10 per cent of all National Science Foundation Fellowship recipients have elected to study at M.I.T. Over 10 per cent of the General Motors National Scholarship recipients elected to enter here, and of the 800 men in the semifinals of that competition about 200 had applied for admission to M.I.T. Last year, of the 32 Rhodes Scholarships awarded in the United States one was to a student at M.I.T., and since the war we have averaged better than one Rhodes Scholar a year.

In suggesting that we press for higher selectivity and higher standards, I am not, in the face of the above evidence, expressing any dissatisfaction with our present academic community. It is in fact so good that it must be better. The advances in science and engineering achieved by our Faculty constantly impose new requirements on the Faculty to be up to date and yet more advanced in its teaching and research.

I therefore urge that we put at the top of the agenda of the Institute's governing bodies a consideration of how we may achieve another step-function in our upward trend of quality and standards of excellence, and I propose that we consider this the most urgent responsibility we have in discharging our trusteeship responsibilities. Of course we have always given priority to quality, but I suggest that we have a special responsibility now to make sure that we achieve here

in Cambridge a high watermark of American intellectual and cultural life. Specifically, I propose that we continue and augment our efforts to:

1: Maintain those conditions of atmosphere, freedom, and creative opportunity which make our institution a place of superior attraction and environment for first-rate minds. M.I.T. should be known to be, and actually must be, one of the most attractive schools in the world in terms of its success in creating and maintaining an environment benign to fruitful teaching, learning, and research. Such an environment is characterized by many subtle qualities: the standards of excellence which prevail, the interaction and interstimulus of first-rate minds, the emphases on growth, advance, and creativity in the fields embraced, the status of dignity and freedom the members of the community of scholars have and *feel* they have. These are the qualities which Milton once so eloquently described as a spirited, cheerful, searching, innovating "passion for thought" dedicated "to the search and expectation of greatest and exactest things."

2: Maintain those conditions of compensation, recognition, and reward which will best serve the environmental ideals which I have just described. Today our most pressing need is for an increased staff salary scale.

3: Maintain our standards for selection and promotion high enough to insure an unexcelled Faculty. In promotion we should always give priority to our own people, provided they are as competent as anyone who might be found elsewhere. We should check our own standards of selection against the highest in other institutions, and in filling vacancies we should seek the best men available anywhere in the world.

4: Apply comparably high standards to the selection of students. Present selectivity is good, but we still find in the end a "lower third" in each class which is not up to the standards of excellence we are discussing here. The achievement of the selectivity here proposed should take precedence over the admission of larger classes. The fact that we now admit a higher percentage of our students from foreign countries (11 per cent) than any other American college gives us an incomparable opportunity to check our student quality against the cream of the world crop.

To these goals for improved environment and selectivity, I would add a number of innovations and improvements in our organization and curriculum *for study* by the Institute's governing bodies. These include:

1: The encouragement of more autonomy and individuality on the part of each of our five schools, especially at the graduate level. Many of us at the Institute feel that the time has come for cultivating a philosophy indigenous to each school and for recognizing more positively the differing characteristics of our schools within the larger unity of the Institute as a whole. Consideration should be given to informal meetings of the Faculty within schools and to the achievement of natural curriculum interchange and coordination among courses within schools.

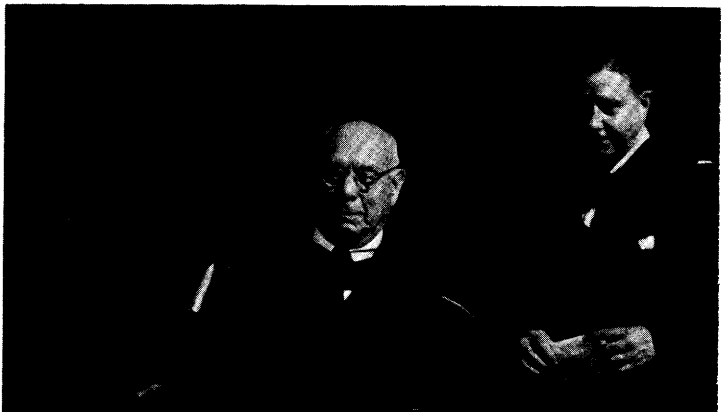
2: Development of better interchange among professors in related fields but residing in different departments or schools. In a few areas, such as electronics, nuclear science, acoustics, and spectroscopy, we have met this problem by interdepartmental laboratories. We have yet-unrealized opportunities to bring teachers and students of related professional interest together in such fields as applied mathematics, automation

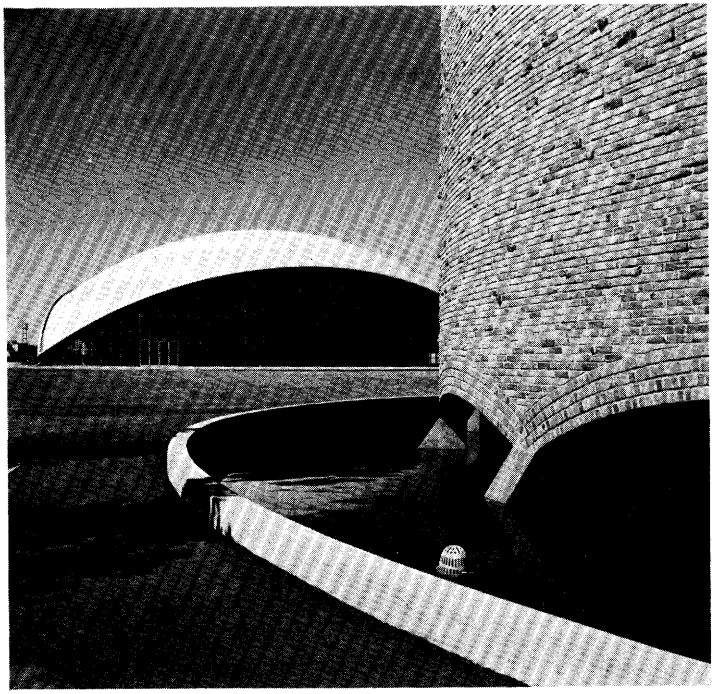
and industrial management, mechanics, materials, and propulsion. Work and people in these fields are now segregated by departments. Can we not preserve the advantages of departmental organization and at the same time gain from mechanisms of integration? There may be other opportunities for interdepartmental groups and laboratories, and we have only begun effectively to use the interdepartmental seminar as a means of bringing scattered people together in areas of mutual interest.

Back of all of this discussion of excellence and of ways to improve our selectivity, our environment, and our program lies the assurance of an institution which has the poise and the self-confidence to look at itself critically and objectively. We can examine our needs and our requirements for augmented strength with a deep sense of self-confidence arising out of the knowledge that the Institute is in a flourishing state, that it has unexcelled standards, that its schools are strong and growing stronger, and that it has a team of Corporation, Faculty, staff, students, and administration working together with great effectiveness and understanding. Herein lies the opportunity and the responsibility to seek the new standards I advocate. In so seeking lies our best response to the manpower needs of our country today in science and engineering.

With informal remarks of uncommon sense, Sebastian S. Kresge, founder of the Kresge Foundation, himself provided the climax of ceremonies on May 8, 1955, dedicating the Kresge Auditorium. President Killian accepted the new building.

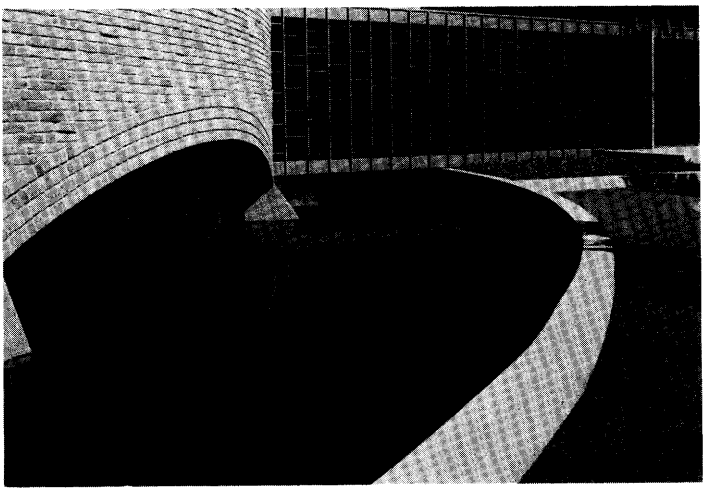
PHILIP LIEBERMAN '56

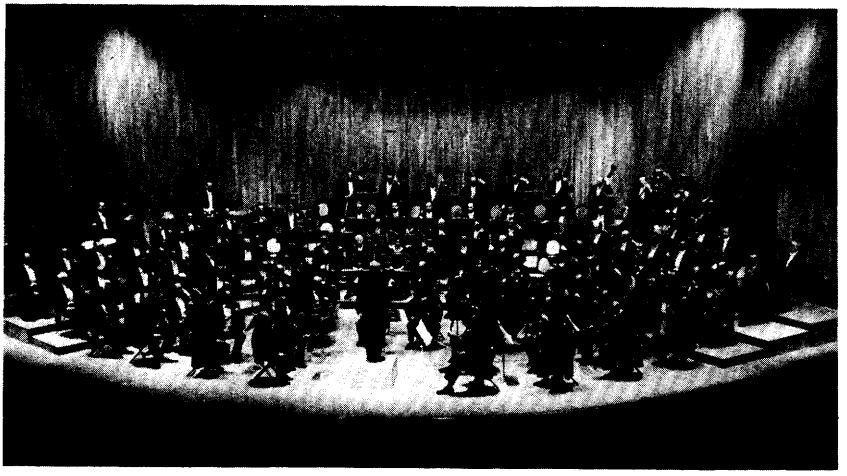




"...fitting adornment of the campus of an institution devoted to advancing the boundaries of knowledge, creative, pioneering, respectful of acquisition, avid of improvement."

— the Honorable E. N. Van Kleffens, Netherlands Ambassador and Minister of State, at the dedication of the Kresge Auditorium and the M.I.T. Chapel.



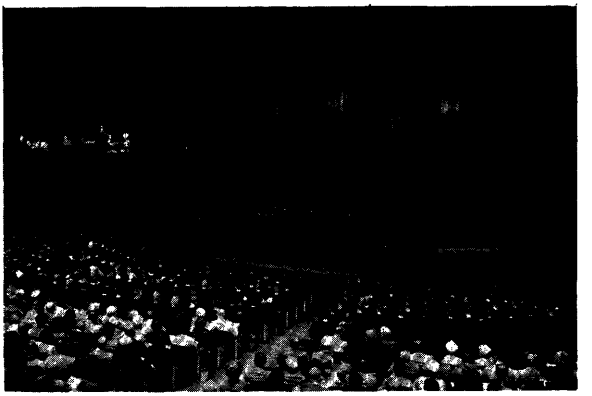


1956 TECHNIQUE

"The orchestral sound kept the listener in a constant state of wonderment. He entered into a world of sound in much the same way he would step into a world of crystal."

Harold Rogers, reviewing for the CHRISTIAN SCIENCE MONITOR the Boston Symphony Orchestra's televised concert in the Kresge Auditorium on October 3, 1955.

1956 TECHNIQUE



The Class of 1955 Baccalaureate in the main auditorium.

"The Kresge Auditorium . . . will call forth such a yearly program of drama, music, speaking (and television) as M.I.T. has never participated in before. Every university in the country ought to possess these facilities and few do."

— Edward Weeks, Editor of THE ATLANTIC MONTHLY, in ARCHITECTURAL RECORD for July, 1955.

PHILIP LIEBERMAN '56

"The King and the Duke," by the Dramashop, in the Little Theater.

A rehearsal of the Concert Band on the main stage.

PHILIP LIEBERMAN '56

PHILIP LIEBERMAN '56

"Canticle of Freedom" by the Choral Society and Symphony Orchestra.

The first christening in the M.I.T. Chapel.

2. THE YEAR IN REVIEW

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

1: The Faculty and Corporation authorized the new degree of Doctor of Science in Nuclear Engineering, in recognition of the rapid growth of educational and research programs in this field; upon recommendation of its Corporation Visiting Committee, the Department of Meteorology is planning to discontinue the undergraduate course (but not the graduate course) in meteorology; upon recommendation of its Visiting Committee, the Department of Civil Engineering has moved to consolidate the undergraduate curriculum in building engineering and construction with that in civil engineering.

2: With the opening of the Institute this fall, the new School of Industrial Management has come up to "critical size," with about 15 new staff members joining its teaching and research ranks. For the first time, the new School is now in a position to exert its full influence and to achieve the goals set forth by Alfred P. Sloan, Jr., the founder of the School.

3: Course XXI, which was still under study when I gave my last report, has now been approved by the governing bodies of the Institute and starts this fall. It provides at the undergraduate level an entirely new opportunity for liberal education in a technological environment.

4: Methods used to strengthen basic physics instruction at the Institute, especially a new approach to laboratory teaching, have been creating nation-wide interest. Similarly, the Chemistry Department is embarked on a program involving important advances in its elementary instruction.

5: The School of Architecture is giving increased emphasis to research in its educational program, and during the year research investigations were under way in the fields of lighting, solar energy for house heating, plastics, zoning regulations as they affect the cost of residential building, the perceptual form of cities, and community costs and revenues involved in new industrial developments.

6: There are a number of unanswered questions in relation to our various housing facilities at the Institute. Some of these are: Does the Institute have a continuing responsibility to provide permanent housing for married students, and, if so, what should be its character and location? Should the East Campus, including Walker Memorial, be architecturally developed so that a more adequate Graduate Center can be provided? Or should the East Campus be developed into a Freshman Center? In what ways can our existing undergraduate dormitories be augmented to fulfill more adequately our educational objectives in the housing system? Is there need for additional undergraduate dormitory space? If so, what should be its nature and location? These and other questions are presently under study by a committee representing the Corporation, alumni, Faculty and students, of which our fellow member, Edwin D. Ryer, is chairman. We all look forward to receiving the report and recommendations of this group during the current year.

Enrollment.

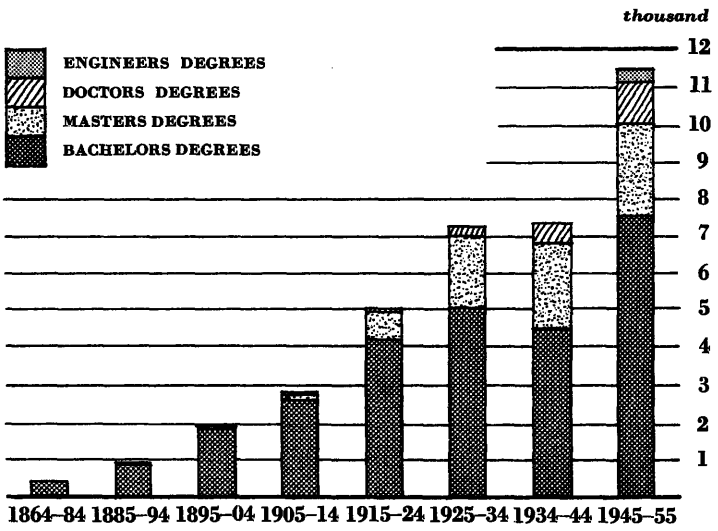
In 1954–55, the student body numbered 5,348 as compared with 5,183 in 1953–54. The estimated enrollment for 1955–56 is 5,650. About 6 per cent of the total enrollment in both 1954–55 and 1953–54 were veterans. In 1954–55, 18 per cent were married, as compared with 20 per cent in

1953–54. One hundred eight women were enrolled, 38 of whom were graduate students. Foreign students numbered over 600, or 11.2 per cent of the student body, and they represented 72 foreign countries.

Enrollment in the graduate school was 1,868, as compared with a record 1,955 the previous year. There were 189 officers from the Armed Services enrolled for advanced degrees, the same number as the year before.

Students enrolled at M.I.T. during 1954–55 held degrees from 409 other colleges and universities, 246 American and 163 foreign.

Degrees Awarded since M.I.T.'s Founding



Response to the growing demand for technological skills.

The number of veterans enrolled under Public Laws 16 and 346 has continued to decline sharply, and those receiving benefits amounted to fewer than 100 students, 50 per cent less than in 1953–54. Conversely, the number of ex-servicemen with benefits under the "Korean G.I. Bill," Public Law 530, approximately doubled over the previous year, reaching a total of 259.

During the 1955 Summer Session, 31 different Special Summer Programs were offered by 16 departments, with 1,791 students in attendance. During the summers of 1950 to 1955 we have given a total of 140 programs, representing 74 distinct topics. In 1955 the Science Teachers Program was broadened to include secondary school teachers of biology as well as chemistry and physics, and increased by 30 to reach 80 science teachers a year.

Student aid.

Scholarship grants totalled $292,628 to 599 undergraduate students in 1954–55, almost exactly the same number and amount as the year before. Total graduate scholarships and fellowships for 1954–55 amounted to $299,902, granted to 233 recipients. This compares with $391,940 granted to 250 students in 1953–54. A total of 129 fellowships were sponsored by industrial companies, an increase of 15 over 1953–54. Staff tuition amounting to $141,929 was paid from departmental funds in behalf of 370 other graduate students holding part-time teaching appointments.

A total of 352 undergraduate students received $245,513 from the Technology Loan Fund in 1954–55; 35 were lent $21,350 from the George J. Mead Loan Fund; and 3 received small loans from other funds, bringing the undergraduate totals to 390 students and $267,798. Five hundred

sixty-five applications, from both graduate and undergraduate students, were presented to the Technology Loan Fund Board in 1954–55, and 510, or 90.2 per cent, were acted upon favorably for a total of $319,386. In 1953–54, 531 out of 596, or 89.1 per cent of the applicants, received loans amounting to $326,312. The grant totals for 1954–55, for both graduate and undergraduate loans from all loan funds, are 550 loan grants adding to $342,571.

The Student Personnel Office placed 1,211 students in jobs during the academic year and enabled them to earn $294,300. In 1953–54, 1,174 students earned about $225,000.

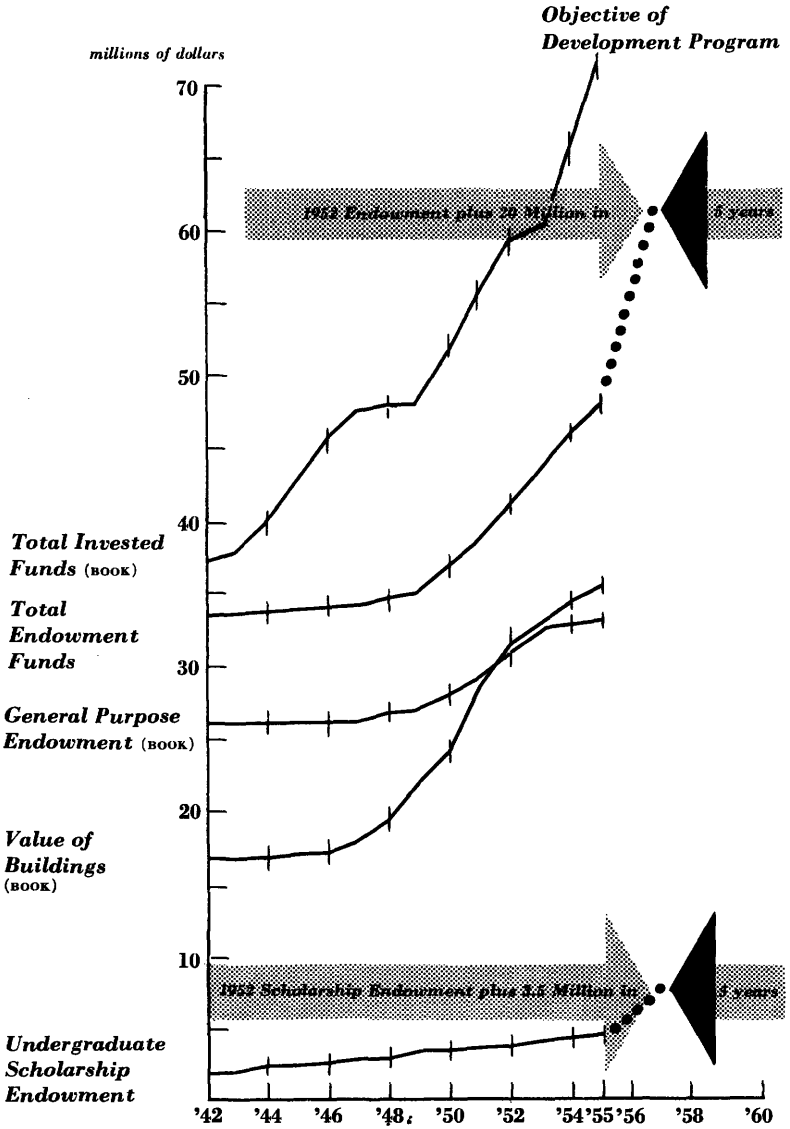
Finances.

During 1954–55 our academic budget amounted to $14,813,000 as compared with $13,693,000 in the fiscal year 1953–54. These figures for the academic budget do not include the funds expended on sponsored research projects in the Division of Defense Laboratories and the Division of Industrial Cooperation.

The Institute's endowment and other invested funds now have a total book value of $71,831,000, an increase over last year of $6,358,000, and are invested in securities with a market value of $108,820,000, greater than 1953–54 by $23,172,000. Plant assets stand at $36,086,000, about $1,669,000 above last year.

The total market value of all M.I.T.'s funds (including those of the Pension Association) was $116,929,000 as of August 30. Comparison of this figure with the equivalent totals of other institutions shows the Institute's to be the fifth highest in the country, being exceeded only by the totals of Harvard University, Yale University, the University of Chicago, and Columbia University.

The Growth of Endowment and Plant Value



To realize its new opportunities, M.I.T. must have increasing endowment resources.

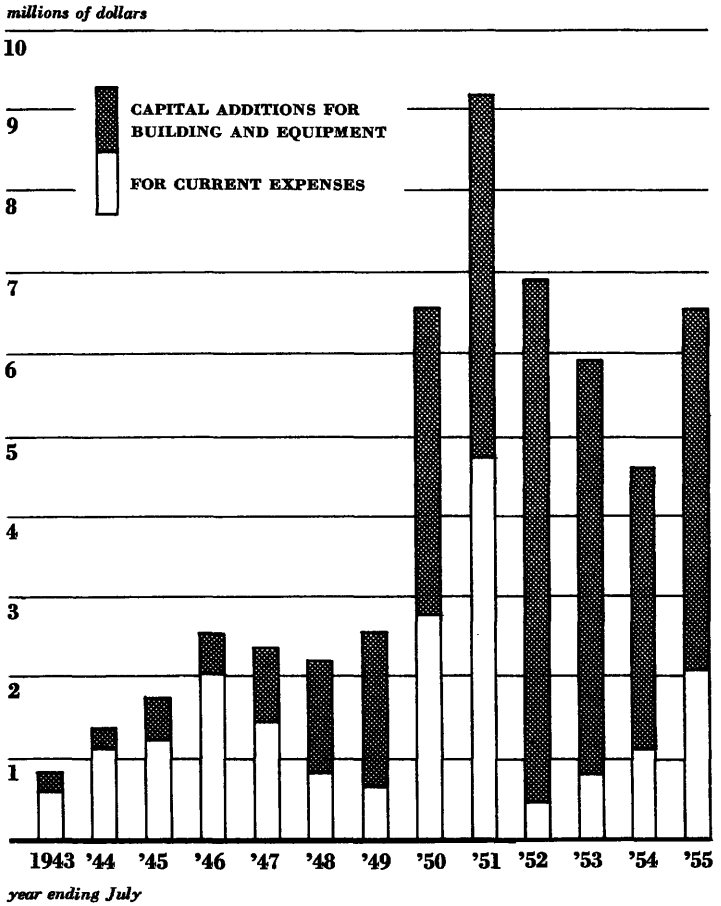
The rate of income earned in 1954–55 on the funds sharing in the general investments was 5.69 per cent of the book value of the funds, compared with 5.15 per cent last year. Of this, 4.5 per cent was allocated to the funds, compared with 4 per cent in each of the previous seven years. Unallocated investment income in the amount of $652,852 was added to the value of undistributed investment income, bringing this reserve up to $3,042,826, of which $500,000 is designated for allocation in 1955–56.

Gifts.

The total value of gifts to the Institute during 1954–55 reached $6,649,000. It is of particular interest to note that in the last few years the School of Humanities and Social Studies has received generous support from several donors: $300,000 from the Rockefeller Foundation for the development of the new course in Humanities and Science; $150,000 from the Carnegie Corporation for general work in the humanities; $150,000 from the Carnegie Foundation in support of research on the relationship between American society and this country's new position in world affairs; $30,000 from the Rockefeller Foundation for an experiment in teaching the core curriculum to selected students in French; and nearly $2,000,000 from the Ford Foundation for research work in the Center for International Studies.

The Alumni Fund, an increasingly important factor in Institute financing, exceeded all previous records this year when 11,176 alumni gave more than $500,000 toward the Karl Taylor Compton Laboratories. Together with the doubling of an anonymous benefactor and an appropriation by the Fund Board from accumulated funds, the Alumni Fund this year was responsible for a total of almost one and a quarter million dollars, a truly splendid accomplishment.

The Growing Gifts to Fund M.I.T.'s Independence



1953–55
figures include maturing pledges to the Development Campaign

Buildings and campus.

With over five million dollars pledged or given toward an objective of seven million dollars, the Executive Committee this summer authorized the start of construction on the physi-

cal sciences building. A fitting memorial to Karl Compton, this new great facility is scheduled for completion in the Fall of 1956.

We plan further to begin construction on the nuclear reactor sometime during the next academic year. This reactor will be a cool, domesticated type for campus use. We have investigated the types of reactors whose performance has been demonstrated in laboratories of the Atomic Energy Commission, and we have decided that one generally similar to the CP-5 reactor of the Argonne National Laboratory best satisfies our requirements with respect to safety, usefulness, and cost. The preliminary plans have been reviewed by the A.E.C.'s Advisory Committee on Reactor Safeguards, which has agreed that our proposal to build a reactor of this type and power level for campus use is reasonable.

At memorable dedication exercises on May 8, 1955, the Kresge Auditorium and the M.I.T. Chapel came into formal use at the Institute. There is already clear evidence of the great contribution to our over-all program which will be made by these two long-needed additions to our campus.

During the year Rockwood, the residence of the late H. Wendell Endicott of Dedham, Massachusetts, was presented to the Institute by the executors of Mr. Endicott's estate. The property consists of a large house containing about 50 rooms, about 18 acres of flower gardens and arboretum, swimming pool, and attendant buildings. Isolated as it is in spacious grounds, the estate offers excellent facilities for conferences, meetings, and other group activities which are a normal part of the Institute's educational program.

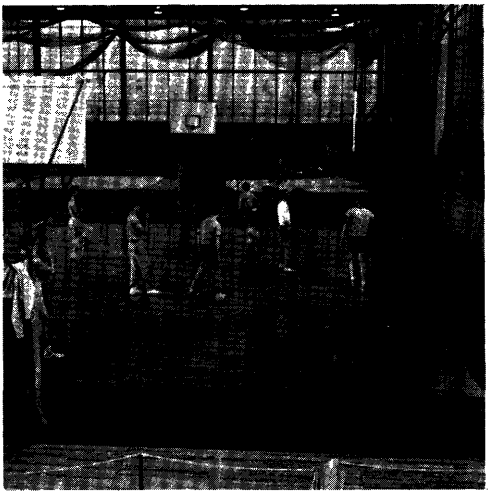
Several new athletic and recreational facilities were added to our plant this year. A portable gymnasium floor was installed in the John Rockwell Athletic Cage, which now

provides an intercollegiate basketball court, two intramural courts, a wrestling area, and a gymnastic space. Associated with this was the purchase of new portable bleachers, with a seating capacity of about 600, and a new portable board track. Construction was completed on an outdoor skating rink which takes advantage of the refrigeration equipment in the air-conditioning system of the auditorium. These new additions represent the most significant growth in our athletic and recreational facilities since the construction of Rockwell Cage in 1948.

During the summer extensive alterations were completed in the Walker Memorial building. These badly needed renovations, particularly in Morss Hall and the dining service area, should do much to improve the general setting for undergraduate dining and extracurricular activities.

Endicott House, the stately residence of the late H. Wendell Endicott in Dedham, Massachusetts, is now a magnificent center for conferences, seminars, and social activities of the Institute and of associated groups.

An outdoor skating rink and portable basketball floor are major additions to the Institute's athletic facilities — and to its students' recreational opportunities.



The M.I.T. community.

A distinguished and important group of long-term visitors have been at M.I.T. during the past year — in many cases on assignments made possible by special funds established at the Institute for this purpose. This contribution of new perspectives to our educational program is of the greatest value; indeed, many of our distinguished guests come to have very special influence with our Faculty and students.

Funds established by the Edwin Sibley Webster Foundation have been used in this way, and this year Dr. Robert A. Ramey, Jr., of the Westinghouse Electric Corporation has been Webster Visiting Professor of Electrical Engineering. Similarly, Sir Alexander Todd of Cambridge University, England, has held the Arthur D. Little Visiting Professorship in Chemistry. Bemis Professorship funds were used to bring a number of distinguished lecturers to the School of Architecture and Planning, including Eero Saarinen of Detroit, Jedd Stow Reisner of New York, and John Johansen of New Canaan, Connecticut. Other lecturers in architecture were Thomas H. Creighton, editor of *Progressive Architecture*; Felix Candela, architect and engineer of Mexico City; and Edwardo Catalano of the School of Design at North Carolina State College.

Among the activities of the School of Industrial Management made possible by the grants of the Alfred P. Sloan Foundation is a year-long series of seminars with distinguished business leaders, who come to the Institute especially to make this important contribution.

Ernst Levy, well-known pianist and composer, spent last year in the Department of Humanities on funds provided by the Carnegie Corporation; our students benefited doubly from his presence, since Professor Levy occupied the master's

suite on the East Campus. I am happy to report that he will return to both assignments this year.

Ernst Levy conducts a music seminar in the East Campus master's suite.

Public events of the year brought to us many other distinguished visitors: the Honorable Dr. E. N. Van Kleffens, Minister of State and Ambassador of the Netherlands, who spoke at the dedication of the Kresge Auditorium; Sir Roger Makins, British Ambassador to United States, who was Commencement speaker; Dr. Charles A. Thomas, president of the Monsanto Chemical Company, the Arthur D. Little Lecturer; and Dr. Frederick May Eliot, president of the American Unitarian Association, who spoke at the student-organized Discrimination Conference and again at the Baccalaureate. Dr. Wendell M. Stanley, professor of biochemistry at the University of California and Nobel Laureate, delivered the annual Sigma Xi address; Professor Harry N. Holmes of Oberlin College spoke after receiving the James Flack Norris Award from the Northeastern Section of the American Chemical Society; and Professor Lionel Trilling of Columbia University spoke at a meeting sponsored jointly with the American Academy of Arts and Sciences.

The School of Humanities series included lectures by Sir Alexander Grantham, governor of Hong Kong; Edward Barrett, formerly Assistant Secretary of State; and Professor Arnold J. Toynbee of the University of London; and a recital by the New York String Trio. Aaron Copland, distinguished contemporary composer, worked with the M.I.T. Choral Society and Symphony Orchestra in rehearsals for the first performance of his stirring "Canticle of Freedom" at the Kresge Auditorium dedication; music seminars, in addition, heard Walter Piston, Klaus Roys, and other prominent composers and artists. In connection with exhibitions of their works in the Gallery of the Hayden Library, Josef Albers, painter, and Jacques Lipchitz, sculptor, presented lectures in the new auditorium. Harry Bertoia, distinguished contemporary designer, was on the campus on several occasions to supervise the installation of the altar screen which he designed for the M.I.T. Chapel.

The student Lecture Series Committee, a venture entirely independent of any Faculty or administration responsibility, presented a varied program of special events, including lectures by Dr. Dimitri Rebikoff, vice president of the French Marine Institute; the Honorable Kasim Gulek, Turkish statesman and diplomat; Dr. Henri Brugmans, rector of the College of Europe, Brussels; and Rear Admiral Donald B. MacMillan, veteran arctic explorer. There was a concert by Emil Beyer, pianist, and a session entitled "Jazz in Huntington Hall."

To all of these cultural and technical resources were added weekly seminars and colloquia in most of the departments. No complete roster of these events is possible, but this very abbreviated list of guest speakers suggests the nature of the experiences opened in this way to our Faculty and students: R. H. Rice, vice-president and chief engineer at North Ameri-

can Aviation, Inc.; Sir Eric K. Rideal, professor of chemistry at Kings College, University of London; Professor Ilya Prigogine of the Free University of Brussels; Father Daniel Linehan of the Weston Observatory; Major General Albert Boyd, commanding officer of the Wright Air Development Center; Dr. Arnold Johnson, president of the National Dairy Research Laboratories, Inc.; Dr. R. E. Larson, head of the Department of Horticulture at the Pennsylvania State University; Captain J. Laurence Pritchard of the Royal Aeronautical Society, London; and Dr. Klaus Oswatitsch of the Royal Institute of Technology in Stockholm.

The Institute was host during the year to meetings of the Association of Teachers of Mathematics in New England, the New England Section of the American Society for Engineering Education, the New England States Institute of the Junior Chamber of Commerce, the Association of American Collegiate Registrars and Admissions Officers, and the International Conference on Combustion sponsored jointly with the American Society of Mechanical Engineers.

During 1954–55, nearly 900 professional visitors were welcomed to M.I.T. by the Registry of Guests. Of these, 24 were official "Guests of the Institute," to whom staff facilities were made available without charge and without academic credit.

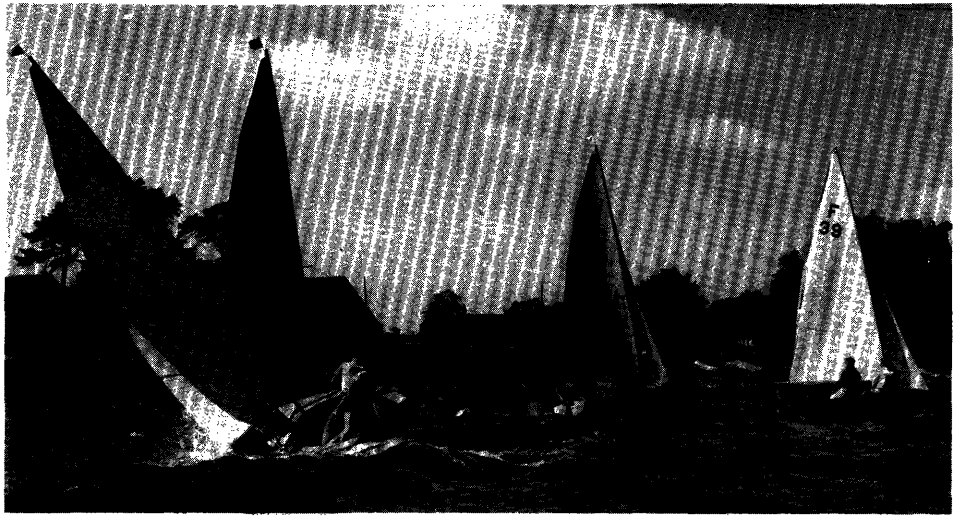
In May, 1955, an educational television station, WGBH-TV, began broadcasting to the Boston Area. The Institute has joined with several neighboring educational and cultural organizations in sponsoring the operation of the station for a trial period. Professor John E. Arnold has handled the Institute's share of the programming in a highly capable manner and has helped prepare a number of interesting pro-

grams. During this experiment with educational television, the station has rented office space on Institute land.

The size of the total M.I.T. community — including Faculty, students, and other personnel — was near or slightly above the all-time record of 11,500.

After M.I.T.'s 1955 Sailing Team won the Morss (national) and Lipton (international) Trophies, three of its members were named to the six-man Combined North American Universities Sailing Team which spent the summer in international races in the British Isles. Here are three boats of the North American team leading in one race of a series at the Barnt Green Sailing Club, near Birmingham, England.

CATERS NEWS AGENCY FROM YACHTING MAGAZINE



Faculty, administration, and Corporation.

Professor Patrick Hurley completed a two-year term as chairman of the Undergraduate Policy Committee. This committee was set up in 1950 as the result of a recommendation of the Committee on Educational Survey. In its function of initiating and reviewing policies of undergraduate education, it has become one of the Faculty's most influential committees. Professor Hurley has served with distinction and unusual vigor as chairman of this important committee. He is succeeded by Professor Antoine Gaudin.

Important changes in our administrative organization included the appointment of Francis E. Wylie as director of public relations. Mr. Wylie has had a distinguished career with Time, Inc., and is ideally qualified to aid the Institute in carrying out its increasing responsibilities of reporting and interpreting our activities to the public.

Dr. James Faulkner has become the Institute's new medical director. He has an ideal professional background to direct the health program for the Institute community, having served most recently as dean of the School of Medicine of Boston University. I wish to express appreciation to Dr. James H. Means for having served as acting medical director during the past year pending the arrival of Dr. Faulkner.

During the year Professor Albert G. Hill asked to be relieved as director of the Lincoln Laboratory in order that he could return to teaching and research in the Department of Physics. During his three years as administrative head of the Lincoln Laboratory, Professor Hill directed its activities with exceptional skill; he is personally responsible for much of the important work accomplished by the Laboratory in the

interests of an air defense system for the continent of North America. We were fortunate in obtaining as Dr. Hill's successor Dr. Marshall Holloway, who had been serving as a division leader on the staff of the Los Alamos Laboratory. Dr. Holloway is a physicist and has done important work in connection with atomic weapons development.

Other major administrative changes during the year included the appointment of Nathaniel McL. Sage as director of the Office of Sponsored Research; F. Leroy Foster as director of the Division of Industrial Cooperation; Henry W. Fitzpatrick as director of the Division of Defense Laboratories; Thomas J. Crane as manager of the Research Fiscal Office; and Robert M. Briber as administrative assistant to the president.

Two appointments in the School of Industrial Management require special mention: Professor Eli Shapiro was appointed associate dean and is sharing very effectively the administrative direction of this School with Dean E. P. Brooks; Houlder Hudgins, widely experienced in industry in the fields of marketing and distribution, came in September, 1955, as professor of industrial management.

The students and faculty lost an exceptionally loyal and devoted friend in the death on January 12, 1955, of Ivan J. Geiger, director of athletics. Professor Geiger was the Institute's first director of athletics and was extraordinarily successful in dealing with young people and in developing our athletic program. As a successor to Professor Geiger we are fortunate in the appointment of Richard L. Balch, who has most recently been serving as chief counselor for men at Stanford University.

I must record the deaths of three members of the Faculty: Walter M. Fife, a greatly loved teacher and associate

professor in the Department of Civil and Sanitary Engineering; Irvin S. Cohen, assistant professor of mathematics; and Walter W. Robertson, assistant professor of naval architecture and marine engineering.

With deep sorrow I must also record the deaths during 1954–55 of four members of the Corporation: John R. Macomber, who for 29 years faithfully and effectively served the Institute on the Corporation and who at the time of his death was a life member, a member of the Executive Committee, and chairman of the Finance Committee; George A. Sloan, devoted friend of the Institute; J. Willard Hayden; and Franklin W. Hobbs, an emeritus life member. Expiring alumni and term memberships lost us the association of John M. Hancock and Pierre F. Lavedan, but Charles A. Thomas and Robert C. Sprague were elected to life membership. Robert A. Lovett, partner in Brown Brothers, Harriman and Company, joined our ranks as a special term member. And Hugh S. Ferguson, president of Dewey and Almy Chemical Company; Fred C. Koch, president of the Wood River Oil and Refining Company; and Max L. Waterman, vice president and director of the Singer Manufacturing Company, became alumni term members.

Three professors have reached the Institute's mandatory retirement age; all serve as lecturers in their respective departments this year. They are Professor Erwin H. Schell, who for 24 years served effectively and devotedly as head of the Department of Business and Engineering Administration; Professor Ralph C. Young of the Department of Chemistry; and Professor George A. Znamensky of the Department of Modern Languages. We shall miss the friendly association of these colleagues in the years ahead.

In conclusion.

In reporting on a year that has been marked by many developments and trends augmenting the usefulness of M.I.T. and indicating its growing importance and leadership in the nation, I want to conclude by emphasizing the contributions which the members of the Corporation and of the Faculty, together with my administrative associates, are making to an increasing degree to this educational progress. I go beyond the usual testimony to teamwork in emphasizing the fine interaction of these governing bodies and their devotion to our institution's welfare. I pay special tribute to the Executive Committee of the Corporation which brings devotion, wisdom, and a superb measure of trustee responsibility to the month-to-month consideration of the selection of M.I.T. personnel and to M.I.T. policy and its execution.

I also pay special tribute to the highly effective service which the Corporation Visiting Committees have rendered to the Institute in recent years. I think that we here in Cambridge often overlook the sacrifices made by Corporation members, alumni, and others in order to attend and participate in these meetings. I can say, however, that in a very important way these advisory groups have guided and greatly stimulated the activities of the Institute over many years of its development.

Respectfully submitted,

J. R. KILLIAN, JR.

Personnel Changes

AS OF SEPTEMBER 14, 1955

CORPORATION

Deaths:

J. Willard Hayden, LIFE MEMBER
John R. Macomber, LIFE MEMBER
George A. Sloan, LIFE MEMBER
Franklin W. Hobbs, EMERITUS LIFE MEMBER

Term Expirations:

John M. Hancock, SPECIAL TERM MEMBER
Pierre F. Lavedan, ALUMNI TERM MEMBER
Charles A. Thomas, ALUMNI TERM MEMBER
Robert C. Sprague, ALUMNI TERM MEMBER

New Appointments:

Charles A. Thomas, LIFE MEMBER
Robert C. Sprague, LIFE MEMBER
Robert A. Lovett, SPECIAL TERM MEMBER
Hugh S. Ferguson, ALUMNI TERM MEMBER
Fred C. Koch, ALUMNI TERM MEMBER
Max L. Waterman, ALUMNI TERM MEMBER

FACULTY

Deaths:

Walter M. Fife, ASSOCIATE PROFESSOR, CIVIL ENGINEERING
Irvin S. Cohen, ASSISTANT PROFESSOR, MATHEMATICS
Ivan J. Geiger, ASSISTANT PROFESSOR AND DIRECTOR OF ATHLETICS
Walter W. Robertson, ASSISTANT PROFESSOR, NAVAL ARCHITECTURE AND MARINE ENGINEERING
Robert P. Bigelow, EMERITUS PROFESSOR, BIOLOGY
Charles M. Curl, EMERITUS PROFESSOR, GRAPHICS
Newell C. Page, EMERITUS PROFESSOR, PHYSICS

Retirements (WITH TITLE PROFESSOR EMERITUS):

Erwin H. Schell Ralph C. Young George A. Znamensky

Promotions:

To Professor:

Alex Bavelas, INDUSTRIAL MANAGEMENT
James W. Daily, CIVIL ENGINEERING
Harold W. Fairbairn, GEOLOGY AND GEOPHYSICS
Herman Feshbach, PHYSICS
Joseph Kaye, MECHANICAL ENGINEERING
Carl W. Wagner, METALLURGY
Henry J. Zimmermann, ELECTRICAL ENGINEERING

To Associate Professor:

Richard B. Adler, ELECTRICAL ENGINEERING
Stanley Backer, MECHANICAL ENGINEERING
John M. Biggs, CIVIL ENGINEERING
David Durand, INDUSTRIAL MANAGEMENT
Richard Filipowski, ARCHITECTURE
Samuel A. Goldblith, FOOD TECHNOLOGY
Myron J. Gordon, INDUSTRIAL MANAGEMENT
Robert L. Halfman, AERONAUTICAL ENGINEERING
Kenkichi Iwasawa, MATHEMATICS
Yao-Tzu Li, AERONAUTICAL ENGINEERING
Kevin A. Lynch, CITY PLANNING
Frank A. McClintock, MECHANICAL ENGINEERING
Gordon J. MacDonald, GEOLOGY
John T. R. Nickerson, FOOD TECHNOLOGY
Thomas H. Pigford, CHEMICAL ENGINEERING
Maurice E. Shank, MECHANICAL ENGINEERING
George P. Shultz, ECONOMICS AND SOCIAL SCIENCE
Howard Simpson, CIVIL AND SANITARY ENGINEERING
Felix M. H. Villars, PHYSICS

To Assistant Professor:

Warren G. Bennis, ECONOMICS AND SOCIAL SCIENCE
George A. Brown, MECHANICAL ENGINEERING
Edward S. Cohen, CHEMICAL ENGINEERING
Peter S. Eagleson, CIVIL AND SANITARY ENGINEERING
Alve J. Erickson, MECHANICAL ENGINEERING
Freddie D. Ezekiel, MECHANICAL ENGINEERING
Carl W. Garland, CHEMISTRY
Frederick D. Greene, II, CHEMISTRY
Hermann A. Haus, ELECTRICAL ENGINEERING
Myron A. Hoffman, AERONAUTICAL ENGINEERING
Herbert O. House, CHEMISTRY
John G. King, PHYSICS

To Assistant Professor (continued):

Frederick J. McGarry, CIVIL AND SANITARY ENGINEERING
Thomas F. McNulty, ARCHITECTURE
Erik L. Mollo-Christensen, AERONAUTICAL ENGINEERING
Norman A. Nelson, CHEMISTRY
Robert E. Ogilvie, METALLURGY
Harald A. T. Reiche, HUMANITIES (AND CARNEGIE FELLOW)
Mahmoud M. Riaz, ELECTRICAL ENGINEERING
Miguel A. Santalo, MECHANICAL ENGINEERING
William D. Stahlman, HUMANITIES
John F. Twigg, GRAPHICS
Earle H. Watts, GRAPHICS
John S. Waugh, CHEMISTRY

Appointments:

G. Wesley Dunlap, VISITING WEBSTER PROFESSOR, ELECTRICAL ENGINEERING
William R. Hawthorne, VISITING HUNSAKER PROFESSOR, AERONAUTICAL ENGINEERING
Knox Millsaps, VISITING PROFESSOR, MECHANICAL ENGINEERING
Richard A. Musgrave, VISITING PROFESSOR, ECONOMICS, EFFECTIVE FEBRUARY, 1956
Robert A. Ramey, Jr., VISITING WEBSTER PROFESSOR, ELECTRICAL ENGINEERING
Claude E. Shannon, VISITING PROFESSOR, ELECTRICAL ENGINEERING
G. E. Kidder Smith, VISITING PROFESSOR, ARCHITECTURE
John G. Turnbull, VISITING PROFESSOR, ECONOMICS
Walter E. Rogers, VISITING ASSOCIATE PROFESSOR, ELECTRICAL ENGINEERING
James S. Tassie, VISITING ASSISTANT PROFESSOR, MODERN LANGUAGES

Professor:

Houlder Hudgins, INDUSTRIAL MANAGEMENT

Associate Professors:

Raymond A. Bauer, ECONOMICS AND SOCIAL SCIENCE
Lieutenant Colonel Donald S. Bowman, MILITARY SCIENCE
Alberto P. Calderon, MATHEMATICS
John F. Elliott, METALLURGY
James A. Fay, MECHANICAL ENGINEERING
Howard W. Johnson, INDUSTRIAL MANAGEMENT
Major Warren Rogers, MILITARY SCIENCE
Louis D. Smullin, ELECTRICAL ENGINEERING
Theos J. Thompson, CHEMICAL ENGINEERING
Major John A. Vanderpoel, AIR SCIENCE
Lieutenant Colonel Sidney F. Wogan, AIR SCIENCE

Assistant Professors:

Nesmith C. Ankeny, MATHEMATICS
Theodore S. Baer, HUMANITIES (AND CARNEGIE FELLOW)
Robert L. Beare, MODERN LANGUAGES
P. L. Thibaut Brian, CHEMICAL ENGINEERING
A. Noam Chomsky, MODERN LANGUAGES
Gregory Chi-chong Chow, INDUSTRIAL MANAGEMENT
Melville Clark, CHEMICAL ENGINEERING
Lieutenant Harry J. Crook, Jr., AIR SCIENCE
John L. Enos, INDUSTRIAL MANAGEMENT
Captain Forest S. Gibson, MILITARY SCIENCE
Frank J. Heger, Jr., CIVIL AND SANITARY ENGINEERING
Louis N. Howard, MATHEMATICS
Ingo Ingenohl, INDUSTRIAL MANAGEMENT
Herbert N. Jenkins, ECONOMICS
Peter S. King, INDUSTRIAL MANAGEMENT
James D. Koerner, HUMANITIES
George F. Koster, PHYSICS (WITH LEAVE OF ABSENCE TO JULY 1, 1956)
Edwin Kuh, INDUSTRIAL MANAGEMENT
William L. Letwin, INDUSTRIAL MANAGEMENT
Martin Lichterman, HUMANITIES
Theodore D. Lockwood, HUMANITIES
Edward N. Lorenz, METEOROLOGY
Richard S. Maffei, INDUSTRIAL MANAGEMENT
Charles L. Miller, CIVIL AND SANITARY ENGINEERING
Rowland L. Mitchell, Jr., HUMANITIES
Henry M. Morgan, MECHANICAL ENGINEERING
Saul Namyet, CIVIL AND SANITARY ENGINEERING
George E. Pugh, PHYSICS
Charles C. Reynolds, METALLURGY
Captain Max N. Ruhl, MILITARY SCIENCE
Gordon Shillinglaw, INDUSTRIAL MANAGEMENT
Alfred K. Susskind, ELECTRICAL ENGINEERING
Captain Willard D. Tease, MILITARY SCIENCE
Warren S. Torgerson, INDUSTRIAL MANAGEMENT
Lieutenant Theodore R. York, AIR SCIENCE

Resignations:

Professors:

Colonel Glenn C. Coleman Raphael Salem

Associate Professors:

Major Vincent J. Gangemi
Lieutenant Colonel Charley W. Haynes
Ernest E. Lockhart
Thomas F. Malone
George A. Miller
Major Franklin B. Moon
Major Edgar W. Nichols
Joseph A. Pechman
Robert C. Seamans, Jr.
Herman J. Shea

Assistant Professors:

Captain Willard Anderson
John S. Archer
James C. Bresee
Carroll J. Brown
John R. Coleman
David K. Felbeck
I-Ming Feng
Herman C. Fischer
Leslie H. Fishel, Jr.
Arthur A. Fowle
Ralph W. Gretter
Melvin A. Herlin
Earl W. Keller
Robert L. Koehl
William J. LeMessurier
Erwin G. Loewen
Arthur Mann
Earle R. Marshall
Paul R. Pasley
Gerhard Reethof
Fazlollah M. Reza
Romney Robinson
Charles W. Rosen
Jack W. Rosengren
Ronald E. Scott
Lacey B. Smith
Thomas A. Staudt
J. Earl Thomas
Lawrence W. Towner
Harry Udin
Roger L. Williams

Leaves of Absence HAVE BEEN GRANTED TO THE FOLLOWING FACULTY MEMBERS DURING THE YEAR:

Charles W. Adams
Isadore Amdur
Raymond A. Bauer
Charles H. Blake
Jack B. Chaddock
J. P. den Hartog
Francis L. Friedman
Albert G. Hill
Robert E. MacMaster
Thomas F. O'Dea
Roland D. Parks
William H. Radford
Lloyd Rodwin
Albert H. Rubenstein
Francis W. Sears
Ascher H. Shapiro
George P. Shultz
Alan H. Stenning
H. Guyford Stever
C. Fayette Taylor
George E. Valley, Jr.
Donald R. Walker
George W. Whitehead
Walter G. Whitman
Norbert Wiener
Jerome B. Wiesner

CHANGES IN ADMINISTRATION

Appointments:

Professor Harl P. Aldrich, Jr., EXECUTIVE OFFICER, CIVIL AND SANITARY ENGINEERING
Richard L. Balch, DIRECTOR OF ATHLETICS
Lawrence E. Beckley, ASSISTANT DIRECTOR, DIVISION OF INDUSTRIAL COOPERATION
Robert M. Briber, ADMINISTRATIVE ASSISTANT TO THE PRESIDENT
Thomas J. Crane, MANAGER OF RESEARCH FISCAL OFFICE
Dr. James M. Faulkner, MEDICAL DIRECTOR
Henry W. Fitzpatrick, DIRECTOR, DIVISION OF DEFENSE LABORATORIES
F. Leroy Foster, DIRECTOR, DIVISION OF INDUSTRIAL COOPERATION
Professor Edwin R. Gilliland, ACTING HEAD, CHEMICAL ENGINEERING
Professor Samuel A. Goldblith, EXECUTIVE OFFICER, FOOD TECHNOLOGY
Marshall Holloway, DIRECTOR, LINCOLN LABORATORY
Professor James Holt, ACTING HEAD, MECHANICAL ENGINEERING
Joe Jefferson, ASSISTANT DIRECTOR OF STUDENT AID
James G. Kelso, ASSOCIATE PLACEMENT OFFICER
Colonel Harmon Lampley, Jr., HEAD, AIR SCIENCE
William Mackintosh, ASSISTANT DIRECTOR OF GENERAL SERVICES
G. Edward Nealand, DIRECTOR OF PURCHASING
Nathaniel McL. Sage, DIRECTOR, OFFICE OF SPONSORED RESEARCH
Professor Eli Shapiro, ASSOCIATE DEAN, SCHOOL OF INDUSTRIAL MANAGEMENT
Albert F. Sise, PERSONNEL OFFICER
C. Edward Slye, MANAGER, OFFICE OF LABORATORY SUPPLIES
Henry T. Spiers, ASSISTANT ACCOUNTING OFFICER
Philip A. Stoddard, ACTING DIRECTOR, INDUSTRIAL LIAISON OFFICE
Francis E. Wylie, DIRECTOR OF PUBLIC RELATIONS

Resignations:

Colonel Glenn C. Coleman, HEAD, AIR SCIENCE
Hamilton Herman, SPECIAL ASSISTANT
Professor Albert G. Hill, DIRECTOR, LINCOLN LABORATORY

Leave of Absence:

William R. Weems, DIRECTOR, INDUSTRIAL LIAISON OFFICE

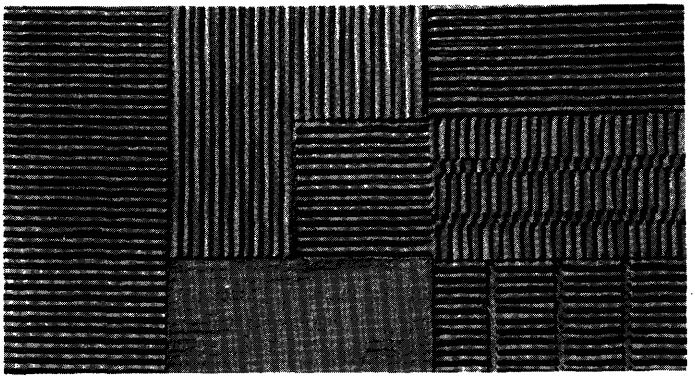
Report of the Dean, School of Architecture and Planning

As the first institution to organize and develop formal architectural education in the United States, M.I.T. has steadily held to the belief that the basic prerequisites for the study of architecture are sympathy for human institutions, esthetic perception, and the ability to utilize effectively the methods of science. Our special environment gives our students great opportunities to add specific knowledge in the fields of structures and techniques. But we have been more than ever alert to the fact that the spirit of man demands more than mere function or stability in a building; a student must be taught to become sensitive to visual and esthetic demands, and he must learn that the whole of architecture is greater than its parts and that mastery of the parts is insufficient.

The aim of our School is not to produce a certain sort of professional man in quantity, but rather to make it possible for each student to become an architect of individual quality. This philosophy of education has been carried out, not through dictation by a single great man or by narrow discipline, but by creating the kind of environment where different minds and talents may find stimulus, motivation, and a sense of direction. This is done by inviting outstanding, even controversial, personalities in architecture or the arts and men of world-wide repute to come to us for brief or long stays to teach, to lecture, or to pursue research in any field related to architecture or planning. This important activity has been made possible mainly by the Bemis Foundation, and we are confident that the results will be as fruitful as those for which the Bemis funds were expended in the past.

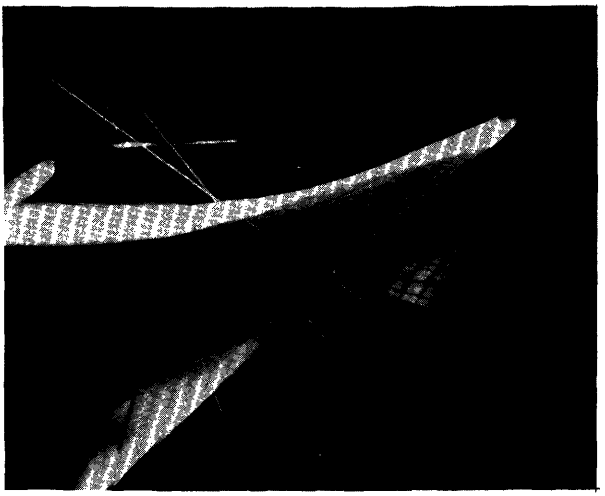
Schools of architecture have been criticized by members of the profession for not inculcating more specific skills known to be useful in practice, but we feel that still more important is a school's endeavor to provide a groundwork of real interest in ideas. For this reason, we try to expose all our students to the esthetic experience of the visual arts and at the same time to the methods and attitudes of engineering without emphasizing details. We feel that particular stress should be laid on the importance of knowing the structural laws and the action of forces with which an architect must deal in performing his tasks, and we try to show the importance of working in the team, not only with engineers but with others in a great many fields of action in which architects are called upon to function.

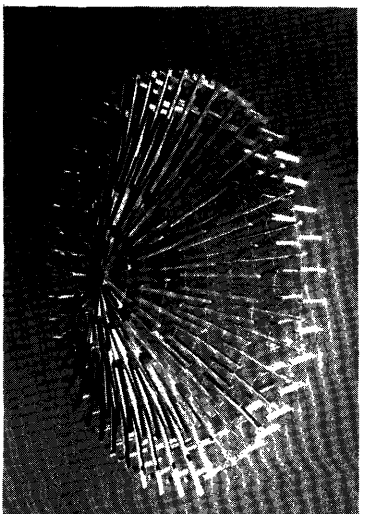
The education of the architect and planner, which never comes to an end, covers a great range of interests — from esthetics to economics, from engineering to administration,



"... the courage to be dissenters when necessary without relinquishing poise and restraint, so that structural inventiveness may at all times be motivated by the satisfaction of visual order ..."

Work by students in design classes of the Department of Architecture.





from acoustics to lighting. In this School we encourage the students to develop both common sense and passion and within those two virtues to learn to search for facts, to understand techniques, to coordinate results, and finally to synthesize them in clear and creative expressions. We hope thereby to give them the courage to be dissenters when necessary without relinquishing poise and restraint, so that structural inventiveness may at all times be motivated by the satisfaction of visual order rather than by the desire to be different. The good student will become a philosopher in the judgment of all consequences of his performance as an architectural designer. Our methods of instruction of course vary, but in general and whenever possible we try to give real case studies — live problems where all the forces at work in the profession are felt and tested.

Teaching and research in planning.

The unfulfilled demand for qualified personnel in city and regional planning agencies, together with the increasing responsibilities being placed on recent graduates of professional planning courses, are matters of serious concern to the faculties of planning schools and to the profession at large. While there has been a noticeable increase in the number of students attending such schools during the past year, graduates of planning courses still have a wide choice of jobs and often find themselves in positions where they are expected to make major policy decisions which normally would be reserved for experienced staff members. This situation calls for some rethinking of educational objectives in this comparatively new field of professional training, and our Department of City and Regional Planning is making every effort to balance the course materials in planning techniques and design procedures with program situations in which students are called

upon to make value judgments on matters of economic and administrative policy.

A newly developing area in which personnel demands are also increasing is that of planning research. Staff requirements in both educational institutions and operating agencies call for persons with more advanced training than that normally demanded of candidates for the Master's degree. A number of the larger planning schools now offer programs leading to a Ph.D. degree in Planning, and serious study is being given to offering such a program within our Department. At the present time two students at the Institute are candidates for a Ph.D. in Planning and Economics; they are following a program supervised by an inter-departmental committee but are registered in the Department of Economics and Social Science.

Educational developments.

The history courses under the direction of Professor Albert Bush-Brown have been strengthened and extended to make manifest to our students the continuity of the creative process and to give them a greater awareness of the present-day challenge. Professor Bush-Brown has also prepared courses and exhibits for the School of Humanities, thereby strengthening our collection of visual material.

The physical facilities of the School have been reorganized and expanded for greater convenience and flexibility. The Department of City and Regional Planning is now grouped on one floor. Junior members of the staff of the Department of Architecture have been grouped in a large, modernized room and each given desk space. All obsolete tables and drafting equipment in the student rooms have been redesigned and rebuilt. The graduate class drafting room

has been extended, and the Exhibition and Emerson Rooms have been repainted and redecorated.

Last year our students were unusually active and participated in many cooperative undertakings resulting in publications, conferences, and a stimulating series of Wednesday night lectures. Our graduate students continue to be of the highest caliber, and the fact that about one-third of them last year came from foreign countries brought an interesting, fruitful interchange of ideas and attitudes.

During the year the following outstanding architects supplemented our permanent staff for a term each in architectural design; Jedd Stow Reisner from New York, Tobias Faber from Denmark, Samuel E. Homsey from Delaware who came as a Bemis visiting lecturer, and R. Buckminster Fuller. During the Spring Term the graduate class had as visiting critics for one or two weeks each Eero Saarinen from Michigan, John McL. Johansen from Connecticut, Minoru Yamasaki from Michigan, and Eduardo Catalano from North Carolina.

Activities of the staff.

During the year Professor Lawrence B. Anderson served as president of the Association of Collegiate Schools of Architecture; he served on the American Institute of Architects Committee on Education; and he organized the jury of award of the architectural section of the Boston Arts Festival. Professor Herbert L. Beckwith, in addition to his many duties, was active as president of the National Architectural Accrediting Board and was a member of the American Institute of Architects Committee on Education. The College of Fellows of the American Institute of Architects formally gave Professor Beckwith a citation for his contribution to the profession of architecture through teaching. Professor Robert B. Newman

was made a fellow of the Acoustical Society of America and lectured at the Universities of North Carolina and Minnesota, at Harvard University, and at a regional meeting of the American Institute of Architects. Professors William H. Brown, Burnham Kelly, and Richard Filipowski participated in educational television for the Institute.

In the Department of City and Regional Planning, Professor Roland B. Greeley served as vice-chairman of the Committee on Research of the United Community Services of Metropolitan Boston. Professor John T. Howard was re-elected president of the American Institute of Planners and delivered a number of addresses at important planning conferences. Professor Burnham Kelly served as chairman of the American Institute of Planners Committee on National Defense Considerations and as consultant to the Office of Defense Mobilization in this field. He also served as the Governor's appointee to represent professional planners on the Massachusetts Legislature's Special Commission on Planning, Zoning, and Subdivision Control. During the spring term Professor Lloyd Rodwin served as a consultant to the New York State Temporary Housing Rent Commission with the responsibility of organizing a Division for Research and Program Analysis. Professor Walter Isard was elected chairman of the Organizing Committee of the Regional Science Association and was active as a member of the Metropolitan Study Group of the Ford Foundation. He also presented papers to the World Population Conference in Rome, to the annual meeting of the Econometric Society, and to the Regional Income Conference at Duke University. Professor Louis B. Wetmore resigned on June 30, 1955, as Director of the Urban and Regional Studies Section to become the head of the Department of City Planning and Landscape Architecture at the

University of Illinois. At the annual meeting of the American Institute of Planners in March, 1955, Professor Frederick J. Adams received a Distinguished Service Award "in recognition of outstanding services to the planning profession over a long period of years."

Dean Pietro Belluschi was elected a life member of the National Institute of Arts and Letters; he served as a consultant to the Secretary of State on Foreign Buildings and as a consultant to the Secretary of the Air Force on the design of the new Air Academy. He is also serving as a member of the Museum Committee on Architecture for the Museum of Modern Art in New York.

Expanding research activities.

Perhaps the most significant activity within the School during the past year has been the expanding program of the Section of Urban and Regional Studies. The study of the "perceptual form of cities," which is being conducted by Professor Gyorgy Kepes and Professor Kevin Lynch under a three-year grant from the Rockefeller Foundation, has been continued. At mid-year a study of the effect of large-lot zoning regulations on the cost of residential development was begun, and this study has been carried on in collaboration with the Division of Planning of the Massachusetts Department of Commerce, under the general direction of Professor Louis B. Wetmore. Professor Isard has directed the Puerto Rico Economic Relations Project of the Social Science Research Center of the University of Puerto Rico, and also research on Community Revenues and Costs Resulting from New Industrial Development for the Federal Reserve Bank. A five-year grant from Resources for the Future, Inc., which receives its financial support from the Ford Foundation, will make it

possible for Professor Isard to expand his studies of the industrial complex and to develop methods of analysis for application to metropolitan regions.

The design implications of technical and industrial advances in the fields of lighting and solar energy continue to be studied under the supervision of Professor Anderson. During the year the F. W. Wakefield Laboratory of Lighting Design completed its initial exploration — a search for the tools and methods most useful in the subjective evaluation of the total luminous environment. Work with the Institute Committee in Space Heating with Solar Energy has focused on the design of another solar-heated house which incorporates a more fully engineered and more fully self-regulating system. Several years of data-taking and analysis from previous experiments have made it possible to establish accurate performance criteria and to design with full confidence in meeting them. Results of the first year's study of the use of plastics in building, under the supervision of Richard W. Hamilton, included architectural evaluations of some of the typical building products that are either wholly or partially composed of plastics, and illustrations of present trends and future possibilities in the use of these materials. Presently, during the second year of this project, efforts of the staff are concentrated on designing a house intended to forecast possibilities that can be achieved when, in the future, we may take maximum advantage of the inherent properties of plastics as applied to house fabrication. A grant-in-aid from the Monsanto Chemical Company is supporting this work; valuable engineering assistance is provided by a close working relationship with the Plastics Research Laboratory at the Institute, whose work is sponsored by the Manufacturing Chemists' Association.

Needs of the School.

Again, financial help to gifted students in need is a most pressing problem. It is true that some generous members of the profession have in recent years given to the School grants and traveling and research fellowships, such as Samuel A. Marx; William Emerson; Ernest A. Grunsfeld, Jr.; Skidmore, Owings & Merrill; and Voorhees, Walker, Smith and Smith. But the need for entrance and tuition scholarships is still great, and we hope that greater progress will be made.

PIETRO BELLUSCHI.

Report of the Dean, School of Engineering

The academic year 1954–55 probably will stand as the turning point in the crisis of professional engineering manpower in the United States. As it relates to M.I.T., this is discussed in some detail in Part I of this report. In Part II are detailed reports of developments within the School of Engineering in 1954–55.

1. M.I.T.'S ROLE IN ENGINEERING EDUCATION

The total number of engineering graduates throughout the nation in 1954–55 was probably the lowest in several years in the Bachelor's category of degrees, with the prospect of a slight increase over previous years in Master's and Doctor's degrees providing the only encouragement. The reasons for this reduction in engineering degrees are many and complex, but in the main they stem from the drop in birth rate in the thirties reflected in a severe decrease in freshman enrollment in the early fifties.

Other causes have been at work, however. The abnormally high engineering enrollment which occurred in the years immediately following World War II gave the nation a false sense of the manpower situation; overproduction of engineers was even considered a possibility — an idea that seemed to discourage a number of prospective engineering students. There is also the question whether engineering education, in the older sense, has the attraction for our gifted youth to the degree it once had. The trends of national enrollment are not quite clear in this respect, but, as the United States Office of Education points out, the increase in freshman enrollment for the fall of 1954 does not reflect the well-publicized shortage of and great demand for engineers. In addition, the great availability of profitable employment has, at least in some instances, discouraged graduate studies; and the situation with respect to military service has also served to complicate the professional manpower picture.

It is reasonably certain, however, that the coming years will be characterized by two major phenomena. The shortage of professionally trained engineers for industry and for teaching will continue, and at the same time the universities will face increasing enrollment of students.

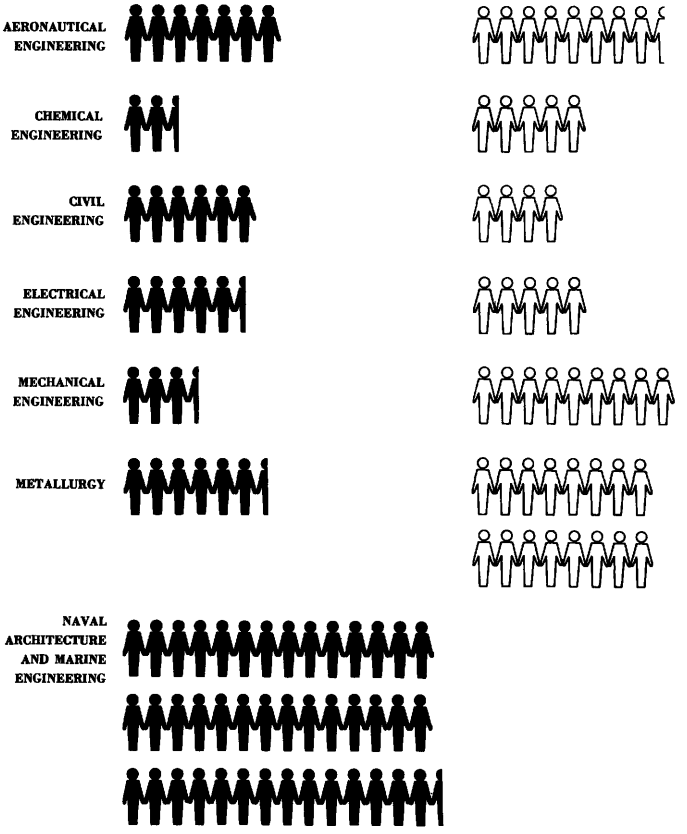
These circumstances cannot fail to have a profound influence on the future of the School of Engineering at M.I.T. As a part of the Institute's effort to plan for this situation, the School of Engineering has started a long-range study to obtain a better understanding of the trends in the professional manpower situation. The ultimate objective is to develop a basis for future long-range plans for the various fields. Final conclusions are a long way off, and only a few comments on the statistical situation will be included in this report.

The School of Engineering, comprising the Departments of Aeronautical Engineering, Chemical Engineering, Civil and Sanitary Engineering, Electrical Engineering, Mechanical Engineering, Metallurgy, Meteorology, Naval Architecture and Marine Engineering, and the Section of Graphics, represents a major portion of the Institute's educational activities. Since most of the other Schools perform an important part of the overall educational program of its students, the School of Engineering awards a preponderant number of the degrees conferred by the Institute. With somewhat less than 50 per cent of the Institute's faculty and budget, the School awards about 70 per cent of the S.B. degrees, 80 per cent of the S.M. and professional degrees, and 40 per cent of the degrees in the doctoral category.

The Course in General Engineering, the Department of Meteorology, and the Section of Graphics occupy special positions and are not included in the present discussion. A decision to discontinue undergraduate education in meteorology was reached during the year, putting this activity outside of our conventional engineering education program.

In its own make-up, the School of Engineering exhibits a considerable range in size, scope, and nature of activity throughout the various departments. Three of its departments

M.I.T.'s Position in Graduate Engineering Education



Out of each 50 advanced degrees given by accredited institutions in the United States in these fields of engineering during the past five years, M.I.T. has awarded

one Master's degree

one Doctor's degree

(Chemical Engineering, Electrical Engineering, and Mechanical Engineering) award over 70 per cent of all S.B. degrees, over 60 per cent of all S.M. and professional degrees, and nearly 60 per cent of all Sc.D. degrees within the School. One of these, the Department of Electrical Engineering, represents about one-fourth of the undergraduate degrees of the School.

On the national scene, the M.I.T. School of Engineering is one of about 150 accredited institutions. At the undergraduate level, the quantitative role of the School of Engineering has in the past five years ranged from 1 to 2 per cent of all degrees conferred in civil, chemical, electrical, and mechanical engineering, to 4 per cent in aeronautical engineering, 7 per cent in metallurgy, and 30 per cent in naval architecture and marine engineering. At the graduate level, the School of Engineering stands near the top in all fields, with an average exceeding 10 per cent of the S.M. degrees and 13 per cent of the doctoral degrees. Outside of the special circumstances in naval architecture and marine engineering, where only three accredited schools are operating, the highest quantitative role at the doctoral level is played by the Department of Metallurgy, which awards about a third of all degrees, and the Department of Mechanical Engineering, with about 18 per cent.

Unbalance in resources and facilities.

There are several long-range problems which might be expected to become more pressing in the years immediately ahead. According to the best estimates now available, the total college enrollment will increase by at least 75 per cent during the next decade, with a corresponding increase in first degrees in engineering and we hope a sharper increase in advanced degrees. The Institute cannot avoid being influ-

enced by this change. One would hope that a greater selectivity of entering students could be one result, and that another could be a more equitable distribution of the students among the various fields of engineering. Whether these things can take place with a controlled and orderly increase of total enrollment will depend to a considerable degree on our ability to interpret the major trends sufficiently early to take necessary action.

Certain tendencies in student enrollment are already discernible — tendencies which, if allowed to operate over an appreciable period of time, might seriously prevent the effective use of our resources. The engineering departments exhibit marked differences in their appeal to prospective students, this appeal sometimes running counter to the employment opportunities in the fields concerned or the professional excellence of their respective staffs. To some degree, at least, these tendencies appear to be country-wide and hence cannot be wholly ascribed to local circumstances.

At the top in prospective enrollment stands electrical engineering, already the largest department of the Institute. Here the potential undergraduate enrollment might eventually be one half of the School as a whole. Next are the Departments of Chemical Engineering and Mechanical Engineering, with slowly rising or stationary enrollments. Within these fields are new engineering specialties, such as the gas turbine and nuclear engineering, which have strong appeal in the graduate field and which may be expected to grow. Finally, there are the Departments of Aeronautical Engineering, Civil and Sanitary Engineering, Metallurgy, and Naval Architecture and Marine Engineering, in most of which undergraduate enrollment has tended to decrease during recent years. The situation is perhaps most acute in aero-

nautical engineering and metallurgy, particularly in view of their unique employment opportunities. It should be noted, however, that in these two fields the position of M.I.T. in relation to other schools is relatively satisfactory. To some extent our excess capacity in these fields has been brought about by our unusually strong position in graduate education and research, which has been the determining factor in reaching our present resources of men and physical facilities.

While graduate enrollment on the whole has so far been satisfactory in all departments, the continued manpower shortage will make it increasingly difficult to maintain the desired standards. There is certain to be increasingly sharp competition for the exceptional graduate students in all of these fields.

There is implicit in these tendencies a still further unbalancing of our resources in manpower and facilities. It is clearly a matter of the utmost importance for us to understand and, if possible, to anticipate the tendencies of enrollment and thus the whole future of our major fields of endeavor.

The factors which determine the destiny of our major professional fields of activity are many and varied — not easily subject to logical analysis. First and foremost stand personal leadership, creative ability, and a strong belief on the part of all staff members in the uniqueness of the exceptional man. Another condition for success is a strong interest on the part of students, their advisers, and their prospective employers — an interest which requires, in turn, that the synthesis of the field be up-to-date and responsive to the vaguely felt potential needs of the times. The matter of synthesis is important, not only to capture the momentum of the tendencies inherent in our society, but also to build solidly for enduring professional recognition. Beside the choice of specific topics as subjects of

instruction and research is the question of whether the synthesis should be based mainly on existing and past practice, on imaginative anticipation of the future, or on broad scientific indoctrination. All must be present to some degree, but leadership along all three lines at the same time is unlikely.

The importance of a wise overall synthesis has become much greater in recent years because of a tendency of major engineering departments to become increasingly independent entities, each more or less covering — with minor differences in emphasis — the entire field of applied science. This is undoubtedly a sign of vigor and strength, but it sometimes stands in the way of integrating certain common fields.

More penetrating surveys of certain fields have been initiated and will be the subject of study in the coming months and years.

2. THE YEAR IN ENGINEERING, 1954-55

During the year the departments of the School have continued their search for improvement in synthesis and teaching methods. Special subjects to stimulate creative imagination have been developed in aeronautical, civil, and mechanical engineering; in the Department of Electrical Engineering the Class of 1955 was the first to complete studies under the new curriculum.

The new venture in electrical engineering, combining strengthened scientific content with greater freedom of choice in the later years, has emerged as a significant departure in engineering education. The program has received favorable recognition in industry, as is evidenced by a General Electric Company grant of $50,000 from its Educational and Charitable Fund. This grant was made with the object of hastening

the completion of that part of the curriculum devoted to the general area of energy conversion. Because of the impact of modern physics on electrical engineering, the Department of Physics has agreed to initiate a junior year two-term sequence of subjects entitled Atomic and Nuclear Physics — a development that may well set a pattern for other engineering disciplines.

Facilities.

The consolidation of facilities has continued during the year, and while some of the departments still have unfilled needs, the general situation with regard to physical facilities appears satisfactory. In aeronautical engineering the Structures Laboratory has nearly completed the first stage of its major facilities, and a special wind tunnel section for boundary layer investigation was installed in the Gas Turbine Laboratory.

In chemical engineering the plans for the reactor for research and instruction are nearing completion, and contracts are to be placed in the near future. The Combustion Laboratory has been completed and is now in operation.

In electrical engineering the construction of laboratories on the lower two floors of Building 10 has been completed, as are other phases in the revitalization of activities in the electric energy field. More effective working space has been provided for the Energy Conversion and the Feedback Control Laboratories.

In mechanical engineering significant steps have been taken in the long-range program of modernizing facilities. Here it has been possible, by discarding obsolete machinery, to make more space available for classrooms and administrative offices without loss of effectiveness in education.

Staff.

Staff members of the School of Engineering have received several significant honors during the year. In aeronautical engineering, Professor C. Stark Draper was invited to present the Forty-third Wilbur Wright Memorial Lecture before the Royal Aeronautical Society in London. Professor H. Guyford Stever was appointed Chief Scientist of the United States Air Force, in which position he is serving on leave of absence from the Institute until July 31, 1956. In chemical engineering, Professor Walter G. Whitman has been on leave of absence for part of the year while serving as Secretary General of the International Conference on the Peaceful Uses of Atomic Energy, held in Geneva. The head of the Department of Mechanical Engineering, Professor J. P. Den Hartog, has returned from a five-month visit to Japan as a Fulbright Lecturer. Professor Ascher H. Shapiro has left for a year's stay at Cambridge University. Dr. William R. Hawthorne, Hopkinson and Imperial Chemical Industries Professor of Applied Thermodynamics at Cambridge, has been appointed the first Visiting Jerome Clarke Hunsaker Professor of Aeronautical Engineering. This distinguished appointment, which is for the academic year 1955–56, provides an opportunity for further integration of our activities in aircraft propulsion. In metallurgy, Professor John Chipman was elected a member of the National Academy of Sciences and also received the Brinell Medal of the Royal Swedish Academy of Engineering Sciences and the Bessemer Gold Medal of the British Iron and Steel Institute. Professor Chipman is the first American to receive the Brinell Medal. Professor Edwin R. Gilliland, acting head of the Department of Chemical Engineering, received the 1954 William H. Walker Award of the American Institute of Chemical Engineers — the fifth M.I.T. Faculty member to win this honor since its establishment in 1936.

Aeronautical engineering.

The Department of Aeronautical Engineering is gradually realizing the build-up of staff and facilities which has been under way for several years. The Department is noted for a close relationship between its educational program and its active research and development program on the frontiers of practical achievement.

The vital problems of the Department continue to be those of attracting a sufficient number of students and of finding properly qualified junior staff members who wish to make teaching a career. At present the enrollment question is being earnestly studied by leading members of the staff.

Two ventures in instruction may be mentioned. Professors Walter Wrigley, Robert K. Mueller, and Sidney Lees have continued the development of a teaching program in weapons systems. Civilians and officers of the United States military services comprise the major portion of this student group. Under the leadership of Professor Paul E. Sandorff, a special subject called Orbital Vehicles has been introduced. This deals imaginatively and creatively with the many problems of vehicles designed to operate outside the earth's atmosphere.

The Honors Group program continues to be an important factor in aeronautical engineering education at M.I.T. Twelve members of the Class of 1955 were added to the Honors Group for the academic year 1954–55, giving a total of 22 seniors and first-year graduate students and 10 social members. In order to serve more effectively the interests of the group with its continually increasing activities, Professors Walter McKay and Sandorff accepted the duties of faculty advisers to work with Professor Holt Ashley in the Honors Program.

The cooperative course is intended to give students in aeronautical engineering an opportunity to acquire scientific

and technical knowledge and at the same time to gain practical background in working with an engineering organization. In practice these objectives are well realized in a program that is being favorably received by the associated aircraft companies. These companies would be glad to absorb many more men than are available for assignment, and students returning from their six-month work period have been enthusiastic about the value of their experience. This fact is reflected in the increasing number of students who elect the cooperative work: in the Class of 1956, 16 members out of a total group of 52 are in the cooperative course.

Activity in the research units of the Department has been varied and productive this year. To conform with the Institute's decision to segregate major military ventures from its research activities, the Instrumentation Laboratory under Professor Charles S. Draper, which represents the largest research unit of the Department, was transferred to the Division of Defense Laboratories. This has not, however, altered its relationship to the educational activities of the Department.

The Flight Control Laboratory pursued four major projects for the United States Air Force and the United States Navy, among them the development and testing of control equipment for hydrofoil craft. It is now considered possible to stabilize hydrofoil craft in pitch and roll, even in rough water, by displacing the foils similar to aircraft surfaces, thus making use of techniques originally developed for aircraft and missiles.

The Aeroelastic and Structures Research Laboratory has added a 200,000-lb hydraulic testing machine and an 80 kw radiant heating furnace to its facilities in order to pursue the important problems of thermal effects in aircraft structures.

Stability and control tests for four transonic fighters were completed in the Wright Brothers Wind Tunnel. The

Tunnel can now be used for blowdown operation in addition to its original use as a continuous low-speed tunnel.

The Naval Supersonic Laboratory is now leased by the Institute for service to the aircraft industry. Continuous improvements of facilities and methods have been made, so that it is now one of the most versatile wind tunnels of its type. The most significant technical problem facing the Laboratory is that of rapid data reduction, which is one of the major objectives for the future.

The Aerophysics Research Group has completed several major tasks during the year, among them a report on transonic aircraft control presented at Wright Air Development Center. This included reports on some of the first work in the United States on inertial cross coupling of the aircraft modes of motion. For basic studies on shock wave boundary layer interaction, a small variable Mach and Reynolds number wind tunnel test section has been installed in the Gas Turbine Laboratory.

Professor E. S. Taylor gave a series of lectures on gas turbines in Tokyo in the summer of 1955, under the sponsorship of the Association of Aircraft Manufacturers of Japan. Professors Draper and Taylor are serving as members of the Scientific Advisory Board to the Chief of Staff of the United States Air Force. Professor Markham, also a member of this Board, participated in the Congress of the Allied Group for Air Research and Development, an agency of the North Atlantic Treaty Organization, which was held during the spring and early summer of 1954 in the Hague, Holland. At the request of the Air Force he also visited wind tunnels, aeronautical research establishments, and aircraft factories in most N.A.T.O. countries. Again in 1955 Professor Markham was invited as a representative of the United States to attend

the Advisory Group for Aeronautical Research and Development Congress in Ottawa, Canada.

Chemical engineering.

The staff has continued to be active in governmental, industrial, and professional society work. Professor Edwin R. Gilliland is serving as acting head of the Department during Professor Whitman's absence.

The enrollment in chemical engineering, both undergraduate and graduate, is continuing to increase, with a larger number of freshmen indicating this course as their choice than in any previous year. The junior class during the past year was also much larger than normal. The increase in applications for graduate work has given the Department the opportunity to be more selective. The demand for chemical engineering graduates at all levels continues to be much greater than the supply, and there has been a large increase in the opportunities for summer employment for students, with several companies now sending personnel representatives to interview for this purpose.

A new undergraduate course in Applied Chemical Kinetics has been developed as an elective for the seniors. The staff is working on the revision of the undergraduate program, and some of the changes in the curriculum will be introduced in the coming fall term.

Graduate instruction in nuclear engineering, under Professor Manson Benedict, is exhibiting a rapid growth, and the staff is being enlarged to carry the increased load. The Corporation has authorized the granting of a Doctor of Science degree in Nuclear Engineering in addition to the Master's degree. The plans for the nuclear reactor are now crystallized, and in March Professor Theos J. Thompson came to the

Department from the Atomic Energy Commission Laboratory at Los Alamos to take charge of the group responsible for the design and construction of this new facility. It is planned that the reactor will be in operation and available for student and staff research in 1957.

The research activities of the Department have continued at a high level, with mass transfer studies occupying a major position among numerous fields of endeavor. In interphase mass transfer, as the net rate becomes large, the conditions at the interface no longer approach equilibrium, and recent work has shown that this effect can be handled as an added resistance which can be predicted from the Langmuir absolute rate equations. Another study on the flow of vapors through porous plugs — a phenomenon of great industrial importance — has shown unexpectedly high rates when the vapor adsorbs on the surface. These results indicate a high mobility for the adsorbed molecules, and in many cases for a given pressure drop the weight rate of flow of an adsorbing vapor through a porous plug is much greater than the same material as a liquid. In these cases the free energy appears to be the proper potential for flow rather than pressure difference.

The Combustion Laboratory has been completed and is now in operation on a number of sponsored and unsponsored research projects. This unit is a valuable addition to the facilities of the Department; it will enable the Institute to augment its outstanding work in this field. In one series of experimental studies, flames stabilized by a blunt object have given unexpected gas compositions in the wake of the stabilizer. The complete evaluation of this effect should give a much clearer picture of the combustion process. Another investigation is attempting to evaluate the absolute rate of the

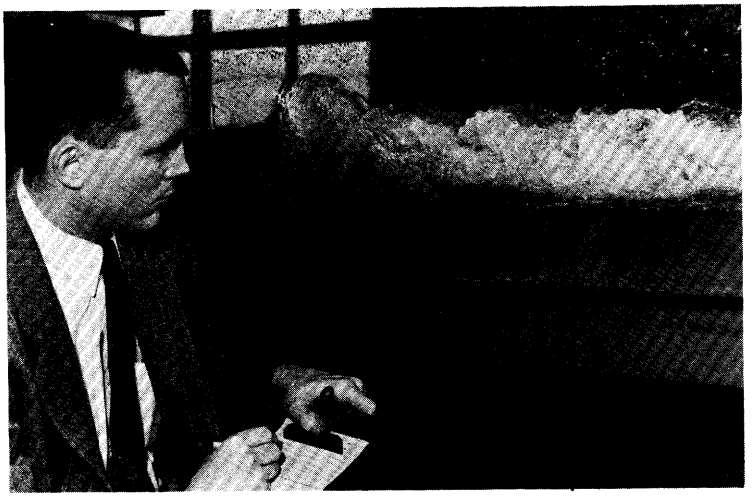
chemical reaction in gaseous combustion. The rate of mixing of the vapor fuel and the air has been increased by the use of jets at sonic velocity until energy releases of 300,000,000 Btu/hr.ft.^{3} have been obtained, indicating that the basic chemical reaction has a rate at least this large. An understanding of the mechanism and rate of the chemical reaction involved will contribute to evaluating the limitations on high output combustion chambers of the type employed in ramjets. Another investigation has greatly extended our knowledge of how to handle radiation in furnaces and combustion chambers and permits quantitative allowance for gas and wall temperature patterns.

Civil and sanitary engineering.

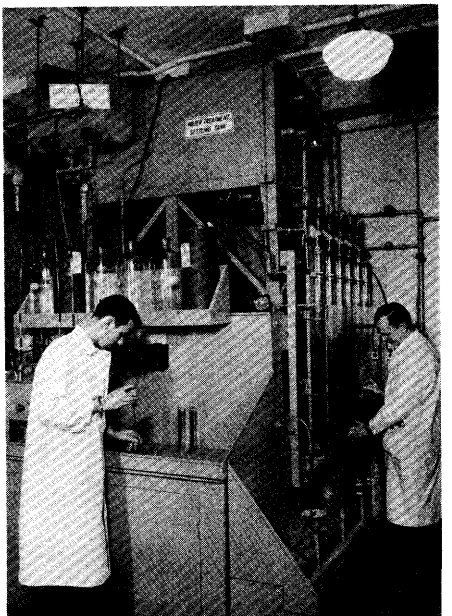
Civil engineering as a field seems to depend to a greater extent than some other areas of engineering on judgment, imagination, and the ability to work with a public group. The Department is searching for new and more imaginative methods in undergraduate education which may contribute to an increased interest and enrollment in civil engineering.

During the past year the undergraduate curricula in civil engineering and in building engineering and construction have been consolidated into a single undergraduate curriculum in civil engineering that becomes effective this fall. As a pilot step toward exploring the feasibility of the vertical concept of engineering education (parallel development in engineering as well as science), this new curriculum includes a subject called Civil Engineering Projects that will run throughout the second year.

The research program of the Department has included a number of important projects. The increasing possibility



These are typical of research facilities in the Department of Civil and Sanitary Engineering: the wave tank for research on oscillatory wave motion in water, in the Hydrodynamics Laboratory; and a pilot plant for removing radioactive wastes in water, in the Sedgwick Laboratories of Sanitary Science.



of water contamination by radioactive fall-out has led the Sedgwick Laboratories of Sanitary Science to a study of water treatment processes that will insure higher removals of radioactive fission products — particularly strontium — from municipal and industrial water supplies. Interest in this research has been intensified by the knowledge that nuclear explosions in Nevada and the Pacific have already shown conventional water treatment processes to be inadequate — they will not remove enough radioactive contaminants to permit normal operations of certain phases of the photographic industry.

The Hydrodynamics Laboratory has undertaken a basic study of structural strains caused by oscillatory wave motion. Experimental and analytical investigations are being made with the ultimate aim of designing offshore structures, such as oil drilling platforms, that will withstand the pressure of hurricane-generated waves.

Research into the fundamental mechanical properties of plastics has been carried on for the past ten years under a continuing program sponsored first by the Plastics Materials Manufacturers Association and later by the Manufacturing Chemists Association when the two organizations merged. Under the direction of Professor A. G. H. Dietz, M.I.T.'s plastics research group this year received the Templin Award of the American Society for Testing Materials for pioneering work on the development of servo-controlled testing equipment for plastic materials.

In a continuing program, the Structural Division, in cooperation with the Massachusetts Department of Public Works, has been conducting research on the vibration of highway bridges.

Professor Dietz has participated in four symposia dealing with plastics. Professor James A. Murray participated

in a survey being made in Iraq for the United States Foreign Operations Administration. Dr. Arthur T. Ippen attended the Fifth Conference on Coastal Engineering in Grenoble, France, and participated in the Joint Admiralty and United States Navy meeting on Hydroballistics at Teddington, England. Dr. James W. Daily continued as Chairman of the O.N.R. Advisory Committee for Basic Research in Underwater Ballistics and in this capacity was instrumental in arranging the Hydroballistics meeting in England. Professor Gordon R. Williams, representing the International Bank for Reconstruction and Development, made a study in Pakistan of methods for constructing and financing the Marala-Ravi Irrigation Canal. Professor Charles H. Norris has served as consultant to the Air Force and to the Armed Forces Special Weapons Committee. Professor Robert J. Hansen undertook a special assignment for the Assistant Secretary of Defense for Research and Development, surveying the status of knowledge in the field of blast effects from atomic weapons.

The death of Associate Professor Walter M. Fife, just prior to his appointment as an Emeritus Lecturer, greatly saddened the Department. A true scholar and teacher, his influence will long be felt. He did much, over the years, to bring the benefits of German developments in structural analysis into the courses taught by the Structural Division.

After some twenty years of outstanding service in the instruction in surveying, Professor Herman J. Shea, who has headed our work in that area, resigned to accept a position in industry. His duties will be taken over by Mr. Charles Miller, who will join the Faculty as an assistant professor.

Electrical engineering.

Continuing its pioneering efforts in education in electrical engineering, the Department this year turned its

attention to a revision in the electrical engineering subjects taught to out-of-Department students, in recognition of the fact that all of today's engineers rely more heavily on electrical technologies in the practice of their profession than heretofore. This work is under the supervision of Professor Thomas F. Jones and is performed in consultation with representatives from other departments of the School of Engineering.

Research by graduate students and faculty made many achievements during the year and continues at a high level.

The High Voltage Research Laboratory completed its fifth year of association with the Lahey Clinic of Boston in studies of the physical and clinical properties of 2-million-volt X-rays, particularly as they relate to the treatment of malignant disease. During this period over 1,200 patients received completed courses of treatment using the radiation facilities of Building 28, and a careful medical follow-up is in progress to determine the efficacy of the improved radiations and the advanced methods of applying them. During the year, with the support of the Damon Runyon Memorial Fund, further clinical use was made of high-energy electrons in the direct treatment of very superficial but extensive skin diseases — often with dramatically beneficial results. Dr. Trump's laboratory is now cooperating with over 20 hospitals in the irradiation of special tissues — such as aorta, femoral arteries, and bone — in order that these may be sterilized for banking and later surgical use.

The insulation of high voltages in compressed gases and in vacua, the acceleration and focussing of electrons and ions, and the interaction of these with matter constitute the basic physical program of the High Voltage Research Labora-

tory. This work is supported by grants from the Godfrey M. Hyams Trust and the National Science Foundation.

The Laboratory for Insulation Research has made significant progress in the understanding of field emission phenomena in gases, liquids, and solids in the domain dynamics of ferroelectricity and ferromagnetics. A fundamental study of the crystal imperfections by precision measurements of lattice constants and densities disclosed an error of atomic weight of germanium and showed the necessity of a revision of International Atomic Weights. The fundamental work conducted under Dr. von Hippel's leadership during the past decade on the synthesis of engineering materials is having significant influence on the evolution of several subjects in the new curriculum.

The efforts of the Stroboscopic Light Laboratory were about equally divided between the development of the flash lights themselves and the application of the lights to measurement problems. Studies made by the Laboratory during the year resulted in a further understanding of the theory of the production of flashing light, especially about its duration and efficiency. Foremost of the applications of the electronic flash equipment has been the development and use of underwater cameras for oceanography with the sponsorship of the National Geographic Society.

The Servomechanisms Laboratory continues its leadership in the development of underwater, landbased, and airborne automatic control and instrumentation systems directly for the government services and for Lincoln Laboratory. Highlighting these activities was a three-day symposium on airborne fire control and instrumentation, at which over 100 representatives of industry and the military received reports on research activities in these areas. The response to the first

presentation was such that a repeat performance for 40 specialists was presented later in the year. During the year the Numerical Control Group in the Servomechanisms Laboratory completed the director system under development for the Giddings and Lewis Machine Tool Company; the Special Summer Program in Numerical Control of Machine Tools, presented in August, 1954, was so well received that it was repeated during the summer of 1955. The Nuclear Instrumentation Group continued its investigations into methods for designing highly reliable and rugged instruments for measuring neutron flux.

The staff members responsible for the new work on energy conversion continue to strengthen the research activity in this field. Most notable was the amount of original material that came to light during preparation of the senior subject in Power Modulators for the new curriculum. Several important aspects of the work are being pursued as doctorate thesis topics, and others are being documented for publication in the professional journals. The staff research program is broadly concerned with the application of electric and magnetic fields and materials to the storage, conversion, and control of electric energy. More specifically, it relates to the manner in which the properties of materials determine the geometry, behavior, and heat-transfer system of the energy-processing devices which they form. The application of new magnetics and semiconductors in new circuits has been receiving much attention.

The Data Processing Group continues to adapt computer technology to the generalized solution of broad engineering problems. Under a grant-in-aid from the Union Carbide and Carbon Company, techniques of linear programming have been adapted to the problem of production allocation of a single product among several plants.

Faculty members in electrical engineering also play an important role in two interdepartmental laboratories, the Research Laboratory of Electronics and the Acoustics Laboratory. These activities are reported separately.

Professor Osman K. Mawardi was awarded a Guggenheim Memorial Fellowship for research at Cambridge University, England. Professor Harold E. Edgerton spent the summer on an expedition to the Mediterranean, sponsored by the National Geographic Society, where he worked with Captain Jacques Cousteau taking underwater photographs from the Bathyscaphe and the Calypso. Instructor Roger Baumann received a Fulbright Award for a year's study in Europe.

The Electrical Engineering Student-Faculty Committee was awarded a $500 Karl Taylor Compton Prize in recognition of its distinguished achievement as a student activity in effecting better and closer relationships between students and staff. Sophomore Bruce DePalma, representing M.I.T., won the Student Papers Contest sponsored by the New England Section of the Institute of Radio Engineers.

To advance its educational objectives, the Department this year invited many leaders from industry and other universities to participate in its program.

The Webster Professorship was held during the second semester by Dr. Robert A. Ramey, manager of the Magnetic Development Section (Materials Engineering) of the Westinghouse Electric Corporation. His skills made a unique contribution to the consolidation of the Department's new educational program in the area of energy and materials exploitation. He taught the first offering of a new graduate subject, Nonlinear Impedances as Power Modulators, to a large class of graduate students and staff. This subject will in the future be taught by Professor David C. White.

Visiting staff members with the Department this year included: Associate Professor Robert M. Saunders, University of California; Assistant Professors Herman E. Koenig, University of Illinois, Robert F. Lambert, University of Minnesota, and Eliezer Mishkin, Hebrew Institute of Technology, Haifa, Israel; A. B. Lees, College of Technology, Manchester, England; and A. B. Jones and W. J. Roths, members of the staff of the General Electric Company Lynn works. Dr. Yasundo Takahashi, in charge of the Institute of Industrial Science at the University of Tokyo, was Visiting Fellow in Electrical Engineering, working with Professor Donald P. Campbell on process control and heat transfer studies. Dr. Sei-Ichi Kondo, Assistant Professor of Physical Chemistry at Osaka Liberal Arts University, Japan, was appointed Guest of the Department to work in the Laboratory for Insulation Research under Dr. von Hippel. Dr. David H. Raab, from the Department of Psychology at Brooklyn College, continued his association with Dr. Walter Rosenblith as a Visiting Fellow in Electrical Engineering. He is working under a special research fellowship awarded by the National Institute of Neurological Diseases.

Mechanical engineering.

Professor J. P. Den Hartog assumed leadership of the Department of Mechanical Engineering in the fall of 1954. Because of a prior commitment, he was away on a Fulbright Lectureship in Japan during the Spring Term of 1955. Professor James Holt served as Acting Head during Professor Den Hartog's absence.

No major changes were made in the curriculum of the Department during the year, but the staff gave considerable attention to applied mechanics and its relation to instruc-

tion in physics and electrical engineering. The study is to be continued this year.

The cooperative course continues to grow and now comprises 25 per cent of the undergraduate class. For the first time some of the students are doing their practical work in plants on the Pacific Coast.

The Department continues to be active in Special Summer Programs, having presented 10 during the past summer.

The research program, while not as large in volume as in some other departments, is remarkable for its great range of topics. The complete list is a long one and includes work on boiling heat transfer by Professor Warren M. Rohsenow; production of liquid helium by Professor Samuel C. Collins; studies of boundary layers in turbomachinery under Professor E. S. Taylor, Robert C. Dean, Jr., and Alan H. Stenning; studies of the aerothermopressor by Professor Ascher H. Shapiro; research on surface ignition of fuel air mixtures under Professor C. F. Taylor; studies of wear and friction under Professor Milton C. Shaw; research on transient creep and brittle crack propagation in steel by Professor Egon Orowan; research on statistics of fatigue by Professor Frank A. McClintock; research on the flow of fluids and solids by Professor William A. Wilson; and the development of an auxiliary power supply for missiles under Professor John A. Hrones.

Professor Collins has reached results of unusual value in his development of machinery for the liquefaction of helium. Whereas in the past research at low temperatures had to be carried out on a minuscule scale, it is now possible to refrigerate volumes of several cubic feet. Investigations are now in progress by Professor Collins, in collaboration with Professor

Orowan's Materials Division, in which regular size metal test pieces in a standard testing machine are brought down to very low temperatures for the purpose of studying the physical behavior of materials under these conditions. This is opening up a broad new field of research in which we may expect to encounter many new and unexpected phenomena.

The aerothermopressor, developed during recent years by Professor Shapiro, is a device whereby finely atomized water droplets are injected into the exhaust stream of a gas turbine in such a way that the power produced by the turbine and its efficiency are increased. Apart from the possible practical utility of the aerothermopressor, particularly for naval ships, the research has led to a valuable increase in our general knowledge of the process of evaporation of a cloud of small droplets.

Professor Den Hartog spent the Spring Term at the University of Tokyo in Japan. Professor C. F. Taylor spent a semester at the University of Delft, Holland, as Visiting Professor and Fulbright Lecturer. Professor McClintock presented a paper and attended a colloquium on fatigue problems in Stockholm, Sweden, sponsored by the International Union for Theoretical and Applied Mechanics.

The Department had four visiting fellows from abroad who took an active part in the academic life of the various divisions last year: Dr. Alfred Slibar of the University of Vienna, Wegener Sleeswyk of Delft, Holland, Professor Yasutoshi Senoo of Kyushu University, Japan, and Professor Sun-Mo Chung of the University of Seoul, Korea. The Student Section of the American Society of Mechanical Engineers and the Pi Tau Sigma Society were the joint recipients of a Karl Taylor Compton Award.

During the year the construction of the Edward S. Miller Room was completed, and dedication ceremonies were held on December 18, 1954.

Metallurgy.

Undergraduate enrollment in metallurgy is still not nearly sufficient to supply the acute demand for graduate metallurgists. In order to bring the merits of metallurgical training to the attention of prospective students of the Institute, the Department, in cooperation with the local chapter of the American Society of Metals, arranged a series of four educational lectures during the month of January. High school science teachers from the Boston area were invited to bring four seniors each, and this provided a lively and interested audience. Later in the season the series was repeated in the form of television performances on station WGBH-TV — the first such scientific series to be offered on the new Channel 2.

The graduate program places considerable emphasis on research. Among many of the research results of the past year, a few are selected for mention here.

Professor Herbert H. Uhlig has shown that metallographic methods, long familiar to the metallurgist, can be used to supply valuable information on the history of the solar system through studies of metallic meteorites. The studies suggest that these meteorites cooled extremely slowly under high pressures and that at some time in their history the pressure was suddenly released.

In response to an increasing military and industrial need for steels with very high tensile strengths, Professor Morris Cohen and Dr. Bernard S. Lement have conducted significant experiments on low-temperature tempering of steel. The

results indicate that strengths approaching 300,000 p.s.i. can be obtained before the onset of the embrittling reaction. Professor Michael B. Bever and his students have continued their study of an experimental laboratory method for measuring with extreme precision the heat of solution of metals in molten tin. This has led to a determination of the amount of energy retained in alloys during cold work and has also permitted many other thermodynamic studies of alloys.

Considerable interest has developed in the solubility of water in molten glasses and in molten metallurgical slag. The presence of water has a profound effect upon the properties of glass, and its presence in metallurgical slags introduces hydrogen as a constituent of the metal. Even three or four parts per million of hydrogen in steel has been found to have extremely deleterious properties. The control of water vapor in slags and glasses is a problem of increasing industrial importance, and the research is aimed at obtaining sufficient basic information to permit such control.

Several years of continued research effort by the Foundry Section of the Metallurgy Department has led directly to the attainment of properties in aluminum alloy castings equivalent to those of forgings. This year saw translation of laboratory results directly into practice by industry; this is an important development since many industries (aircraft is a good example) depend heavily on light metals for optimum performance.

Meteorology.

Because the enrollment in the Meteorology Department is predominantly in the Graduate School, the Visiting Committee recommended at a meeting in April, 1955, that the undergraduate program be discontinued. This is not

expected to make a major change in the activities of the Department.

A small reduction in the total number of students enrolled resulted from a decrease in the number of Air Force officers in attendance. Although the need for weather officers remains high, the Air Force has been unable to obtain a sufficient number of personnel who are qualified to take our meteorology program.

The Department sponsored two Special Summer Programs of two weeks each in June. The first of these was on the use of radar in meteorological research and forecasting, a new and growing field in which the Department's Weather Radar Research project has played a leading part. The second special course dealt with the newer developments in weather forecasting, including both numerical weather prediction and statistical techniques developed here during the past year. The interest in these Special Summer Programs has been very heartening, and the Department plans to offer similar subjects of this general kind in the future.

A large part of the total effort of the Department is devoted to the research program, which consists of nine projects sponsored by the three military services and the Weather Bureau. All of these projects have made significant progress during the year. Several particularly important and interesting accomplishments are worthy of note.

The project under the direction of Professor Victor P. Starr has made notable progress with one of the most fundamental problems of meteorology — the mechanism of global circulations of the atmosphere. Previous investigation showed that energy transfer from low to higher latitudes was accomplished by quasi-horizontal processes in which the traveling cyclones play a key role. It has now been demonstrated how

the kinetic energy of these cyclones is transferred to the zonal westerlies, of which the jet stream is a striking feature. Dr. Hsian-lan Kuo has recently succeeded in developing equations that describe how the potential energy, established by radiational processes, is transformed into kinetic energy. The results of this study appear to be of the utmost significance and hold the promise of an early resolution of at least the main features of the fundamental circulation mechanism.

A project under the supervision of Professor Thomas F. Malone was instituted for the purpose of developing a new type of synoptic climatology based on atmospheric circulation patterns rather than on mean temperature and rainfall as in the past. With the aid of statistical methods developed by Professor George P. Wadsworth of the Department of Mathematics, the original aim was achieved. One unexpected result of this study was the discovery that the same statistical procedures could be utilized to make forecasts one or more days in advance which compare favorably with the results now being achieved by numerical prediction based on the dynamical equations. The statistical approach also holds promise for longer period forecasts. It is hoped that eventually dynamical principles can be incorporated into the statistical procedures, thus leading to a more precise forecast than that made by either method alone.

One of the most difficult problems of experimental cloud physics has been the measurement of the size and size-distribution of cloud drops in the free atmosphere. A project under the supervision of Professor Delbar P. Keily has developed a new and most promising device for this purpose.

Naval architecture and marine engineering.

The major curriculum change in the Course in Naval Construction and Engineering during the past year was the

introduction of a fifth option in nuclear engineering. The new option was originally designed to replace the fifteen-month nuclear engineering curriculum being offered by the Department of Chemical Engineering. However, a growing need for nuclear engineers in the Navy has indicated the necessity of continuing both curricula for an indefinite period. The first group of four students began the Nuclear Engineering Option in the 1954–55 academic year.

During the 1954 Summer Session, eight naval activities participated in the Department's Summer Program for Naval Civilian Employees.

The new curriculum of the Course in Shipping and Shipbuilding Management has now taken definite shape, and the program was offered for the first time this year.

Last spring the Institute Museum Committee relinquished its jurisdiction of displays in the Francis Russell Hart Nautical Museum — a task to be undertaken in the future by the Department. A scheme of rotating exhibits has been activated, one of which this year included many noted half models from the Captain Arthur Clark Collection and another, half models made by Frank C. Paine.

During the past year the Propeller Tunnel has been used largely for thesis work. During the summer of 1954, two officers of the United States Navy remained on duty at M.I.T. for work in connection with instrumentation for experimental determination of propeller generated vibratory forces on adjacent bossing structure, and they also assisted in major overhaul of the dynamometer and propeller driving apparatus. An instrumentation study undertaken by the Navy in the summer of 1954 subsequently was expanded into a thesis of considerable magnitude and continuing importance, particu-

larly since it is closely associated with a project of the Society of Naval Architects and Marine Engineers.

The Ship Model Towing Tank continued to be a very usable and valuable research tool. This year has been an extremely active one, with seven thesis projects underway by ten students. In addition, the Towing Tank was active in several research projects — in particular, research on models operating in waves. It was shown that appreciable pitching damping can be obtained from suitably placed fixed hydrofoils at the bow.

The instrumentation of the Towing Tank has been augmented by two new pieces of apparatus: an electronic wave height recorder, and an interesting gyro pitch angle and pitch velocity recorder consisting of a very compact and sensitive guided missile gyro redesigned and remodeled for ship model research.

Activity at this installation reached its peak during the Second Term. More than once the Tank was in operation 24 hours a day, with students running tests even during the midnight to 9:00 a.m. shift. There can be no doubt that the Tank has been a needed and welcome addition to the educational process of this Department.

Assistant Professor W. W. Robertson, who had been on a long leave of absence because of poor health, passed away on October 30, 1954. His many years of good service to the Department will be remembered by all who knew him.

Professor George C. Manning returned in September from a Visiting Professorship at King's College, Durham University, England.

Professor Martin A. Abkowitz represented M.I.T. at the Seventh International Towing Tank Conference in Scan-

dinavia in the summer of 1954. His contributions to this Conference were important and gave high credit to M.I.T. Professor Troost also attended the Conference and presided at some of the technical sessions. Professor Abkowitz worked for about two months at the Netherlands Ship Model Basin. This proved to be a very satisfactory arrangement, and the M.I.T. Tank is collaborating with the Netherlands Basin on research work for a Netherlands shipping company.

Professors E. Eugene Allmendinger and Amelio M. D'Arcangelo will each teach a six-week course this summer for the Department of Mechanical Engineering at the University of California.

Graphics.

Under Professor John T. Rule the Section of Graphics is continuing its adjustment to the circumstances of the new freshman program whereby Engineering Drawing and Descriptive Geometry are now electives. This program has been in effect for only two years, and the percentage of students taking these subjects has not yet stabilized. The trend, however, is downward, with Descriptive Geometry being the chief sufferer. Only about 20 per cent of the freshman class took this subject, probably because of the desire of freshmen to elect available upperclass subjects.

The Section is attempting to meet this situation by offering other attractive subjects in graphics as electives. For the coming year, Engineering Drawing, which has contained considerable work in engineering graphics, will be entirely engineering drawing in the traditional manner; the work in graphics will be offered as a special subject for those interested. Such a presentation was offered during the past year and proved to be quite successful. Elementary nomog-

raphy, navigation, and advanced graphics will complete the program.

The staff continues to view the theoretical development of graphics as a science as its chief research goal. New methods are constantly being explored and perfected.

General science and general engineering.

General science and general engineering do not comprise a separate department; activities in this area are supervised by Professor John T. Rule, and the following comments may be appropriate here.

Enrollment in general science and general engineering totaled 60. In addition, there were eight students in the Science Teachers Program, although no degrees were awarded in this field this year. It is encouraging that interest in the Program is increasing and that the number of inquiries from students was considerably greater during the past year. The need of secondary schools for good science and mathematics teachers was reflected in the number of positions available to our students. Furthermore, the potential salaries were definitely higher than in the past. It therefore seems probable that this program will expand over the coming years.

3. INTERDEPARTMENTAL LABORATORIES

The following reports of Interdepartmental Laboratories have been provided by their directors, Professor Richard H. Bolt in acoustics and Professor Jerome B. Wiesner in electronics.

Acoustics Laboratory.

Interactions between turbulence and sound have aroused new research interests in several groups of the Acous-

tics Laboratory during the year. The sibilant sounds of speech are generated by air turbulence at the teeth and lips. The noise from jet aircraft engines is created largely by turbulence. The high-speed airflow past an aircraft fuselage in supersonic flight vigorously excites the skin and produces intense noise in the cabin. Sound is scattered by turbulence, a phenomenon that markedly influences the propagation of sound through the atmosphere.

In a crucial experiment conducted by Professor K. Uno Ingard and Dr. David C. Pridmore-Brown during the year, the scattering of one sound wave by another sound wave was measured quantitatively for the first time. The scattered distribution in angle and frequency confirms theoretical predictions that were also made during the year. Since turbulence can be viewed as a statistical assemblage of acoustic fluctuations, this basic experiment opens up a powerful new technique for studying the scattering of sound by turbulence.

Other research in sound propagation has dealt mainly with inhomogeneous and moving media. Emphasis has been placed on atmospheric acoustics; instrumentation was completed for field studies in the correlation of meteorological factors with sound field behavior. In addition, results have been obtained on refraction of sound in temperature and wind gradients over the ground. The basic problem of propagation of sound into a moving medium has been considered for velocities that are larger than that of sound. The result has indicated the appearance of what might be called ordinary and extraordinary sound rays, in analogy with propagation of light in crystals.

Using a new high-speed acoustic absorption spectrometer developed during the year, the ultrasonics group headed by Dr. Theodor F. Hueter is studying visco-elastic loss mechan-

isms in biological substances. Measurements over a wide frequency range have been made on castor oil, milk, egg white, beef liver, and other materials. The results are expected to assist in the theoretical analysis of biological materials in terms of their equivalent mechanical models.

Another research program, conducted by Dr. James E. Young, is concerned with the temperature dependence of sound absorption in air and nitrogen at temperatures of up to 1000°C. The theory of molecular relaxation has been extended to the high temperature range, and the results of current experiments are expected to yield values of state lifetimes for the dynamic process and estimates of atomic radii.

Research in the speech group under Professor Kenneth N. Stevens, aimed at the transmission of speech information over communication channels of low capacity and narrow bandwidth, includes studies in the automatic analysis and synthesis of speech by electronic devices, phonetic and linguistic studies of the vocal communication process, and psycho-acoustic studies of the perception of sounds by man. The group encompasses the necessary backgrounds, including persons trained in engineering, physics, linguistics, phonetics, and psycho-acoustics. Work has continued on two types of electronic speech synthesizers, one of which is already producing fairly intelligible speech from control signals of very low information rate. An electronic speech analyzer was developed, and a complete bandwidth compression system is in an embryonic stage. Phonetic and psycho-acoustic studies, designed to extend basic knowledge of the process of speech communication, have included the investigation of consonant articulation and perceptual tests on synthetic speech sounds. Professor Morris Halle's speech research group has moved into the Acoustics Laboratory to consolidate work in this

area, but his program continues to be sponsored by the Research Laboratory of Electronics.

A long-range program in fully automatic analysis of complex acoustic signals was initiated five years ago. The resulting analog computing system, developed under the supervision of Mr. F. Mansfield Young, was operated as a whole for the first time during the past year, with input signals scanned from oscillogram films and output answers tabulated by an electric typewriter. This work should point the way to more widespread usefulness of magnetic recording as a precise experimental tool for scientific research.

The Laboratory's administrative pattern remained about the same. Some 50 staff and students and about 25 service personnel participated in the activities. The Laboratory conducted a series of 16 acoustics seminars. Members of the Laboratory presented about 35 talks before professional organizations and published about 20 papers. Fifteen theses completed during the year were submitted by students in the Departments of Physics, Electrical Engineering, Naval Architecture and Marine Engineering, Economics and Social Science, and Civil and Sanitary Engineering.

A two-week special course on Noise Problems in Aviation, attended by 116 senior Air Force officers, was presented by the staff of the Acoustics Laboratory under the supervision of Professor Bolt.

The first award of the Institute of Radio Engineers Professional Group on Audio was received by Dr. Kenneth W. Goff. The Owens-Corning Fiberglas Fellowship in Acoustics was awarded to Mr. Peter A. Franken. Professor Osman K. Mawardi spent the year at the University of Cambridge, England, studying problems related to turbulence. Professor Walter A. Rosenblith received three new committee appoint-

ments in connection with his work on interactions between noise and man.

A much-needed new journal, *Noise Control*, launched during the year by the Acoustical Society of America, was developed under the chairmanship of Professor Leo L. Baranek, who was also president of the Society.

Research Laboratory of Electronics.

The Research Laboratory of Electronics has continued to operate at a high level of activity. During the past year 47 Faculty members and 97 students participated in the research program of the Laboratory. The staff was drawn from the Departments of Physics, Electrical Engineering, Economics, Chemistry, Mathematics, and Modern Languages. In addition, guests from five foreign countries participated in the research program, and the Laboratory was host to a very large group of foreign visitors.

The research program of R.L.E. is largely defined by the specific interests of the Faculty members involved and therefore changes considerably from year to year. At the present time the physics program includes research on the following topics: the structure of atomic nuclei using atomic beam methods (Professor J. R. Zacharias); nuclear resonance (Professors Francis Bitter, L. C. Bradley, and J. S. Waugh); radio frequency spectroscopy (Professor M. W. P. Strandberg); microwave gas discharges (Professors S. C. Brown and W. P. Allis); thermionic emission and high vacuums (Professor W. B. Nottingham); and soft X-rays (Professor G. G. Harvey).

The electrical engineering program also includes research on: network synthesis (Professor E. A. Guillemin and Dr. M. Cerrillo); switching circuits (Professors S. H. Caldwell and D. A. Huffman); information theory and communications

(Professors R. M. Fano and Peter Elias); the non-linear circuit theory (Professors H. J. Zimmermann and S. J. Mason); microwave electronics (Professors L. J. Chu, L. D. Smullin, and H. A. Haus); noise theory (Professors Y. W. Lee and Wiesner and their students); propagation studies (Professor Wiesner); solid state devices (Professors R. B. Adler and Fano); bioelectric signals (Professors W. A. Rosenblith, Norbert Wiener, and R. C. Booton, Jr.); neurophysiology (Drs. W. S. McCulloch, J. Y. Lettvin, W. J. Pitts, and P. D. Wall); systems development (Professor Zimmermann); and psycho-acoustics (Professor J. C. R. Licklider).

In addition, Professors W. N. Locke and V. H. Yngve of the Modern Language Department are directing an extensive investigation of methods of language translation by means of machines, and Professor Morris Halle of that Department is studying the properties of speech signals. Professor C. W. Garland of the Chemistry Department is studying properties of materials at low temperatures.

Some important results of these programs are reported briefly below:

In Professor Zacharias' Atomic Beam Laboratory there were two notable advances of very different types. First, it was definitely shown that the magnetic effects of an atomic nucleus can arise from a distribution of magnetism which is not spherically symmetrical — a so-called nuclear magnetic octupole moment. The effect was demonstrated for the two isotopes of gallium. Secondly, a resonance frequency in the cesium atom was used to stabilize the frequency of an oscillating circuit to a precision of 1 in 10^{10}.

The microwave spectroscopy group completed a comprehensive study of the ground state of the oxygen mole-

cule. The problem of determining the source of the ground state splitting, which has elicited a high level of interest for two decades, was solved using the Laboratory's very sensitive and precise electron paramagnetic resonance spectrometer. The correlation of the analytical and experimental spectrum is so good that sources of the ground state splitting are assignable in amount.

The physical electronics group, directed by Professor Nottingham, has recently completed the most significant of a long series of studies carried on at this Laboratory to determine the thermionic properties of tungsten. This work, done as a doctor's thesis by Dr. Andrew Hutson, not only has given new values to the differences in work-function as a property of crystallographic direction, but it has also served to give a direct evaluation of the temperature coefficient of the work-function and also the first actual test by direct observation of the reduction in work-function described as the Schottky Law.

In addition, a student member of the group, Haywood Shelton, designed and constructed a new type of ionization gauge which we have called the massitron. The gauge not only has very acceptable sensitivity and freedom from all spurious effects, but at the same time it identifies the particular gas responsible for the ionization measured. This instrument is an important electronic development; it has already been used to great advantage in improving the techniques by which extremes in ultra-vacuum are obtained.

Professors Wiener and Rosenblith, together with Dr. Mary A. B. Brazier of the Massachusetts General Hospital, have developed an electronic correlator for electrical signals taken from the brain. This new measurement technique makes possible the study of electrical activity in the brain which formerly was completely masked by background noise. With

it, inter-relationships of electrical signals from different parts of the brain are being studied.

A number of graduate students have also made important contributions to R.L.E.'s research program. Among these are: David I. Kosowsky, who developed a synthesis procedure that greatly simplifies the design of crystal filter networks for use in communication circuits; Alan L. McWhorter, whose theory of random noise generated in semi-conductor materials such as germanium represents a major step in the understanding of this phenomenon; and Amar G. Bose and S. D. Pezaris, who together developed a fundamental theorem concerned with the minimum noise figure in a very general class of circuits.

Further details on all these activities may be obtained from the Research Laboratory of Electronics Quarterly Progress Reports.

C. RICHARD SODERBERG.

Report of the Dean, School of Humanities and Social Studies

Following a unanimously favorable vote by the Faculty, the Corporation in June approved the introduction of a new undergraduate course of study at M.I.T. known in the Institute's shorthand as Course XXI. This event ranks with the strength achieved earlier in economics, the creation of a School of Humanities and Social Studies in 1950, and the inauguration of the Center for International Studies in 1951 as a major milestone in the progressive development of the humanities and social sciences here.

The new course of study is more appropriately explained in detail in other publications. When coupled with a slightly modified Course XIV, also now available, it offers an entirely new opportunity for undergraduate education in

a technological environment. The hours of the curriculum in the four-year program are about equally divided between fundamental science and engineering subjects on the one hand and social science and humanistic subjects on the other. In each of the two divisions the student pursues what amounts to a major. All the majors of the Schools of Science and Engineering are available, and in the School of Humanities majors may currently be constructed in economics, American industrial society, political science, and literature and philosophy.

At the end of his four-year program, the successful student will have earned a degree of Bachelor of Science. If his formal university education stops there, we believe he will have experienced a general education especially well suited for an understanding of the world of the second half of this century; but the curriculum is designed to encourage him to carry his formal study farther. He will be able in one more year in an engineering department of his choice to earn a further bachelor's degree with specification of engineering field; he will be able to enter graduate work at once in the field of science in which he has carried on his major; equally he should be prepared to enter a graduate school in the field of humanities or social sciences in which he has carried his other major; finally, and of considerable importance, he should have remarkably good preparation for immediate entrance to graduate schools of law, of medicine, and of business or public administration.

This course structure will, we believe, offer an educational opportunity new to the United States, inevitably lead to a further strengthening of an already excellent Faculty in the humanities and social sciences at M.I.T., and very likely draw to the Institute some excellent students of a type we have failed to attract in the past. The latter development will take

time, for there remain in the minds of many parents, school principals, and headmasters some archaic ideas of the quality and the depth of the educational and extra-curricular experience now available here, over and above the strong experience in theoretical and applied science about which they are naturally better informed and which they almost take for granted.

Almost immediately after the new course structure had been approved we were further heartened by two substantial grants, each of which will in a different way give us a strong leg up in going forward with this program.

The Rockefeller Foundation has made a ten-year wasting grant of $300,000 entirely to be devoted to the development of Course XXI. The program for utilizing this particular grant calls for devoting almost all of it to teaching and, primarily, to teachers' salaries. Since the plan is to increase slowly, upwards of $40,000 a year of new income will be available for most of the decade. That this will materially strengthen the teaching resource is obvious. The grant will be administered by the Department of Humanities under the direct management of Professor Howard R. Bartlett, head, and Professor John M. Blum, who will direct the new Course XXI.

A little later the Carnegie Corporation made a three-year grant of $150,000 in support of research on the relationship between American society and this country's new position in the world, together with a subsequent national conference on the same subject. This study will be managed by the Center for International Studies and most directly by Professor Walt W. Rostow of the Department of Humanities. It is the beginning of what we hope may evolve into a general program of research on American society, a program that should obviously offer many opportunities for contributions to the

Institute's teaching program — and sharply so in several of the options of Courses XXI and XIV.

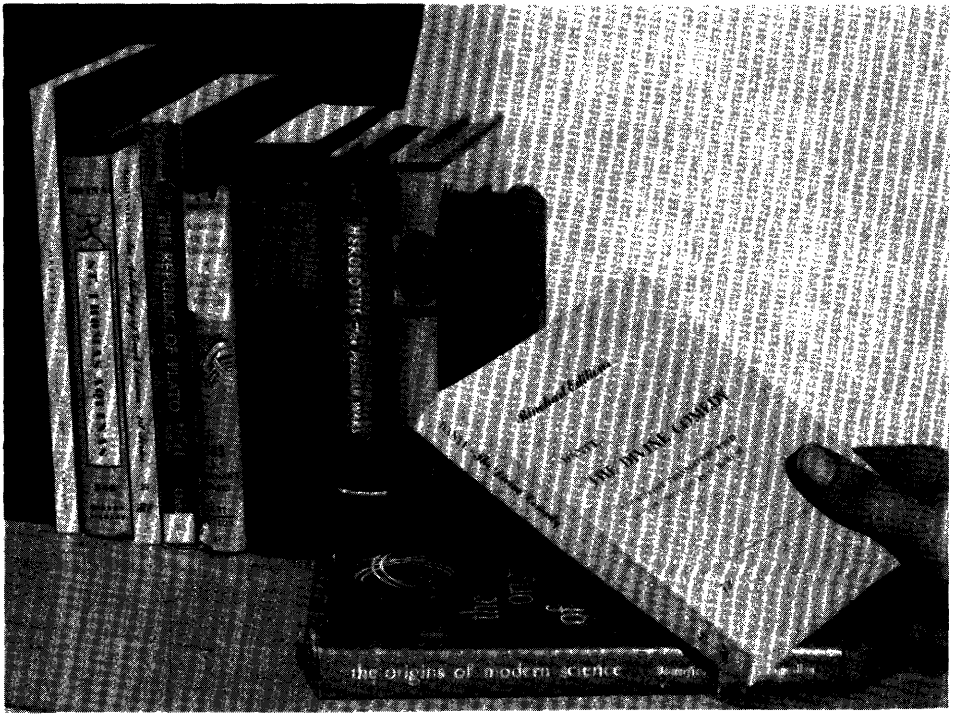
When the effect of these two grants is coupled with the real ferment provided by earlier grants — $150,000 from the Carnegie Corporation for general work in the humanities, $30,000 from The Rockefeller Foundation to start what is turning out to be a successful experiment in teaching the core curriculum to selected students in French, and nearly $2,000,000 from the Ford Foundation for research work in the Center for International Studies — it is quite obvious that the School of Humanities and Social Studies at M.I.T. can find no reason to be anything but happy about the foresight and the generosity of America's largest foundations.

Undergraduate teaching.

With no significant exceptions, every undergraduate at M.I.T. studies a subject with some member of the Faculty of the School of Humanities and Social Sciences in every semester of his residence at the Institute. Thus, despite the increasing volume of effective research and publication which inevitably receives emphasis in a report of this kind, there is little doubt that the heaviest single part of the total effort of the School is expended on undergraduate education. At the same time the philosophy of the School is that we will be unable to do good undergraduate teaching unless our Faculty is working on the frontiers of scholarship. The reconciliation of these two somewhat diverse aspirations has never been easy anywhere; but it is essential, and on the whole we believe we have managed it reasonably well here.

There are times when drastic changes in the undergraduate curriculum have required extensive use of this report to describe them. That is not so this year. The core curriculum required of all freshmen and sophomores and now

These are among the books with which freshmen make an intimate acquaintance in the first-year core curriculum in the humanities.



directed by Professor E. Neal Hartley has proved in most respects successful, and the changes to be made next year are distinctly minor. The reading lists for this core have attracted the attention of numbers of people outside the Institute, and the Department of Humanities is called upon to mail copies far and wide.

The elective program of the upper two years will probably require continuing study (as indeed any educational program does) because it takes experiment to find those really powerful combinations of three or four elective subjects in a single discipline which together make a brief and meaningful concentration.

For example, the totality of work going on at the Institute in political science is extensive. There is the group which for years has been offering work in international relations under Professor Norman J. Padelford in the Department of Economics and Social Science; there is the scholarly work in nationalism by Professor Karl W. Deutsch in the Department of Humanities, from which he offers also some courses; there is the extensive work in the Center for International Studies, from which in this area we have drawn teaching support from Professors Ithiel de Sola Pool and Raymond A. Bauer. There is risk of too much coordination; there is risk in too much scatter. Accordingly, through the year we have had a committee at work under the chairmanship of Professor Charles P. Kindleberger of the Department of Economics. This committee has proposed helpful and interesting reorganization of activities in this area, including concentrating the teaching in a section of political science. The aims of this section will be to eliminate existing duplication, to fill obvious gaps in personnel and programs, and to provide a coherent undergraduate option. These recommendations all seem

sensible and capable of being carried out. Although this area of study is less quantitative in general than many fields of economics, it seems to us that along with economics a proper understanding of political institutions and behavior is an essential for sensible conduct in the modern world.

A similar study of psychology was made for us a year ago by a distinguished outside committee under the chairmanship of Professor Donald G. Marquis of the University of Michigan. Some of the recommendations of this committee have been achieved; others remain for the future to develop. Insofar as the undergraduate program is concerned, I am happy to report that it is being studied by members of the Psychology Section in cooperation with their colleague psychologists in the Industrial Relations Section and the School of Industrial Management. The outcome of this study will be in part the evolution of an introductory course in psychology particularly designed to meet the needs of M.I.T. students. The whole format of undergraduate training in psychology is being revised at this same time and will entail the introduction of at least three new subjects, including one on the Psychology of Motivation. Some of these subjects will no doubt replace existing ones. The object of the revamped program will be to provide integrated training in psychology better suited to engineering students.

The junior-senior elective programs in economics, history, literature, and philosophy have all been sharpened by re-examination, but no such extensive changes have been made as in political science and psychology. There are now four advanced music subjects instead of the original two, and these cover the opera, the Beethoven piano sonatas, twentieth-century music, and a seminar in music which this year was devoted to the art song. It is probably not generally realized

how much these advanced subjects involve "live" examples. This year, for instance, in addition to the regular faculty of Professors Klaus Liepmann, Gregory Tucker, and Ernst Levy, we have had a series of meetings with guest composers including Walter Piston, Harold Shapero, Klaus Roy, Arthur Berger, Nicholas Van Slyck, Stefan Grové, and Sydney Davidoff. As before, lecture demonstrations have been given by vocalists and by various artists on the viola da gamba, flute, recorder, clarinet, violin, and piano.

Interest in the humanities core courses in French and the upperclass electives in French and German literature taught in French and German is on the increase as measured by registration. The freshman-sophomore offering of the core in French attracts, perhaps obviously, students of exceptional calibre.

The new all-Institute freshman program permits the freshman to choose from a variety of general electives. The ones offered last year in the Department of Humanities were English Composition and Public Speaking. They had enrollments, respectively, of 90 and 103 against 46 and 92 the previous year, and thus between them accounted for about one-fifth of all the freshman elections. Two new electives have been prepared for 1955–56 at the request of the Committee on the First Two Years. The Department of Humanities will offer an introduction to Philosophy and Scientific Methodology; the Department of Economics will offer an introduction to American Character and Institutions.

A less colorful but important part of undergraduate instruction is related to training upperclassmen in technical writing, a service performed by the Department of Humanities in collaboration with professional departments requesting it. Traditionally, the Departments of Electrical Engineering and

Mechanical Engineering have had such programs. This year the Department of Metallurgy requested assistance during the second term in a subject in Physical Metallurgy. All of this work fell principally on the shoulders of Professor Robert R. Rathbone, who has the unusual talents and experience necessary to do this job well. In addition to the work with metallurgy, he carried on his regular duties with the other engineering departments and instructed more juniors than ever before, which was another objective in our program to expand this kind of training. As a result of his efforts, at least 175 seniors and 180 juniors have had practice and criticism in writing reports and technical articles, an increase of 130 over last year. This effort is altogether laudable; it should be expanded.

Graduate teaching.

Thriving institutions are likely to take their strongest achievements for granted and worry about others. A report like this is almost inevitably doomed to pay inadequate attention to such a successful venture as the graduate degree programs in economics. Carried on by a distinguished faculty, this program is an outstanding success as measured by the number of applicants for graduate study in our Department of Economics and Social Science. The ratio of those applying to those admitted to the Graduate School is naturally high in all departments of the Institute, and this may occasion no general surprise; but it is probably not generally realized that this ratio in the Department of Economics is consistently among the highest in all of M.I.T. and frequently, as it was last year, the highest. Almost all candidates seek the Ph.D. degree.

The graduate work in the School can be materially bettered as we are able to work out more clearly a program

for using part of the services of the distinguished men who from time to time work in the Center for International Studies. This is generally understood, and progress is being made. A new field of concentration has been introduced in our graduate program, consisting of studies in economic development, and next year Professors Max F. Millikan, Everett E. Hagen, and Paul Rosenstein-Rodan will offer courses in this area. A still wider display of talent is available for thesis supervision. The Center for International Studies offers a limited fellowship program for students in economic development and participates as well in some of the graduate programs of the School of Industrial Management.

At present these are the only areas of the School of Humanities in which graduate study is carried on to the full extent associated with the Doctor's degree, and it is reasonable to inquire whether the total aspirations of the School of Humanities and Social Studies should be limited to these fields. The short answer to such a question is probably "no," but this should be coupled at once with the statement that there is no *a priori* desire in this School to develop more graduate work; rather there is an intention to let things develop naturally and as student demand and faculty capacities and interests indicate. Further full-scale graduate work may in the future be justified in some aspects of psychology, political science, and history — notably studies of American industrial society. This is a long forecast; and in making it I am mindful of the principle that M.I.T. is a special kind of university polarized around science and engineering, and of the fact that we have a splendid working agreement at the graduate level with our elder colleague, Harvard University. We do not seek to begin new undertakings in any of these overnight or full-panoplied.

Even with these limitations, other Faculty members of the School participate in various types of graduate programs. The Departments of Humanities and of Economics contribute to instruction in the Executive Development Program of the School of Industrial Management. Individual members of the Faculty in widely different areas lead individual graduate students in selected minors in the humanities and social sciences; and the Department of Modern Languages continues its effective training of graduate students to meet graduate requirements in foreign languages, what I personally continue to believe to be a brilliant tour de force in a poor educational cause. But this is a cause which will not be won or lost on the fields of M.I.T. What we do is in conformity with American graduate-school tradition, based on a day when knowledge of a foreign language, particularly German, was an *essential* tool in day-to-day operations of the serious student and when the knowledge of language was real. By this tradition the young American could not only read the language of his limited technical field, haltingly, with the aid of a dictionary and for a brief period of time, but he could read the great literatures of the foreign languages and could associate at a high cultural level with people who spoke only the other language. It is the American failure to restore this balance at the very time in American history when it is most important for us that I deprecate.

Problems of development.

There are four principal problems of development of institutions now existing in the School of Humanities and Social Studies:

1: *The expansion of the Faculty and program to permit a full exploitation of the opportunities implicit in the new Course XXI and the older Course XIV.* Here we are but at the beginning,

and no very clear problems emerge except that we know that undergraduate registration for degrees in Course XIV is smaller than the course deserves, and we suspect that the Department of Economics should be more aggressive in making sure that the M.I.T. undergraduate understands the opportunities offered by its program.

2: *The coordination and moderate expansion of the activities in political science.* Here we have the recommendations of the Kindleberger Committee to deal with, and the first steps are already in hand; the problems, if any, will arise later.

3: *The consolidation of our position in psychology.* The situation here is that, taken as a whole, the psychologists at M.I.T. constitute a powerful and skillful faculty. But they are widely dispersed. Some are in the School of Industrial Management, some are in the Industrial Relations Section, some are in the Psychology Section of the Department of Economics headed by Professor Joseph C. R. Licklider, and a considerable number are engaged in various research projects at M.I.T. The latter are used to some extent in the teaching program and are valuable additions to our total resource. But the difficulty in this situation was pointed out by the Marquis Committee: what psychology needs at M.I.T. is a stronger center of support — not necessarily a consolidation of all psychologists into one group, since the different applications of psychology to departmental or school needs are so various. At the base of this strength rests an organization something like that proposed for the Center for International Studies, a long-term financing which would support the equivalent of, say, four full-time tenure posts and a rotation of men holding such posts from research to teaching with a corresponding reverse flow of other psychologists on the Faculty. It would seem that the long-range support of this venture offers the largest

current problem for psychology at M.I.T. The problem is thus quite analogous to that associated with the much larger effort in the Center for International Studies to which I now turn.

4: *The consolidation of the position of the Center for International Studies.* This group, which is large and very well financed for short-run research, has made real contributions to our total effort in the few years of its existence. But its most pressing problem remains one of financial uncertainty. As Professor Millikan pointed out in his annual report, the Center has had to rely largely on short-term project financing from a variety of sources. A regular, continuing income would provide far greater flexibility — as well as stability — in the Center's program, and we might set the goal at $100,000 per year in unrestricted funds.

The Center has also minor problems of space. Space is always a harassing need all over M.I.T., but in the long run this is not a fundamental difficulty for the Center. We must make a still better definition of how we are to integrate Center activities and personnel with existing departments. This integration is bound to evolve gradually rather than dramatically. In my view the progress to this point has been satisfactory.

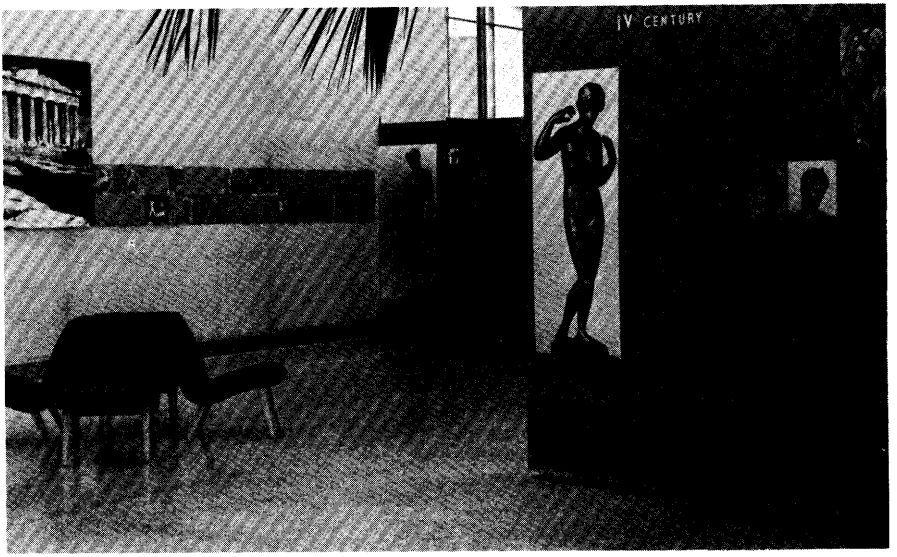
Extra-curricular activities.

This School has naturally to make rather regular and rather formally defined contributions to the extra-curricular education of students, particularly to experiences in social behavior and the humanities which go outside the classroom. Our Faculty naturally shares with the Faculties of other Schools the general responsibility for helping individual student activities as our talents and interests and their desires permit.

Beyond that, however, there are five activities which can be more sharply distinguished.

1: *Exhibits.* The exhibition room of the Hayden Library continues to be used effectively under the direction of Professor Herbert L. Beckwith of the Department of Architecture and his associates. The program of rotating shows is arranged to provide a certain number of historical experiences in the arts, coordinated with the program of the core curriculum. Over the years, and with the aid of Carnegie Corporation funds, Professor Beckwith and his advisers have developed two excellent shows, one of Classical Greece and the second of Medieval (and particularly 13th-Century) France. This year a new show has been added, with great imaginative and scholarly assistance provided by Professor Albert Bush-Brown, who works both in the Department of Architecture and the Department of Humanities. This show is a photo-mural exhibition of English and Italian Renaissance, focussing on the different development in two colleges of Oxford and on the exploitation of Leonardo's theory of the circle and the square. The newest is in many respects the most effective and "teachable" show yet devised. It is the plan to develop one new show each year until the eight periods of the core curriculum are adequately covered.

The other half of the exhibit time is devoted to current materials and last year included a comprehensive show of the work of Yves Tanguy and Kay Sage, of French impressionist and post-impressionist prints, of the painting of Josef Albers, and of bronze sculpture by Jacques Lipchitz. The Lipchitz and Albers exhibits were accompanied by gallery talks by the artists in collaboration with the Architecture Lecture Committee. Three of the gallery shows were first showings of the artists' work in this region.



A series of exhibitions, coordinated with work in the humanities core curriculum, has been prepared for the gallery in the Hayden Library.

We are convinced that this bringing of the mountain to Mahomet is an essential element in preparing for our undergraduate Mahomets' later visits to the mountain.

2: *Debating.* Under the direction of David J. Hardy of the Department of Humanities, the debating teams have had a successful season. Measured by victories in tournaments, the M.I.T. debaters won 70 per cent of their rounds and placed first in the New England Forensic Conference. Twenty-eight colleges sent teams to the Tenth Annual M.I.T. Tournament, which is now the oldest one in New England. Victories in debating are in our view much less important than the training for life afforded by this experience — one in which more students could profitably participate. The Samuel W. Stratton prize funds are now awarded to members of the debating teams.

3: *Music.* It is no longer news that the Concert Band, the Glee Club, the Symphony Orchestra, and the Choral Society, all under the general direction of Professor Liepmann, have won their way to a place in the serious life of the Boston musical community. The Glee Club has sung with the glee clubs or choral societies of Sargent, Simmons, Tufts-Jackson, Radcliffe, Bradford Junior, and Mount Holyoke Colleges. The Orchestra has given numerous concerts and played jointly with the Smith and Wellesley College Glee Clubs. The Choral Society, which has the most ambitious program, has sung Stravinsky's *Mass*, Mozart's *Requiem*, and Haydn's *Creation* with members of the Boston Symphony Orchestra. The Brass Choir directed by Mr. John Corley has become one of our strongest musical assets. All of the groups collaborated in an impressive display at the dedication of the Kresge Auditorium in May, at which time two new works were performed — a Fanfare by Professor Levy, and an Overture

and Chorus, "Canticle of Freedom," by Aaron Copland. The latter was specially commissioned for and had its premiere at the dedication. Another first performance was that of Professor Levy's Suite for Band which was played by the Concert Band in its program at the time of the Dedication Festival in May.

In addition to all this live music, created by members of the student body and staff of our own institution, we continue the Humanities Series concerts which, now that we have the new auditorium, will be heard in surroundings more auspicious than those of Huntington Hall.

Altogether the students at this institution have an opportunity (and take advantage of it) for a rich musical experience on our campus — in addition, of course, to the enormous opportunities in the total Boston community. Most of the credit for this on the campus must in the final analysis rest with Professor Liepmann, who is a great asset to the Institute and to the School of Humanities.

4: *The Drama Shop.* After some years of hiatus we have set about to revive the student Drama Shop which had an earlier distinguished history and which, with the construction of the Little Theatre, has an opportunity to bloom again. For this purpose we have appointed Professor Joseph D. Everingham to give courses in literature and to direct student theatre. His first production at the time of the Dedication Festival set the standards he hopes to attain. It was an experimental play by Francis Fergusson, "The King and the Duke," with incidental music by Professor Tucker. The plan for this group is to seek novel productions involving a maximum of student participation on the many levels of theatrical production which extend beyond amateur acting; this seems to us wiser than the effort to produce a few former Broadway successes,

however well — particularly as so many of these plays can be seen with original casts in this area and particularly as the Staff Players, an adult organization at M.I.T., does such a very good job in this field.

5: *Lectures.* Most of the general extra-curricular lectures at M.I.T. are managed entirely by the student body under the direction of the student-run Lecture Series Committee, and the function of the School in this regard is simply to provide advice *when asked.* However, the School does for various formal reasons bring a number of visitors to the campus; among those who have been here this year and have talked on subjects of general interest are Professors Edmund S. Morgan of Brown University; Joseph Strayer of Princeton University; Carl Friedrich of Harvard University; Kenneth MacLean of the University of Toronto; Lionel Trilling of Columbia University; Edward Barrett, formerly Assistant Secretary of State; Sir Alexander Grantham, governor of Hong Kong; and Arnold Toynbee. This takes no account of the considerable number of more specialized colloquia presented by visitors or of the extensive program of the Lecture Series Committee.

Research.

The present level of scholarly productivity in this School is so high that it is quite impossible to make any adequate presentation of it in a brief report, and any sample may seem invidious. Nonetheless an effort must be made. The purpose of this section is rather to indicate the range of interest than necessarily to try to assess the projects or to name the most important. The total scope of the effort is better indicated by the list of publications which appears elsewhere in the Institute's administrative report.

In the Department of Humanities, Professor Deutsch nearly completed his work on historical experiences and contemporary problems of international organization — a contribution to a volume for the Center for Research on World Political Institutions at Princeton; Professor John B. Rae continued his study of the engineer as business man under grants from the Social Science Research Council and the Sloan Research Fund of the School of Industrial Management, after three previous years of support from the Research Center in Entrepreneurial History at Harvard; Professor Hartley completed his historical research in connection with the restoration of the First Iron Works at Saugus, Massachusetts; Professor Thomas H. D. Mahoney spent the summer in England examining newly available collections of the letters of Edmund Burke; Professor Blum began his study of the activities of Henry Morgenthau, Jr., while the latter was Secretary of the Treasury, a project which will require the major portion of Professor Blum's research time for at least three years.

There are two very interesting and potentially intersecting lines of research in the Department of Modern Languages administered generally by Professor William N. Locke, head of the Department. The Speech Analysis Project is carried on by Professor Morris Halle, assisted by a number of graduate students who are finding increasing possibilities for thesis material in this research, combining as it does linguistics with acoustics and electronics. Insofar as so complex an investigation can be curtly summarized it may be said to have as its purpose a deeper understanding of the question of how men understand each other's speech. For this work a strictly behavioral definition is used for the word "understand," equating it with "being able to write down what one hears." The work in the last year has been concerned with the dis-

covery of the minimal distinctions of Russian and English speech sounds. The Russian description has been completed; the investigation of English has been started with a study of English fricatives and has led to rather satisfactory results.

The other project is of equal scientific interest and perhaps of more immediate application. It is directed by Professor Victor H. Yngve, who has gathered a staff of four of the most promising young linguists in the country to develop methods for translating languages by machine. Translation is of course a vital world problem, under study by numerous world organizations.

No humanist should be alarmed by the nightmare that a translating machine is about to receive the *Commedia* of Dante at one end and produce a literary equivalent in English at the other. But there are many lower levels of communication on which mechanical translation now seems possible and definitely useful. Mechanical translation, when accomplished, will shorten the time when important research published in a foreign tongue comes to the attention of scholars. The research, which is supported by the National Science Foundation, involves work in the Institute's Research Laboratory of Electronics to develop methods for using electronic digital computers and allied equipment. It seems probable that existing devices could do the work if we knew enough about languages. Modern descriptive linguistics has advanced to the point where it has provided many of the methods and techniques necessary to advance our understanding of sentence structure to the degree of detail needed to state a mechanical process for translating sentences. The M.I.T. project aims at putting linguistics and computer technology together.

In order to provide a means of intercommunication for students of this new field, Professors Locke and Yngve are

editing a journal, *Mechanical Translation*, founded one year ago. Four numbers have appeared, including a running bibliographical survey and papers. It is partially supported by a grant from the Rockefeller Foundation.

These projects in the Department of Modern Languages have been described in some detail because they provide a striking example of how scholarship in the humanities and scholarship in science and engineering can work hand in hand, an arrangement which has by no means been effected in several other areas where it seems possible, given enough imagination and desire.

Very major research activities in the social sciences are carried on in two organizations, the Center for International Studies and the Industrial Relations Section of the Department of Economics; each publishes its own annual report where these matters can be dealt with in more detail.

Of the Industrial Relations Section, let me say only that Professor Charles A. Myers, its head, spent most of the year in India investigating labor problems as part of a research program financed by the Ford Foundation and conducted jointly by Harvard, the University of California (Berkeley), the University of Chicago, and M.I.T.

The enormous volume of work in the Center for International Studies can be well understood only by reference to its own reports, but the following may be said of the research year:

1: The projects in communication, economic development, and United States-Communist Bloc relations entered the critical stage of gathering large quantities of basic data. From this now flows the raw material on which the analytical and interpretive final reports will depend. Much of this work

has been conducted overseas in France, Germany, India, Italy, and Indonesia.

2: Six research programs were started during the year; two were closed out and their staffs transferred to other work. Four of the independent new projects are:

A comparison of income growth in India and China.

A sociological study of the forces that determine the characteristics of Soviet military leaders.

A study of the combinations of economic, political, and military policies that have proved effective in frustrating Communist efforts at subversion in underdeveloped countries.

A study of the structure of the economy of East Germany.

The other new projects, each of which conveniently supplements the existing work on economic development, were sponsored by the National Planning Association, a private non-partisan research group. These are:

An appraisal of the Standard-Vacuum Oil Company's Indonesian operations in that country's economic development.

A preliminary survey of the role atomic energy might play in the economy of Italy.

Major projects terminated after publication of final reports were Professor Rostow's work on Chinese Communism and Alex Korol's work on Soviet slave labor.

3: The volume of publications, both finished and intermediate, is naturally large in such an organization as the Center. Four books were published, substantial progress was made on three others scheduled for early publication, and more than 20 multilithed monographs and 70 dittoed working papers were reproduced. This has required the establishment of a post of Publications Officer, now filled by Mrs. Jean Clark, a long-time member of the staff.

4: I have already referred to the substantial grant from the Carnegie Corporation in support of a new project which we hope will lead to a general program of research on American society.

I know of no member of the faculty of the Department of Economics who is not engaged in interesting research. Among the studies which Professor Ralph E. Freeman, head of the Department, singles out for mention this year are the following:

There are four types of study in econometric and statistical work which seem to us particularly appropriate in our kind of institution. These are studies of linear programming by Professors Paul A. Samuelson and Robert M. Solow; a study of the statistical theory of engineering tolerances and its relationship to Professor Norbert Wiener's theory of prediction by Professor Harold A. Freeman; investigation into capital theory by Professor Solow; and work on dynamic programming and related questions by Professor Samuelson. Professor Kindleberger returned last fall from fifteen months' leave spent mostly in Geneva, Switzerland, undertaking research into Europe's terms of trade — that is, the relation between prices at which Europe exports and those at which it imports. He has already published several articles on this subject and a monograph will appear this fall. This research was financed by the Merrill Foundation for the Advancement of Financial Knowledge.

During the year Professor Licklider established in the Sloan Building a new laboratory equipped for advanced and fundamental research on the psychology of hearing. Support for this project comes largely from the Operational Applications Laboratory of the United States Air Force. The laboratory draws students from various graduate and under-

graduate departments, notably mathematics and electrical engineering. Professor William J. McGill continued to develop his study of applications of information theory in multivariant analysis.

Other Faculty activities.

Professor Morris A. Adelman has continued to serve on the Attorney General's committee to study the anti-trust laws, the report of which has now been published. Professor E. Cary Brown has served as adviser to the Subcommittee on Tax Policy of the Joint Committee on the Economic Report. Professor Samuelson is vice president of the American Economic Association and has attended the Brookings conferences with the Council of Economic Advisers. Professor Harold Freeman is associate editor of the *Journal of the American Statistical Association* and Professor Solow is a member of the editorial board of *Econometrics*. Professors Howard Bartlett, Rathbone, and Lynwood S. Bryant managed a one-day symposium on Industrial Programs for Improving Engineering Reports, in collaboration with the Industrial Liaison Office; Professor Giorgio de Santillana spent the year lecturing at several Italian universities, leaving his very successful book, *The Crime of Galileo*, to appear in his absence; Professor Alfred D. Chandler took six months' leave to organize, administer, and in part teach a new course on the basic elements of national strategy to senior captains preparing for flag rank at the Naval War College, Newport, Rhode Island; Professor Padelford was absent for six months on leave for studies in international relations conducted from a base in Geneva; Professor Deutsch has participated widely in conferences at the American Historical Association, at the University of Chicago, and at Northwestern University. Professor Carvel Collins has held important chairmanships both in the Modern Language

Association and the College English Association; he is spending the summer as Visiting Professor of American Literature at the Salzburg Seminar in Austria.

Programs such as those of the Center for International Studies inevitably lead their personnel into many activities of an advisory or consultative nature on the national level and even in other countries they may visit. I shall make no attempt to list these here but merely point out that Professor Millikan's visit to all the countries studied by the Center has been of great value, as have been the activities of Professors Daniel Lerner in France, Edward A. Shils and Wilfred Malenbaum in India, Benjamin H. Higgins in Indonesia and Rosenstein-Rodan in Italy. The steady flow of people of this stature from M.I.T. to these other nations and back, as well as the larger flow of the many distinguished foreign visitors to M.I.T. whom I cannot mention, have a most stimulating effect on our entire educational effort in this School.

Personnel.

A School which is growing with such seriousness and vigor and with such an input of able young men on its staff — men who, it may be said, might not in earlier years have thought it appropriate to be on our Faculty at all —inevitably suffers a considerable turnover of junior personnel. This we regard not only as necessary and proper but definitely desirable, provided we are able to replace the men who leave with men of equal calibre and provided those who leave us go on to first-class institutions and to first-class opportunities. Thus even with the abnormally large turnover of the year which I must now report (a turnover which does not involve any senior member of the Faculty) we can be happy about the state of affairs, confident of the new men we have chosen

and whose achievements will appear in later reports, and confident too of the successes awaiting the men who leave. We shall miss each individually, but we can also be confident of his future success.

Professor John R. Coleman has left the Department of Economics to join the faculty at Carnegie Institute of Technology, and Professor Romney Robinson to go into business; from the Department of Humanities Professor Leslie H. Fishel goes to Oberlin College, Professor Robert L. Koehl to the University of Nebraska, Professor Arthur Mann to Smith College, Roderick E. McGrew to the University of Missouri, Professor Roger L. Williams to Michigan State University, and Professor Lacey B. Smith to Northwestern University; Professor Lawrence W. Towner will be associate editor of *The William and Mary Quarterly* and associate professor of history at William and Mary College. Some of these departures are inevitable results of limitations on tenure positions available in certain fields in the departments; some are because other institutions were able to offer wider immediate opportunities than we could.

Professor Charles W. Rosen, after two very successful years teaching the new humanities core subject in French, has resigned from the Department of Modern Languages to devote full time to the other area in which he is brilliant, that of being a concert pianist.

Leaves of absence will be taken by Professors Thomas F. O'Dea, who will use a fellowship at the Center for Advanced Study in the Behavioral Sciences; Robert E. MacMaster, who will use a fellowship at the Russian Research Center at Harvard; and George P. Shultz, who will act as adviser on labor matters to the Council of Economic Advisers. Professor James G. Kelso has left the Department of Humanities for

duties as acting director of student placement at M.I.T. Professor Alex Bavelas, returning from a year spent at the Center for Advanced Study in the Behavioral Sciences, will leave the School of Humanities for comparable duties in the School of Industrial Management. Professor George A. Znamensky retired in June, after long years of fruitful service in teaching Russian at the Institute. Dr. Frederick Bodmer also retired; this distinguished scholar made a great contribution to our Faculty during the late years of his active life.

Unfinished business.

There is manifestly unfinished business for this School, and much of it is serious. However, we could not wish it otherwise, for if there were none or if we could not perceive it stagnation would be inevitable. We must find long-term financing for the Center for International Studies and the Psychology Section; we must effect an early integration at least of the curricular work in political science; we must achieve an orderly and rapid development of the opportunities for us implicit in Courses XXI and XIV.

The most glaring defect in M.I.T.'s humanities program is our long postponement of a thorough curricular approach to the general understanding of the visual arts, although we do well enough in the non-curricular aspects. This is a joint responsibility of the School of Architecture and this School, and we must move forward on it. The state of art education in America and the general public attitude to the visual as opposed to the other arts and the sciences is such that this is no easy problem. But solve it we must.

There will also be, and always will be, the unfinished business of new funds — aside from those needed in political science and psychology. In the light of what I have reported

above we cannot insist that the great foundations of this country have passed by the humanities at M.I.T.; indeed, though we shall doubtless appeal to them from time to time, we must now look elsewhere as well. It is a fine thing for the humanities in this country that industrial support now looks upon the liberal arts colleges as one of its responsibilities. However, there is irony in the possibility that, even in the long run, only the foundations might understand that there are several ways to the liberal arts in America and that one of these ways is to be found in an Institute of Technology. It would be ironic if, under a misapprehension, all the generous industrial support of activities at M.I.T. should go to our science and technology and no appropriate, if small, part be directed to an aspect of the total M.I.T. program which industrialists — almost better than any one else — understand to be of fundamental importance in the training of their future colleagues.

JOHN E. BURCHARD.

Report of the Dean, School of Industrial Management

In my report of a year ago, my second as Dean of the School of Industrial Management at M.I.T., I devoted considerable space to the place of management in the future industrial needs of this country and to the problems which face a school such as this in developing an educational program aimed to train young men to assume, as rapidly as possible, positions of responsibility in the management of enterprise. Since management is the element of society responsible for organizing our economic activity, the magnitude, scope and direction of our productive machinery is tied intimately with the quantity and quality of present and future management personnel.

It is this realization that keeps our growing Faculty searching constantly for better ways to develop in our students

an understanding of the complexities of a business enterprise and its relationship to the external world — economic, social, and political — in which it conducts its activities.

Since the School does not profess to train specialists in any of the functional compartments into which business and industry are customarily divided, I find myself using the word *understanding* more and more frequently in describing our educational objectives — understanding of enterprise itself, understanding its aims and purposes, understanding the interrelationship of the productive function with that of distribution and of these with finance, all brought together by human beings organized in what we call administration. It is the understanding of what these elements of internal operations are, the constitution of each to the whole, and the interplay between them that concerns us.

It is of no less importance that these young men develop an understanding, currently and historically, of the external environment in which industry operates and of the growing need for management to make its decisions in the light of the demands and aspirations of the world of economics, sociology, and government.

Students must gain specific knowledge of the mechanisms of the business enterprise and, while doing so, develop a breadth of view with respect to the world at large; ideally this produces a realization of the dynamic nature of the American business system. We must strive to develop in each student the ability to analyze, so that he will have the tools with which to attack the new problems which will face him in the future. He must learn that the art of management calls for accomplishing the aims of the business by getting things done through people. And perhaps most important of all, he must learn that successful management is based on sound character.

All this is a large order. To attain this high goal — the best preparation of our students — it is elementary to note that no area comprising a segment of business, and no topic, can be "covered" in an adequate sense. The task of a faculty is to select those areas and subjects which, to their trained minds, seem to contribute most sharply to this understanding. First is the separation of the things which a school can best do from those which industry itself can do, if not better, at least as well. Then selection begins between the important and the less important. The underlying criterion used in this selection is the estimate of management needs of the future and not what was required in the past.

To this end the staff during the past year has continued its studies of the curriculum of the School. Important changes occurred in the teaching of the functional fields comprising business activity (e.g., production, distribution, etc.). Increasing attention was given to the application of the new analytical methods to solving the problems of management. I am pleased to report the integrated approach which the staff is taking in these matters: excessive compartmentalization is being avoided; it is not unusual for several instructors, representing different fields, to participate in a single course.

The School in the M. I. T. environment.

This synthesis of approach within the area of education for management leads me to point out another significant development. One of the greatest assets of the School is its existence in the total M.I.T. environment. How best can we capitalize on this opportunity which gives us a unique position among management schools with our objectives? The close cooperation of our School with the Department of Economics and Social Science is well known, as is our relationship with other departments in the School of Humanities. More and

more members of our staff are creating joint seminars with members of the Faculty of the School of Engineering. To cite but a few: Professor John A. Hrones and other members of the Department of Mechanical Engineering are conducting a seminar jointly with members of our staff. Professor Donald P. Campbell of the Department of Electrical Engineering is doing likewise with another group. Professor William K. Linvill of the Department of Electrical Engineering has had substantial contact with our staff in an attempt to provide an integrated approach to the broad problem of data processing. Plans are being discussed for further joint educational efforts from which much may be expected.

In no subject can the merging of other M.I.T. fields with the problems of business be more fruitful than in the "new" area laboring under the name "automation."

Probably the word "automation" was spoken more often during the past year and appeared more often in print than ever before. Its concept is frightening to some; to others it symbolizes the hope of maintaining in the future our ever-rising standards of living and our continued world leadership in production. "Automation" is not something new to our managerial thinking; in one form or another it has been coming into our industrial process for many years.

Even with recent great advances in electronics and mechanical devices, "automation," in the newest sense of the word, is not likely suddenly to overrun us like a tidal wave or a swarm of locusts. More and more, automation of industrial processes is becoming an enormously valuable tool to management. But it brings with it all manner of new problems — of things, of work, and of human beings.

We think of the School as a logical meeting place where the developments of M.I.T.'s researches in electronics,

in computing machines, and in the whole field of data processing can be made to join with the needs of the business world in accounting, forecasting, and managerial controls. There are vast possibilities for fruitfulness in this integrated approach, and there is every reason to believe that the report for the coming academic year will call attention to substantial progress in research and curriculum development in the managerial implications of data processing.

The development of an intellectual program is characterized by a substantial lag between work in process and the ultimate product. The past three years have been concerned with the maintenance of a relatively small School and student body in order to provide maximum opportunity for experimentation. As our program has developed, we feel it is now desirable to extend the scope of our activities. In the coming academic year we will have doubled the enrollment of graduate students. If this increment to the student population proves valuable, it will merely be the first of a series of expansions. It is our intent, however, to maintain a relatively small school.

In addition to our increased Executive Development Program we are currently developing additional areas of training for management. At this time it is not possible to specify the various facets of our contemplated additional management training programs. But I hope that in my succeeding report I will be able to call attention to new programs of management training, designed to provide industries with the much-needed enlarged supply of industrial managers.

Research: adding knowledge of industrial processes.

A significant challenge to schools of industrial management operating in university environments is the need to

develop proper programs of research. Such programs, it seems sure, must have social as well as commercial value. Studies of the relative values of home permanents and various other devices do not appear to be the proper purpose of a university, but studies designed to increase our total productivity, to reduce the hours of work, to stimulate employment, to diminish variation in economic activity associated with the business cycle, or to improve human relations in industry are desirable goals and deserving of support as much as any project in which a university can engage.

I feel very pleased to report that our research program at the School of Industrial Management has made substantial progress — despite demands on the staff stemming from our continuing efforts to devise a curriculum for what we perceive to be the needs of the future industrial managers.

We are confident that the research now in progress is adding to our knowledge of the industrial processes. Professors Thomas M. Hill, Myron J. Gordon, and Thomson M. Whitin continue to contribute to our understanding of inventory management. Professor Robert H. Gregory has utilized the M.I.T. environment of data processing to explore the uses of this tool in industrial management. Together with Professor Thomas V. Atwater, Jr., Professor Gregory has spent considerable time studying the economic implications of work done on a numerically controlled milling machine.

Professor Douglass V. Brown has been in the vanguard of research on the general problem of the guaranteed annual wage. His studies were widely quoted in the period preceeding the recent discussions on general wage agreements in the automobile industry.

Aided by a generous grant from the Sloan Foundation, Professors Douglas M. McGregor and Alex Bavelas

are continuing their research in the area of executive behavior. They are planning to work on a full-time basis and hope to provide our society with greater insights into the vexing problem of executive selection.

Professor Eli Shapiro has recently accepted an appointment to the staff at the National Bureau of Economic Research, where he is working on a detailed analysis of the post-war capital markets in the United States.

Professor Elting Morison continues his research on a biography of Mr. Henry Stimson. In addition, with Mr. Edward Lurie, he is preparing an extensive bibliography on technological change on the American economic scene.

Professor Ross M. Cunningham has prepared a draft on his research into the general subject of brand loyalty. Dr. David Durand is bringing to completion a study of the bank capital problem done under the aegis of the National Bureau of Economic Research. In addition, he is preparing a manuscript on the valuation of public utility securities.

Professor William A. W. Krebs, Jr., is studying the role of the states in relation to industries and the Federal Government in the development of atomic energy in the United States. Interest in this subject is extremely timely because amendments to the Atomic Energy Act in 1954 injected a new element of private enterprise into a program which had, heretofore, been almost entirely government-financed and conducted within the orbit of the Federal Government.

Professor Gerald B. Tallman is undertaking an exploratory study into the sales phenomenon currently described as the discount house. Having been among the first to work in this field in the middle thirties, he returns to this subject with a background of preparation and knowledge associated with expertness.

Professors Robert B. Fetter and Edward H. Bowman are continuing their research endeavors designed to utilize advanced techniques of mathematical analysis in the solution of problems facing the production departments in manufacturing enterprises.

The Work Management Laboratory, under the direction of Professor Leo B. Moore, has been developing a system by which advances in the broad areas of human relations can be introduced into the operations of the individual firm.

Professors Herbert F. Goodwin and Moore, together with Professor George P. Wadsworth of the Mathematics Department, have been cooperating in a study of production line techniques, and their contacts in industry have shown a good deal of cooperative concern for the effort. We are anxiously awaiting the results of this research.

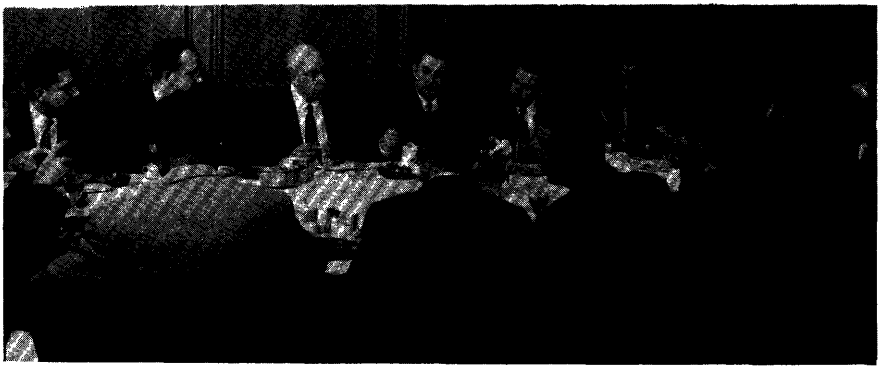
Professor Albert H. Rubenstein returns this fall from a trip to Europe financed by a Fulbright award. While in Europe, he has been studying the general problem of organization, control, and evaluation of staff functions in European industry.

Personnel: maintaining M.I.T.'s high standards.

I have touched on many of the activities of the School indicating the things that are happening, our progressive planning, and the programs ahead. But there is no surer way of recording progress made during the year than to mention the new appointments to the staff.

The supply of able, experienced men of high character and intellectual promise who measure up to the high standards which M.I.T. has always set for itself is not large. The number of such personnel coming into the academic world is reduced sharply by the great inducements offered by the

business world. The remainder of the group of outstanding men is sought by every other academic institution in our country. This shortage of first-rate academic personnel, while serious at this time, will become critical in the foreseeable future as the student population in institutions of higher learning expands. Some of the posts are now being filled only after two and more years of search. Others are still open. But progress in securing and absorbing new members can be recorded.



Dr. Chester I. Barnard, chairman of the National Science Board and former president of the New Jersey Bell Telephone Company and of the Rockefeller Foundation, was one of many distinguished seminar guests before members of the 1954–55 Executive Development Program.

First in significance was the appointment of Professor Eli Shapiro to the office of Associate Dean, made vacant by the untimely death of Professor Ronald H. Robnett. Dr. Shapiro came to the School in 1952 as Professor of Finance from the University of Chicago where he had earned an enviable reputation in economics and his particular field of finance. In December, 1954, he joined me for a limited tour of duty in the administration of the School with the understanding that he preferred to have finance rather than administration

as his permanent field. Almost immediately, our momentum increased due to his knowledge of academic matters and leadership of academic personnel, his sound judgment, and his devotion to the aims of the School.

Professor Bavelas returns to M.I.T. after a year's leave spent at the Center for Advanced Study in the Behavioral Sciences at Stanford University. He joins the staff of the School on his return and, with Professor McGregor who returned last September, will share the instruction and research in the field of human relations. The elements of the social sciences which have to do with an understanding of human relations in management are essential ingredients in the education for managerial thinking. The School of Industrial Management has leadership in this field which is recognized by both industry and the academic world.

Professor Houlder Hudgins comes to the School from a partnership in the financial consulting firm of Galen Van Meter and Company, following long experience in executive posts with several large companies. He is a graduate engineer from Cornell University where he taught management and accounting in the School of Engineering before entering his business career.

Professor Howard W. Johnson joins our staff as an Associate Professor of Industrial Management to become director of the programs in the field of executive development. For the past six years he has been the Director of Management Projects in the Industrial Relations Center of the University of Chicago. He has had full-time employment in industry as well as consulting to industry in conjunction with his academic work. His extensive experience in the field of management and executive development, both in theory and practice, should

make him of great value in organizing our programs in this growing field of interest.

Dr. David Durand has been newly appointed Associate Professor of Statistics. He served as a Research Associate at M.I.T. since 1953. After graduating from Cornell University, he received his A.M. and Ph.D. degrees at Columbia University. The author of numerous books and articles, he has held posts with the National Bureau of Economic Research and the Institute for Advanced Study as well as having consulted with the Twentieth Century Fund. Professor Durand's stature as a financial statistician is a great asset to the School.

Dr. Warren S. Torgerson joins the faculty as Assistant Professor of Industrial Management. Professor Torgerson comes to us from a post as Teaching Assistant at Princeton University and Research Associate for the Educational Testing Service. He will be associated with Professors McGregor and Bavelas in their studies in executive behavior.

Dr. William Letwin joins the staff as Assistant Professor of Industrial History, coming from the University of Chicago where he was a post-doctoral fellow in the Department of Economics and Research Associate in the Law School.

Dr. Gregory C. Chow comes to the School as Assistant Professor of Statistics. His training in management, economics, and mathematical statistics makes him a valuable addition to the School's work in the application of special statistical methods to the problems of management.

John L. Enos completes his studies for his doctorate at M.I.T. in the Fall of 1955. He joins the staff as Assistant Professor of Marketing where his three years in industry with the Standard Oil Company (Ohio), together with his academic background, indicate a promising addition to the work being done in the field of marketing.

Dr. Ingo Ingenohl comes as Assistant Professor in Industrial Management. His career in industry has included employment and consulting for fifteen years in Germany, Denmark and, most recently, Canada. His research interests in production methods and analysis will support the work of the Management Laboratory under Professor Moore in collaboration with Professor Goodwin.

Professor Peter S. King has been appointed Assistant Professor of Marketing, coming to the School from the University of Indiana where he has been an instructor and most recently a Faculty Lecturer in Marketing.

Dr. Edwin Kuh comes as Assistant Professor of Finance from Johns Hopkins University. Dr. Kuh was recently awarded the Wells Prize at Harvard University for his joint research in the field of capital expenditures of business firms.

Richard B. Maffei, a graduate of M.I.T., Class of 1945, has been appointed Assistant Professor of Industrial Management, coming here from the Wharton School of the University of Pennsylvania where he received his M.B.A. and has been an Instructor. He has been associated with the firm of Alderson and Sessions in some of their research work and has participated in a number of government-sponsored research projects.

Dr. Gordon Shillinglaw joins the staff as Assistant Professor in Accounting, coming to us from the consulting firm of Joel Dean Associates where he has been for three years following his teaching experience at Hamilton College and Harvard University.

Mr. Zenon S. Zannetos has been appointed Instructor in the field of accounting. Mr. Zannetos is our first School of Industrial Management graduate student to join our staff.

It is a pleasure to report the promotion of Dr. Gordon to Associate Professor of Accounting.

Unfortunately, we must also record personnel attrition. Professor Carroll J. Brown resigned to accept a position in industry. Mr. Lurie has tendered his resignation to accept a flattering teaching post in another institution. Professor Joseph A. Pechman has found his work in the Federal Government sufficiently stimulating to tender his resignation to M.I.T.

In particular I must record that Professor Erwin H. Schell has reached the Institute retirement age after being a member of the Faculty since 1917 and head of Course XV since 1931. Professor Schell has been the chief architect of Course XV throughout most of its existence at M.I.T. He has a host of former students of the Course who, with the members of the faculty and particularly myself, wish him happiness and a long life of continued usefulness. And our good wishes go also to Mrs. Schell, who with her husband, extended her hospitality so generously to countless students and thereby made their lives at the Institute more memorable. Fortunately for the School, Professor Schell will continue his influence with the undergraduates, graduate students, and the Sloan Fellows by means of a special series of lectures.

E. P. Brooks.

Report of the Dean, School of Science

College enrollments in the United States are expected to double in the next ten years. The increasing pressure that the Institute now faces to enlarge its enrollment is of especial importance in the School of Science, which has a large service load in the first two years in addition to an expanding professional load. Since the continuing policy of the Institute is to emphasize quality rather than quantity, our hope is to hold quantitative expansion to the minimum possible while selectivity and quality are pushed ever higher. Nevertheless, analysis shows that in certain directions the present facilities of the School would permit small increases of enrollment.

The size of a given department depends primarily on its undergraduate and graduate professional loads, which

reflect the demands for its graduates; its service load; and, in the case of a small department, the coverage of sub-disciplines, which sets a minimum size for a department staff.

The approximate numbers of students majoring in each of the science departments are now: physics 500, chemistry 250, mathematics 150, geology and geophysics 100, biology 100, and food technology 60.

Another measure of the professional load is the number of roll cards received by a department from its own majors in all department courses during any particular term. This number has held fairly steady at between 800 and 900 over the past five years in physics and at around 800 in chemistry. In mathematics, however, there has been a drop from about 275 in 1950 to some 200 in 1954, a falling-off of more than 25 per cent in five years. Arbitrary limitations have been imposed where necessary to prevent increases in graduate enrollment, and especially in physics do the figures reflect a strong resistance to pressure for enlargement.

In most fields of science it is increasingly difficult to consider a man to be adequately trained in his profession without a doctor's degree or the equivalent. Graduate study, therefore, is of outstanding importance in the School. Only in the two largest science departments, physics and chemistry, is the quota limiting graduate students still of importance in holding down numbers.

The service loads of the science departments are heavy only in physics, chemistry, and mathematics. These have increased by from 20 to 30 per cent in all three of these departments during the past five years. Although such increases have been desirable in connection with the over-all growth of the Institute, pressures on our departments are such now that further expansion would be difficult without

increases in staff, space, and facilities.

The demands for scientists in industrial, government, and academic institutions is now greater than ever before in all disciplines and is still expanding. For example, the chemicals industries have been growing at three times the rate of the economy as a whole. The number of chemists in the United States has been doubling every 15 years; there are now more than 100,000, not including chemical engineers. M.I.T. produces about 3.5 per cent of the 1200 new doctors in chemistry each year, being third in output of U.S colleges. A small expansion in graduate enrollment could be handled with our present staff and facilities.

Industries depending on modern physics are expanding even more rapidly than the chemicals industries. The number of physicists in the United States, only about 20,000 now, doubles every eight years, so that more than 20,000 new physicists will be needed in the next decade. As large a proportion as possible of these should have the doctorate. The country now produces only 480 doctors in physics per year, of which the Institute produces at present about 8 per cent. Despite our limitation of graduate enrollment in physics to 175, we are second in graduate enrollment in the country, and we are probably first if students devoting less than half-time to college work are not counted. Further expansion in this field would be very difficult at present, without additional staff, space and facilities. Physics has the heaviest service load of any laboratory discipline, and as its sophomore laboratories will next year be loaded to capacity, this department appears to set the present basic limitation on undergraduate expansion at the Institute.

From 6000 to 7000 replacement and additional mathematicians with the doctorate will be needed in the

U. S. in the next ten years. To produce these would require two to three times the country's present output. We are now increasing the size of the department staff to help meet this situation, but space sets a serious limitation.

The use of geologists and geophysicists in the petroleum and nuclear fuels industries is rapidly expanding. Despite this increased demand, national production of graduates in the earth sciences has declined from 3649 in 1945 to 2369 in 1953. We are attempting to build up the earth sciences at M.I.T., but we need additional staff and laboratory space for even the present number of geophysics majors to cover properly the various sub-disciplines of geophysics. Definite steps are now being taken to obtain these, and once we have adequate space we should be able not only to take care of the present students but to increase geology and geophysics graduate enrollment by 10 per cent and undergraduate enrollment by as much as 50 per cent. Since the numbers involved are small, this would not involve much expansion of the Institute enrollment as a whole.

There is great demand for our graduates in biology, biophysics, and biochemistry because of the present-day scientific needs in medicine and industry. The number of American students of biology has fallen from about 11,000 a few years ago to not many more than 6000 today. In our new Dorrance Laboratories we have adequate space for any reasonable expansion. The department is thus prepared to teach considerably more students than are enrolled; we are studying the factors which influence students to elect biology as a major, and we hope that from this study may come an effective means of increasing the department's enrollment.

The M.I.T. Department of Food Technology produces about 10 per cent of the nation's food technologists and

has ample facilities in the Dorrance Laboratories for further expansion. As at present organized, the department could handle an expansion of graduate students of about 50 per cent, all of whom are needed in industry.

Though professional demands are increasing, most American scientists are still the product of only four years of college. One of our principal contributions remains the production of professional workers in disciplines in which a four-year terminal college curriculum is still useful. However, increasingly important is our function of producing graduates with the baccalaureate who are sufficiently well trained to go into graduate work here or elsewhere.

New facilities for science departments.

The new geochemical laboratory, put into operation last year by the Department of Geology and Geophysics, has been improved by additional space and facilities for work on changes in crystalline structures at elevated temperatures under controlled conditions, and the Cabot Spectrographic Laboratory has been enlarged to allow an expanded program in the spectrometry of earth materials. The laboratory used in General Geology and Engineering Geology, in which undergraduate enrollment has been increasing, is now being refurbished.

The Mathematics Department remains in serious need of more office space and still has library problems.

Construction of the Karl Taylor Compton Laboratories for the physical sciences is now under way. These will provide greatly needed space for the various physical and chemical research activities associated with the Laboratory for Nuclear Science and the Research Laboratory of Electronics. In physics, a strong neutron diffraction program is being

planned, to center around the forthcoming Institute nuclear reactor, which will become part of a strengthened program in experimental solid state physics. This program will be under the direction of Dr. C. G. Shull, formerly of the Oak Ridge National Laboratories, who has recently joined the Institute staff. Steady progress has been made in the design of a 5 B.E.V. electron accelerator conceived to be operated jointly by Harvard University and M.I.T., and it is hoped that final approval for this undertaking will be given in the near future.

Personnel developments.

In biology, Professor Charles H. Blake has been awarded a Fulbright Fellowship for ornithological work in the island of Jamaica. Three members of the Chemistry Department were granted sabbatical leave for study abroad as Guggenheim Memorial Foundation Fellows: Professor David N. Hume, who spent the year at the Danish Technical University, Copenhagen; Professor Walter H. Stockmayer, who worked at the University of Strasbourg, France; and Professor C. Gardner Swain, who spent part of the year at the University of London. Professor Roland D. Parks in geology was granted a year's leave of absence to become Guest Professor of Metal, Mining, and Surveying at the Indian School of Mines and Applied Geology in Dhanbad, India.

In mathematics, Professor Norbert Wiener delivered the Fawley Foundation Lecture at the University of Southampton in England in late May. Professor C. C. Lin was on leave during the year on a Guggenheim Fellowship, which he spent partly at Cornell University and partly at the California Institute of Technology. Professor W. T. Martin spent part of the summer of 1954 as a participant in the Summer Institute

of the American Mathematical Society, which was devoted to work in the field of several complex variables.

During the Fall Term, Professor Sir Alexander R. Todd of Cambridge University, England, delivered a series of lectures here as the third Arthur D. Little Visiting Professor of Chemistry. These were entitled "Selected Topics in Natural Products Chemistry" and dealt with the chemistry of the B— group of vitamins and their function in enzyme systems, and with the general field of nucleotide chemistry.

In food technology, Professor Samuel A. Goldblith has been appointed executive officer of the Department. Professor E. E. Lockhart of the same Department resigned at the close of the year to accept a responsible position in industry.

Three new assistant professors were appointed in the Department of Geology and Geophysics during the year: Professor Stephen Simpson, Jr., took on duties in geophysics and was appointed faculty adviser of the Geophysical Analysis Group Program; Dr. Gordon MacDonald was appointed Assistant Professor of Geology and has been giving a part-time series of lectures in theoretical geology with emphasis on aspects of crystalline structures at elevated temperatures and pressures; and Dr. William Brace accepted an assignment in engineering geology.

During the year the Mathematics Department suffered two serious losses in the resignation of Professor Raphael Salem, who was elected to a professorship at the Sorbonne, and the death of Assistant Professor Irvin S. Cohen while on leave from the Institute at Columbia University.

Four members of the Physics Department faculty were away during the year on Guggenheim Fellowships. Professor David Frisch studied at the Institute for Theoretical Physics of the University of Copenhagen. Professors Clark

Goodman and William Kraushaar both worked at universities in Japan, and Professor Herman Feshbach spent the year doing research at Harvard. Professor Jerrold Zacharias was on leave for half of the year on a special mission for the Department of Defense.

The Physics Department is pleased to welcome back Professor A. G. Hill, who has relinquished his temporary assignment as Director of the Lincoln Laboratory. The Department was host during the year to a number of distinguished visitors who gave special lectures, including Professor Werner Heisenberg, Director of the Max Planck Institute für Physik at Göttingen, who gave a series of five stimulating lectures on theoretical physics; Dr. Fritz Zernike of the University of Groningen, Holland; Dr. Llewellyn Jones of the University College of Swansea, Wales; Dr. R. P. Chasmar of the Radar Research Establishment, Malvern, England; Dr. B. H. Flowers and Dr. A. M. Lane, both of the Atomic Energy Research Establishment at Harwell, England; and Dr. D. H. Wilkinson of the Cavendish Laboratory, Cambridge University, England.

Undergraduate courses and curricula.

Enrollment in the new freshman subject, Perspectives in Life Science, given for the first time last year by Professor R. C. Sanborn of the Biology Department, increased 50 per cent this year, and the subject appears to be stimulating interest in biology among M.I.T. undergraduates. The undergraduate biochemical and physiological subjects of the Department of Biology, General Biochemistry and Physiology, have recently been revised and integrated under the leadership of Professors John M. Buchanan and Francis O. Schmitt and with the cooperation of all staff members in biochemistry and cell physiology.

Faculty action recently taken to reduce the number of contact hours scheduled for freshmen has caused a reduction to an average of six per week in the number of hours devoted to freshman chemistry. These first-year subjects are now being revised to accommodate this change. As in the past, there will be two lectures and two hours of recitation per week, but the time devoted to laboratory will be reduced to ten three-hour periods during each semester of 15 weeks. In the opinion of members of the Chemistry Department staff this schedule does not permit sufficient time in the laboratory, but it is the one which will make the most efficient use of that available.

Various methods of providing better instruction in elementary chemistry are being actively considered. There has been general agreement among members of the Chemistry Department staff, and of the Visiting Committee for Chemistry, that it is better to offer a single fundamental and rigorous subject in general chemistry for everyone than to offer several varieties of elementary chemistry to meet the needs of groups of students with special interests in various fields of engineering and science.

After almost a year of study by the Faculty of the Department of Food Technology, the entire undergraduate curriculum in that field has been revised, with the following changes: a lecture and laboratory subject in Instrumental Analysis has been substituted for the subject in Qualitative Analysis; a subject in Probability and Operations Analysis has been substituted for the subject in mathematics on Differential Equations; and the subject in Bacteriology is now scheduled for the second year instead of the third. At the recommendation of the Department Visiting Committee, contact with food technology students will in the future be established in the sophomore year instead of in the junior year, by

substituting a new subject entitled Food Production for the second term subject in biology. In addition, a new elective subject will be offered for the first time, designed to acquaint freshmen scientifically with foods and their production.

The most important change in the curriculum of the Course in Geology was the initiation of a four-term series of lectures in Theoretical Geology by Professor MacDonald. It is planned to strengthen this program further by arranging for specialized research work at the Geophysical Laboratory in Washington for certain graduate students. Enrollment in the freshman elective subject, Earth Science, was approximately the same as last year.

Enrollment in mathematics subjects during the Fall Term was again the highest in the history of the Department. This reflects both the increased size of the student body and the increasing demand for mathematics on the part of students in engineering and science as their training becomes more basic. After conducting certain experiments during the past two years, the Department found that it could strengthen its second-year subject, Differential Equations, and a revised curriculum in the subject will go into effect during the coming year. This will subsequently permit the two subjects in Advanced Calculus (M351 and M352) to be revised by the inclusion of new material, giving more thorough coverage of topics previously treated only briefly.

The most significant event in connection with undergraduate physics has been the initiation of new subjects in modern physics at the junior level for nonphysics majors. The nationwide interest in the role of physics in engineering education has been reflected here in two intramural conferences; at these the Physics Department reported on the aims of our physics instruction and the methods by which

it is attempting to attain the desired objectives, and the engineering departments reported their assessment and requirements of the physics instruction. It has become evident that more than two years of physics are now a necessity for many engineers, and it is anticipated that there will be a steadily increasing demand for modern physics for engineers as advanced undergraduates and even at the graduate level. As a first step, a new subject in modern physics at junior level has been initiated, and this will be expanded next year into a two-term sequence. For electrical engineers these subjects will replace Thermodynamics and Statistical Mechanics and Electronics. Of great help in getting these subjects off to a good start will be the excellent book on modern physics, designed for non-physicists, recently written by Professor John C. Slater. It is evident that in the long run a strong third-year laboratory program for non-physics majors must be developed to accompany the classroom subjects. In view of the large load on the Department and the present lack of space this is not a simple problem to solve, but it cannot be ignored.

In the over-all undergraduate activities of the Physics Department it is significant that for a number of years the students have exerted considerable pressure on the staff to include more advanced and difficult subject matter in the undergraduate curriculum, and this healthy trend continues. The methods used to strengthen our elementary physics instruction have aroused nationwide interest, and we are assuming a strong position of leadership in this area.

Graduate courses and curricula.

Among new subjects in biology are Mathematical Biophysics, offered by Professor Myles Maxfield, which deals with the application of statistical mechanics to biology and mathematical problems involving the physical chemistry of

biological systems; and Molecular Configuration in Biological Systems, organized by Professor Richard S. Bear, which emphasizes the application of X-ray diffraction methods to the study of crystallographic problems of such biological materials as proteins, polysaccharides, and nucleic acids. During the Spring Term, Professor Roland F. Beers for the first time offered an advanced biochemistry subject, Physical and Chemical Properties of Heme-proteins and Related Compounds, devoted solely to those proteins which contain iron, such as hemoglobin and several of the respiratory enzymes.

The new Master's programs leading to degrees in either biology, biochemistry, or biophysics have been set in operation during the past year and are now running smoothly. The demand of industry for graduates of such programs is great.

In the Ph.D. program in biology, examination methods have been considerably revised during the past year. Under the new system the preliminary examinations will be given as two parts, the first in the fall at the completion of one year of graduate work and the second the following spring. The first part will examine the students' general background in biology, chemistry, and physics; the second part of the examination will review the students' knowledge in their fields of specialization, such as biology, microbiology, biochemistry, and biophysics. During the coming year it is expected that there will be additional financial support for graduate students through new teaching assistantships, research assistantships, and pre-doctoral fellowships made available to the Department. This increased support is expected to improve the quality and increase the total number of graduate students in biology.

At the beginning of the Fall Term this year, a regular weekly Mathematics Colloquium was established. This col-

loquium was supplemented by the regular M.I.T. Mathematics Lecture Series at which visiting mathematicians gave series of two or three lectures in the fields of their specialty.

Summer programs in the sciences.

The special six-weeks' course for secondary school science teachers, given this summer for the seventh time under the sponsorship of the Westinghouse Educational Foundation, was enlarged both in attendance and content. In 1955, 76 science teachers took the course, four fellowships not having been filled because replacements could not be made at the last minute for several fellows who unavoidably dropped out. This year, for the first time, the course was opened to biology teachers, and 14 lectures on biology were included in the program. To supervise this new aspect of the course, Professor Irwin W. Sizer was appointed to the Advisory Committee. The introduction of biology as a partner with physics and chemistry has been well received by the students in the course, which again was under the able direction of Professor Arthur R. Davis.

During the past summer, the Biology Department for the first time offered a professional subject in the summer school program, Biochemical and Biophysical Cytology. This subject was under the direction of Professor Schmitt in association with Drs. Betty B. Geren and Jerome Gross, with the active participation as lecturers of Professors Bear, David Waugh, Cecil E. Hall, and Maxfield, and Drs. Jesse F. Scott and David Spiro. Also participating in the instruction were several staff members from Harvard University and the Massachusetts General Hospital as well as guests from abroad and from other parts of the country. Some 50 individuals from institutions all over the world took the subject. The students were about equally divided between those having

M.D.'s and Ph.D.'s, most having affiliations with medical schools. The lectures presented the background and most recent advances in the ultrastructural, biochemical, and biophysical aspects of the major cell and tissue components, with special attention to the physico-chemical characterization of isolated fractions and purified constituents. It is believed that this and similar subjects can make a major contribution to analytical cytology on an international scale.

The seventh M.I.T. Geology Summer Camp was held in 1955 at the Nova Scotia Centre for the Geological Sciences, under the direction of Professors Walter L. Whitehead and Parks. Thirty-seven students took basic field instruction, of whom 23 were from M.I.T., ten from other colleges in the U. S., and four from Nova Scotian colleges. Several undergraduate geophysicists also participated in the summer cooperative plan carried out with Geophysical Services, Inc., working as helpers in geophysical parties across the western part of the country. This important experiment continues to attract favorable nationwide attention.

With the cooperation of Professor Y. W. Lee of the Department of Electrical Engineering, the Mathematics Department again conducted a Special Summer Subject in the Mathematical Problems of Communication Theory, with lectures given by Professor Wiener, Professors Robert M. Fano and Lee of the Department of Electrical Engineering, and Dr. Claude E. Shannon of Bell Telephone Laboratories. Also during the summer of 1955 the Department conducted a two-week Special Summer Subject in Numerical Analysis, under the supervision of Professor Francis B. Hildebrand. Lectures were given by Professor Hildebrand and by Dr. Frank M. Verzuh of the Statistical Services of the Institute, Mr. Dean Arden of Project Whirlwind, Dr. Milton Abramowitz of the

National Bureau of Standards, and M. Y. W. Luke of the Midwest Research Institute. Both subjects attracted a large number of persons from industry, business, and government.

The Physics Department was, as usual, host to the annual Conference on Physical Electronics organized by Professor Wayne B. Nottingham, in addition to cooperating in the summer session program for science teachers.

A Special Summer Program in Infrared Spectroscopy was held again under the direction of Professor Richard C. Lord of the Department of Chemistry, which was attended by about 130 industrial and academic research workers. Aiding in this program were Dr. F. A. Miller of the Mellon Institute; Professor E. R. Lippincott of Kansas State College; Professor John Strong of Johns Hopkins University; Dr. Norman Wright of the Dow Chemical Company; and Dr. Stanley Francis of the Texas Company.

Research in the science departments.

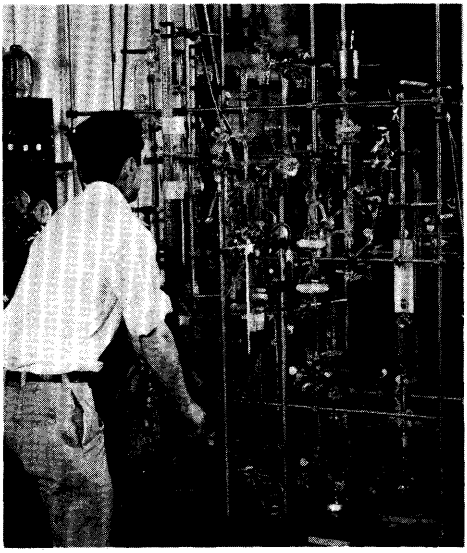
Inasmuch as the research activities of the School involve several hundred active programs of investigation, it is not possible to do more than comment briefly on a few fields in this report.

In biology, investigations have continued on the structure and properties of the fibrous proteins, with particular emphasis on the native macromolecule of collagen and the fibrous protein of the nerve axone. Electron microscope and biochemical research on the mechanism of impulse propagation in nerve fibers has also been continued; in this work the efficient large-scale procurement and processing of live squid is proving invaluable. The manner in which protein-protein interaction influences the components of the blood clotting system has received further study by physical chemical means.

The research of the Division of Biochemistry is concerned with the biosynthesis of several important biological compounds such as the amino acids, the vitamins, and the purines. By fractionation of liver, various enzymes have been isolated which permit the synthesis and isolation of the several intermediates in the synthesis of purine compounds; azoserine, an important anticarcinogen, has been found to have a specific inhibitory effect on one of the reactions of this synthetic process.

Research in chemistry is increasing our knowledge of molecular interactions at small separation distances; of the thermodynamic properties of solutions, including protein solutions; and of the photochemical oxidation of aqueous solutions containing cerous ions. The detailed structures of a number of organic and inorganic compounds have been studied by spectral methods, in particular by infrared spectra, and research has been started on nuclear magnetic resonance spectra as a method for studying structures. Useful methods for the synthesis of peptides have been developed. New light-catalyzed organic reactions have been discovered, and studies have been continued of condensation reactions catalyzed by sodium and of the reactions and structures of organic compounds with several unsaturated linkages. Organic reaction mechanisms have been studied by methods employing radioactive isotope exchange. Fission yields, ion exchange phenomena, and the chemistry of silicon have been principal subjects for research in inorganic chemistry. Progress has been made in polarographic, spectrophotometric, and electrodeposition methods of analysis.

In food technology, research in radiation sterilization, in which the Department pioneered, has begun to show fruition with the first commercially irradiated pharmaceutical product now on the market. As a result of advances in this



This vacuum system handles radioactive hydrogen and carbon dioxide for "tracer" studies in the organic chemistry laboratories.

Positronium — an atom formed by a brief association of electron with positron — was first identified in research at the Institute. By exciting positronium atoms, this glow discharge helps in studies of their properties.

area, the Department of the Army has now initiated a multi-million dollar research program for making feasible military applications of radiation sterilization, under the guidance of a National Research Council Committee of which Professor Bernard E. Proctor, head of the Department, is Chairman and Professor Goldblith, Executive Officer, is technical aide. A new fundamental research program on the development of rheological techniques for objective measurements of the physical characteristics of foods was initiated during the past year.

In geology and geophysics, new techniques have been developed for obtaining more rapid solutions in the X-ray analysis of crystal structures by use of the Whirlwind digital computer. Determinations of the natural variations in the isotopic abundances of several elements have been continued, resulting in greater knowledge of the time of origin of meteorites and chemical homogeneity in the solar system. Investigations are continuing on the relationship between observed statistics and the physical interpretation of ground motions in seismic exploration. A good correlation with observed seismic velocities has yielded information on the chemical composition and homogeneity of the earth's upper mantle. An improved method of prospecting for sub-surface conductive mineral deposits, utilizing frequency-dependent effects that result from localized polarizations, has been developed and tested with success.

Much research activity continues in the Department of Mathematics, to which reference can most easily be made by consulting the detailed list of publications in this year's Administrative Reports.

In physics, new and important information has been uncovered by members of our staff by analyzing K-meson

interactions on nuclear emulsion plates exposed at the University of California (Berkeley) using the bevatron. New precision techniques in nuclear spectroscopy have enabled staff members to collect much precise data on nuclear levels for many isotopes of elements from lithium to gold. The study of positronium has been continued in an attempt to analyze fine structure components. Detailed insight into the mode of generation of light in a plasma has been obtained. Precision measurements in microwave molecular spectroscopy continue. The solid state group has made important progress in a program using the Whirlwind computer to solve hitherto intractable problems in molecular and solid state physics, a program which promises to yield results of great significance.

Notable among improvements in the experimental facilities of the Laboratory for Nuclear Science have been: further circuit improvements to the synchrotron with resulting increase in beam intensity and stability; the active initiation of plans for a one M.E.V. Van de Graaff electron injector for that machine; establishment of developing and scanning techniques for large (up to 10″ x 16″) nuclear emulsions; plans for, and partial construction of, a large, counter-controlled bubble chamber; completion and application to experiment of a liquid hydrogen target; the successful attainment of a high intensity cyclotron alpha-particle beam of very good stability; the development of energy sensitive monitors for measurement of the linear accelerator Bremsstrahlung spectrum; and the development of a short (about .04 microsecond) injection pulse for the linear accelerator for use in time-of-flight neutron studies.

Studies of the new heavy particles have been continued using the large multiplate cloud chambers in Colorado and at the Brookhaven cosmotron. Activity with the latter has been

less than expected because of the extensive repair down-time of the cosmotron. The Colorado chamber has been operated actively and data has been accumulated giving strong evidence supporting two K-particle decay modes; tentative determinations have been made of the relative abundance, mean lifetime and mass of two K-mesons. A large number of V° event photographs are in hand and are being analyzed.

Work in cosmic rays has also included the completion of measurement of the mean free path of primary nucleons at high altitude; completion of a general mathematical analysis of the N-component of cosmic radiation; and the measurement of small sidereal variations in the intensity of high-energy cosmic rays. Instrumentation for an extension of the last of these has been sent to Chacaltaya, Bolivia, and is now in process of installation.

Studies of the photoproduction of mesons using the M.I.T. synchrotron have included the establishment of a lower limit for the lifetime of the π° meson; the observation of π^+ meson photoproduction from liquid hydrogen at small angles and at 180° to the beam; the elastic photoproduction of π mesons from hydrogen and deuterium; measurements of the angular distribution of scattered high energy gamma rays to investigate S-wave production of π° mesons from hydrogen. Additional synchrotron experiments have included high-energy photonuclear processes: determinations of the total photodisintegration cross sections of the deuteron in the 40–120 M.E.V. region; an attempt to determine the initial momentum of nucleons in nuclei; an examination of the high energy photoeffect as a function of atomic number; and the scattering of X-rays from a number of nuclei including hydrogen.

As in all cases cited, the above summary covers only a small fraction of the work being carried on in the Laboratory.

In the Spectroscopy Laboratory, the new methods involved in echelle spectroscopy have been extended into the vacuum ultraviolet as far as 1500A. Further progress has been made on the ruling of diffraction gratings under interferometric control. The program of studies in molecular spectroscopy is now enhanced by the completion of automatic recording high-resolution spectrometers for work on the Raman effect and in a large portion of the infrared spectrum. These instruments are being utilized in the determination of the molecular geometry and potential constants of cyclopropane and various related molecules. Analyses of rare earth and other complex spectra continue.

Under the Godfrey L. Cabot Solar Energy Program four projects are being actively pursued: the study of solar house-heating and the planning of M.I.T.'s next solar-heated house; the economic possibilities of solar distillation of sea water; studies of the photochemical decomposition of water involving cerium and uranium salts; and light-catalysed organic syntheses.

GEORGE R. HARRISON.

Report of the Treasurer

The principal aspects of the Institute's fiscal year 1954–55 are compared with the preceding year in the following table:

	Change	*1954–55*	*1953–54*
Academic operations	+$1,120,000	$14,813,000	$13,693,000
Endowment funds	+ 1,998,000	48,056,000	46,058,000
Total funds	+ 5,822,000	73,833,000	68,011,000
Gifts and grants	+ 2,008,000	6,650,000	4,642,000
Plant assets	+ 1,669,000	36,086,000	34,417,000
Investments — market value	+23,696,000	109,344,000	85,648,000
Investments — book value	+ 8,747,000	71,831,000	63,084,000
Division of Industrial Cooperation	− 5,672,000	9,568,000	15,240,000
Division of Defense Laboratories	+10,460,000	27,708,000	17,248,000

The decrease in the direct expenses of the Division of Industrial Cooperation and the increase in those of the Division of Defense Laboratories were due primarily to the transfer of the Instrumentation Laboratory and other projects to the Division of Defense Laboratories.

Operations.

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

Revenues and Funds	*1954–55*	*1953–54*
Tuition and other income	$ 4,673,000	$ 4,487,000
Investment income	1,259,000	1,232,000
Gifts and other receipts	3,560,000	2,775,000
Contract allowances for indirect expenses	3,543,000	3,472,000
Auxiliary activities	1,778,000	1,727,000
Total	$14,813,000	$13,693,000
Expenses		
Academic	$ 6,142,000	$ 6,157,000
General and administration	3,919,000	3,491,000
Plant operations	2,975,000	2,318,000
Auxiliary activities	1,777,000	1,727,000
Total	$14,813,000	$13,693,000

Grants and funds included in gifts and other receipts were drawn on more heavily than last year to meet academic expenses and increased plant operations expenses, leaving other sources of income available for the increase in general and administration expense. Academic salaries and wages were higher, but total academic expenses were little changed because special non-recurring expenses decreased from the preceding year. Improved employee benefits, higher development expenses, and increased salaries and wages accounted for most of the change in general and administration expenses. Building space changes, major construction alterations, and special maintenance work made up the large increase in plant operations expense. Continuing the practice initiated

in 1953–54, gifts and other receipts and contract allowances for indirect expenses were used as required to meet current expenses.

Funds.

Endowment and other funds have continued to increase during the year:

	June 30, 1955	*June 30, 1954*
Endowment for general purposes...	$33,569,000	$32,929,000
Endowment for designated purposes	14,487,000	13,129,000
Total endowment funds.....	$48,056,000	$46,058,000
Other funds.....	25,777,000	21,953,000
Total funds.....	$73,833,000	$68,011,000

The increase in the Faculty Salary Fund from $4,451,000 to $4,898,000 was included in endowment for general purposes. A primary development objective of the Institute is the additional capital of $20,000,000 required to fund completely the salaries of tenure members of the Faculty. Recognizing the importance of ultimately funding a substantial proportion of the current expenses now met with year-to-year revenues, the Executive Committee authorized the establishment of a fund for this purpose to be provided from current receipts. In 1954–55 $400,000 was added, bringing this reserve to $609,000, which is included in other funds. Endowment for designated purposes included new resources of $222,000 for undergraduate scholarships and $966,000 for the support of plant operations. The addition of $1,998,000 in endowment funds was supplemented by a net increase of $1,685,000 in building funds during the year.

Gifts.

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

	1954–55	*1953–54*
Endowment	$ 611,000	$ 760,000
Buildings	1,531,000	274,000
Current use — invested	1,893,000	726,000
Industrial Liaison support	817,000	1,225,000
Other funds for current use	1,523,000	1,657,000
Gifts of real estate	275,000	—
Total gifts	$6,650,000	$4,642,000

The greater gifts received for building funds reflected the successful efforts to secure the funds for the Karl Taylor Compton Laboratories and the nuclear reactor. Funds for current use — invested were increased by a distribution from the Edmund Dana Barbour Trust, the substantial Alumni Fund contributions for the Karl Taylor Compton Laboratories, the support of the Rockefeller Foundation for the School of Humanities, and the anniversary gift of the Class of 1905. Gifts classified as other funds for current use included $313,500 from the Alfred P. Sloan Foundation for the School of Industrial Management and the Foreign Student Summer Project.

Plant Facilities.

Construction has been undertaken on the Compton Laboratories, and the financing of the structure has been assured through funds on hand, contributions pledged, and the use of unrestricted funds. This new building will add eleven classrooms, bringing the total at the Institute to one hundred forty-seven. The financing of the nuclear reactor has reached the stage where planning can proceed with confidence that this educational and research tool will soon be under

construction. A possible site for the reactor has been purchased by the Institute, but final permission for its use is yet to be secured from the Atomic Energy Commission.

By use of unrestricted funds, some forty thousand square feet of land on the north side of Vassar Street was transferred from investments to educational plant assets. The Endicott House in Dedham, received as a gift from the estate of H. Wendell Endicott, was added to the off-campus property of the Institute. To clear the area for the Compton Laboratories, the Barbour Field House, the remaining part of temporary Building 22, and Building 18 were demolished and removed from educational plant assets. The cost of the skating rink was met with unrestricted resources, and unallocated construction and equipment costs were reduced to $120,000 by drawing on the same source of funds.

With the addition of the Kresge Auditorium and M.I.T. Chapel during the year, the book value of the educational plant reached $36,086,000 on June 30, 1955. Funds for the final equipping and finishing of the auditorium and chapel were included in building funds at the end of the year.

Special alterations, construction, maintenance, equipment, and space changes included in operations expense were $1,189,000 during 1954–55 compared with normal plant-operations expenses of $1,600,000. Space changes of $458,580 included over $200,000 as the cost of renovating a building for use by the Instrumentation Laboratory and extensive renovations of a number of laboratories within the main building group. Over $200,000 of furniture and equipment was added; and a systematic program of upgrading both interior and exterior building maintenance throughout the

Institute was initiated, with approximately $250,000 set aside for this purpose out of total expenses of this type of $730,000.

The unamortized value of the Westgate housing project was $313,000 on June 30, 1955, and this property has a limited useful life if extensive and expensive repairs are not undertaken. Architectural and economic studies which will be completed in the coming year, should indicate the feasibility of permanent housing for married students at the Institute. This past summer major repairs and alterations have been under way in Walker Memorial and the Graduate House, with the total combined expenditure in excess of $150,000.

Investments.

The investment position of the Institute on June 30, 1955, and June 30, 1954, is presented in the following table, which is exclusive of the investments of the M.I.T. Pension Association:

	June 30, 1955		*June 30, 1954*	
	Book Value	*Market Value*	*Book Value*	*Market Value*
General Investments				
Bonds	$31,696,000	$ 31,675,000	$24,685,000	$25,122,000
Stocks	20,348,000	54,772,000	18,929,000	39,411,000
Real estate	10,496,000	10,496,000	10,852,000	10,852,000
Cash and commercial paper	3,711,000	3,711,000	3,219,000	3,219,000
Total	$66,251,000	$100,654,000	$57,685,000	$78,604,000
Special investments	4,347,000	7,457,000	4,387,000	6,032,000
Student notes receivable	1,233,000	1,233,000	1,012,000	1,012,000
Grand total	$71,831,000	$109,344,000	$63,084,000	$85,648,000

The rate of 5.69 per cent was earned on the average book value of the funds sharing in the income from the general investments compared to 5.15 per cent last year; and 4.5 per cent was allocated to the funds as compared to 4 per cent last year. The total investment income on the general and special investments was $3,416,000, of which $1,259,000 was used for current expenses, $285,000 added to principal of endowment funds, $596,000 added to fund balances for redistribution against current expenses, $500,000 designated for expenses in 1955–56, and $153,000 added to the reserve of unallocated investment income. The net unallocated investment income reserve on June 30, 1955, was $2,542,000. On the investment of $4,651,-000 in student housing, only $18,000 was taken into investment income for the year; but $151,000 was added from operations to the reserves for amortization of these facilities, bringing these reserves to $893,000 at the year end. The general investments gain and loss account increased from $3,498,000 to $4,498,000 due to net gains on sales of securities during the year.

The costs of a number of possible improvements in the benefits available to the members of the M.I.T. Pension Association are now being reviewed by the consulting actuaries of the Institute. On December 31, 1954, the total contributing membership in the Association was one thousand ninety-two, and seventy-four members were retired as of that date. The Executive Committee appointed President Killian and Marshall B. Dalton trustees during the year. The investments of the Association on June 30, 1955, had a market value of $7,585,000, with nearly 50 per cent of these investments in common stocks.

Organization.

The newly organized financial and business administration completed its first year of service in 1954–55. Carl M. F. Peterson, Director of Physical Plant, worked with great effectiveness with the architects and contracting firms employed by the Institute; and he and his associates in the Department of Buildings and Power further demonstrated their exceptional capacities to deal with serious emergency conditions affecting the safety and well being of Institute employees, the continuity of building and related services, and the property of the Institute.

R. Colin Maclaurin, Director of General Services, is working with skilled competence with Albert F. Sise, Personnel Officer, and members of the academic and research administration to secure fair and sound relationships between the Institute and its employees. Mr. Maclaurin and his fellow officers are aggressively seeking to improve our housing and dining management, and the results of their efforts are becoming apparent on the campus.

Paul V. Cusick, Assistant Treasurer, has successfully assumed increased responsibility for the research-fiscal operations of the Institute, and in the office of the Vice-President and Treasurer financial and other matters related to plant operations and service operations are under his direction. During the year management-consulting services have been engaged to review plant operations, purchasing, and certain other business procedures.

General.

The operating budget for the year was balanced, all construction projects in progress were financed, and yet it was

possible to make the additions to the funds of the Institute required under established financial policies. Unrestricted funds were drawn on heavily to meet operating expenses and capital expenditures, but these funds were maintained at the minimum level considered prudent in the light of the scale of the Institute's activities. In apportioning unrestricted resources, we have been mindful of the importance of applying these funds to improving existing facilities and programs as well as to financing new undertakings. The increase in endowment income and tuition combined should at least keep pace with the increase in academic expenses composed largely of direct salaries and wages. Income from endowment will need to move ahead more rapidly than academic expenses if an increasing proportion of these expenses is to be funded. The tuition increase effective in 1956–57, approved by the Corporation during the year, will provide long-term financing of scholarships and salary and wage increases granted recently that are being met temporarily by other means.

Respectfully submitted,

JOSEPH J. SNYDER,
Vice President and Treasurer.

August 31, 1955

SCHEDULE A
BALANCE SHEET
JUNE 30, 1955

INVESTMENTS

General investments:			
U. S. Government bonds		$11,344,147	
Other bonds		20,351,521	
Preferred stocks		339,594	
Common stocks		20,008,304	
Real estate (including $5,118,990 devoted to Institute use) and mortgages		10,496,120	
Commercial paper		3,187,324	
	(A-1)		$ 65,727,010
Investments of funds separately invested	(A-2)		4,347,344
Students' notes receivable	(A-13)		1,232,849
Advanced for current operations			523,526
			$ 71,830,729

CURRENT AND DEFERRED ASSETS

Cash:			
General purposes		$ 1,401,849	
Restricted to certain research contracts		778,238	
Students' safe-keeping deposits		77,153	$ 2,257,240
Accounts receivable:			
U. S. Government	(A-14)	$ 1,482,484	
Other	(A-14)	381,973	1,864,457
Contracts in progress, principally U. S. Government	(A-15)		2,076,126
Inventories, deferred charges and other assets	(A-16)		955,415
Advanced to Division of Defense Laboratories			29,970
			$ 7,183,208

DIVISION OF DEFENSE LABORATORIES ASSETS

Cash ($965,498 in restricted accounts)	$ 1,151,902
Accounts receivable	2,192,962
Contracts in progress	4,514,386
Deferred charges	59,321
	$ 7,918,571

EDUCATIONAL PLANT

Land, buildings and equipment	(A-20)	$ 36,086,005
		$123,018,513

SCHEDULE A
BALANCE SHEET
JUNE 30, 1955

Invested Funds

Endowment funds:			
Income for general purposes	(A-3)	$33,569,279	
Income for designated purposes	(A-4)	14,486,704	$ 48,055,983
Student loan funds	(A-5)		2,968,438
Building funds	(A-6)		3,095,733
Other expendable funds:			
General purposes	(A-7)	$ 960,187	
Designated purposes	(A-8)	7,077,588	8,037,775
Unexpended endowment income for designated purposes	(A-4)		1,188,869
Agency and annuity funds	(A-9 & A-10)		943,237
General investments—gain and loss account	(A-11)		4,497,868
Unallocated investment income ($500,000 designated for distribution in 1955-56)	(A-12)		3,042,826
			$ 71,830,729

Current Liabilities and Funds

Advanced from invested funds		$ 523,526	
Accounts payable and accrued wages		628,477	
Students' advance fees and deposits	(A-17)	370,731	
Students' safe-keeping deposits		77,153	
Withholdings, deposits and other credits	(A-18)	781,610	
Advances by U. S. Government for certain research contracts		2,799,650	
Total current liabilities			$ 5,181,147
Gifts and other receipts for current expenses	(A-19)		2,002,061
			$ 7,183,208

Division of Defense Laboratories Liabilities

Accounts payable and accrued wages	$	1,121,947
U. S. Government advances		6,766,654
Advanced from Institute funds		29,970
	$	7,918,571

Educational Plant Capital

Endowment for educational plant	(A-21)	$ 36,086,005
		$123,018,513

SCHEDULE B

SOURCES OF REVENUES AND FUNDS USED TO MEET EXPENSES OF CURRENT OPERATION FOR THE YEAR ENDED JUNE 30, 1955

Sources of Revenues and Funds Used

Tuition and other income	(B-1)	$ 4,672,610
Investment income	(B-2)	1,259,058
Gifts and other receipts	(B-2)	3,559,753
Reimbursement of direct costs of research contracts of Division of Industrial Cooperation (see note)	(B-3)	9,568,122
Contract allowances for administration and plant operation	(B-3)	3,543,285
Auxiliary activities	(B-7)	1,777,689
		$ 24,380,517

Expenses of Current Operation

Academic departments	(B-4)	$ 6,141,875
Direct costs of research contracts of Division of Industrial Cooperation (see note)	(B-3)	9,568,122
Administration and general	(B-5)	3,918,677
Plant operation	(B-6)	2,974,827
Auxiliary activities	(B-7)	1,777,016
		$ 24,380,517

Note: This schedule includes only contracts under supervision of academic departments. Costs and revenues under all research contracts are shown on Schedule B-3.

SCHEDULE C

STATEMENT OF FUNDS
FOR THE YEAR ENDED JUNE 30, 1955

		Balance June 30, 1954	*Gifts and Other Receipts*	*Investment Income*	*Transfers In-(Out)*	*Expenses*	*Other Charges*	*Balance June 30, 1955*
Endowment funds:								
Income for general purposes	(A-3)	$32,929,233	$ 111,956	$ 1,483,271	$ 77,950	$ 1,033,131	.....	$33,569,279
Income for designated purposes	(A-4)	13,128,629	609,393	*	748,682	.....	.....	14,486,704
Student loan funds	(A-5)	2,808,887	42,072	91,335	26,204	.....	$ 60	2,968,438
Building funds	(A-6)	1,410,421	1,531,684	65,848	1,355,564	.....	1,267,784	3,095,733
Other expendable funds:								
General purposes	(A-7)	1,022,510	765,680	70,888	(766,547)	27,599	104,745	960,187
Designated purposes	(A-8)	6,221,365	2,688,639	338,430	(1,289,903)	544,684	336,259	7,077,588
Unexpended endowment income for designated purposes	(A-4)	1,112,442	6,937	666,898	(119,003)	225,767	252,638	1,188,869
Agency and annuity funds	(A-9 & A-10)	952,050	201,324	46,670	(209,100)	160	47,547	943,237
General investments — gain and loss account	(A-11)	3,497,987	999,881	.....	.....	.....	.....	4,497,868
Unallocated investment income	(A-12)	.....	.....	652,852**	2,389,974	.....	.....	3,042,826
Total invested funds		$63,083,524	$ 6,957,566	$ 3,416,192	$ 2,213,821	$ 1,831,341	$ 2,009,033	$71,830,729
Gifts and other receipts for current expenses	(A-19)	2,537,046	2,533,772	.....	176,153	2,987,470	257,440	2,002,061
Investment income unallocated to funds		2,389,974	.....	.....	(2,389,974)	.....	.....	.....
		$68,010,544	$ 9,491,338	$ 3,416,192	$	$ 4,818,811	$ 2,266,473	$73,832,790
Gifts received during year (excluding gift of plant, $275,000)			$ 6,374,857	Investment income used		$ 1,259,058	$ 1,438,452	Buildings
Appropriations from research contract allowances			1,156,232	Gifts & other receipts used		3,559,753	488,432	Scholarships and Fellowships
Net realized gain on general investments			999,881					
Other			960,368			$ 4,818,811		
			$ 9,491,338				339,589	Other charges to funds not representing operating expenses
							$ 2,266,473	

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

**$500,000 is designated for allocation in 1955–56.

Auditors' Certificate

TO THE AUDITING COMMITTEE OF THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY:

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

Schedule A — Balance Sheet as at June 30, 1955.

Schedule B — Sources of Revenues and Funds Used to Meet Expenses of Current Operation for the Year ended June 30, 1955

Schedule C — Statement of Funds for the Year ended June 30, 1955.

Our examination was made in accordance with generally accepted auditing standards, and accordingly included such tests of the accounting records and such other auditing procedures as we considered necessary in the circumstances.

In our opinion, said statements present fairly the financial position of Massachusetts Institute of Technology at June 30, 1955, and the results of its operations for the year then ended.

LYBRAND, ROSS BROS. & MONTGOMERY

Boston, Massachusetts, September 12, 1955

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, 1955, and their certificate is submitted herewith.

Respectfully,

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

STATEMENT ON ACCOUNTS

Supporting schedules for the balance sheet as of June 30, 1955, and the sources of revenues and funds used to meet expenses of current operation are presented in full in the Treasurer's Report Issue of the *Bulletin*. Only those believed to be of more general interest are reprinted on the following pages. Copies of the Treasurer's Report Issue may be obtained from the office of the Treasurer, Room 4-110, Massachusetts Institute of Technology, Cambridge 39.

JOHN A. LITTLE, C.P.A.,
Accounting Officer

SCHEDULE A-1
GENERAL INVESTMENTS

Par Value				*Book Value*	*Net Income*
	U. S. GOVERNMENT BONDS				
$2,000,000	U.S. Treasury"B"	1⅝%	1957	$ 2,000,000.00	$ 19,959.22
2,000,000	U.S. Treasury...	2⅜%	1958	1,997,526.85	22,926.42
200,000	U.S. Treasury...	2¾%	1961	200,000.00	7,414.36
3,018,000	U.S. Treasury...	2½%	1961	3,018,000.00	93,600.50
2,040,000	U.S. Treasury...	2½%	1963	2,040,000.00	.....
1,500,000	U.S. Treasury...	2½%	1968–63	1,469,218.75	37,500.00
500,000	U.S. Treasury...	2½%	1969–64	504,167.00	11,500.00
10,000	U.S. Treasury...	3¼%	1983–78	10,836.00	224.66
100,000	U.S. Savings"G"	2½%	1956	100,000.00	2,500.00
3,000	U.S. Savings"G"	2½%	1961	2,894.00	75.00
	Small holdings..			1,504.72	27.60
	Income from bonds sold or matured.....			.....	33,439.76
	Total U.S. Government bonds...			$11,344,147.32	$229,147.52
	CANADIAN BONDS				
	Financial				
$500,000	Can. Acceptance Corp., Ltd. Reg. (Can. Funds)	4½%	1968	$508,500.00	$21,377.87
500,000	Gen. Motors Acc. Corp of Canada Deb. (Can. Funds).....	4¾%	1969	511,500.00	22,828.91
	Industrial				
180,000	Aluminum Co. of Canada, Ltd. S.F. Deb. Call (U.S. Funds)..	3⅞%	1970	181,200.00	6,375.00
192,000	Aluminum Co. of Canada, Ltd. S.F. Deb. (Can. Funds).....	4½%	1973	196,790.00	6,873.13
	Public Utility				
200,000	Bell Tel. of Canada 1st Mortgage Ser. J, (Can. Funds).....	4½%	1967	203,500.00	7,719.38
200,000	Interprovincial Pipe Line 1st A Coll. Tr. (Can. Funds).....	3½%	1970	197,375.00	7,205.63
	Income from bonds sold.....			.....	825.08
	Total Canadian.....			$ 1,798,865.00	$ 73,205.00

SCHEDULE A-1—(Continued)

Par Value				*Book Value*	*Net Income*
	INDUSTRIAL BONDS				
$ 150,000	Commonwealth Oil Refining Co. Inc. S.F. Deb. Reg.	6%	1966	$ 150,000.00	$ 6,575.00
1,000,000	Gen. Motors Corp. Deb.	3¼%	1979	1,004,000.00	31,700.00
200,000	LaGloria Oil & Gas Co. Sinking Fund Deb. Reg.	5½%	1974	199,999.00	11,000.00
150,000	McMurrey Refining Co. Particpat. Deb.	6%	1974	150,000.00	4,500.00
81,000	Shamrock Oil & Gas Corp. S.F. Deb. Call	3½%	1967	81,000.00	2,644.41
300,000	Southern Producduction Co. Inc. Note Reg.	3½%	1962–69	300,000.00	8,156.48
102,000	Union Oil Co. of Cal. Conv. Deb.	3%	1975	102,000.00	(64.50)
26,000	U.S. Steel Corp. Corp. Deb.	1.30%	1955	26,000.00	165.24
34,000	U.S. Steel Corp. Deb.	1.80%	1956	34,000.00	299.20
36,000	U.S. Steel Corp. Deb.	2.05%	1957	36,000.00	360.80
36,000	U.S. Steel Corp. Deb.	2.25%	1958	36,000.00	396.00
23,000	U.S. Steel Corp. Deb.	2.40%	1959	23,000.00	269.87
10,000	U.S. Steel Corp. Deb.	2.50%	1960	10,000.00	122.22
10,000	U.S. Steel Corp. Deb.	2.55%	1961	10,000.00	124.67
10,000	U.S. Steel Corp. Deb.	2.60%	1962	10,000.00	127.11
10,000	U.S. Steel Corp. Deb.	2.65%	1963	10,000.00	129.56
5,000	U.S. Steel Corp.. Deb.	2.65%	1964	5,000.00	64.78
	Income from bonds sold				10,294.56
	Total industrial bonds			$ 2,186,999.00	$ 76,865.40
	PUBLIC UTILITY BONDS				
$ 200,000	Am. & Foreign Power Deb.	5%	2030	$ 197,182.41	$ 10,000.00
50,000	Am. Gas & El. Co. S.F. Deb. Call	3⅜%	1977	50,000.00	1,687.50

SCHEDULE A-1—(Continued)

Par Value				*Book Value*	*Net Income*
	PUBLIC UTILITY BONDS (Continued)				
$ 500,000	Am. Tel & Tel. Co. Deb.....	3¼%	1984	$ 511,600.00	$ 6,389.23
200,000	Columbia Gas System Inc. Deb. D.....	3½%	1979	202,750.00	2,475.00
263,000	Great Lakes Pipe Line Co. S.F. Deb. Reg. Stamped.....	3¼%	1957	263,000.00	8,194.18
591,000	Great Lakes Pipe Line Co. Reg..	4%	1974	591,000.00	19,929.58
105,000	Northern Natural Gas S.F. Deb..	3⅝%	1973	105,750.00	3,656.25
200,000	Northern Natural Gas S.F. Deb..	3¼%	1974	200,800.00	4,861.40
107,100	Pacific Northwest Pipeline.....	5½%	1957	107,100.00	(1,036.01)
97,000	Southern Natural Gas Co. 1st Pipe Line Sinkg. Fd.	4%	1973	96,030.00	3,880.00
200,000	Tennessee Gas Transmission Co. Deb.....	4%	1975	202,250.00	(538.88)
	Income on bonds sold.....			.....	13,692.57
	Total public utility.....			$ 2,527,462.41	$ 73,190.82
	RAILROAD BONDS				
$ 100,000	Baltimore & Ohio R.R., 1st A....	4%	1975	$ 86,985.00	$ 4,000.00
50,000	Baltimore & Ohio R.R., Pitts. Lake Erie & W. Va. Sys. Ref. A....	4%	1980	48,643.75	2,000.00
250,000	N.Y. Central R.R. 3rd Eq. Tr. 1950.....	2¾%	1957	248,560.66	(706.60)
123,000	Northern Pacific Ry. Prior Lien	4%	1997	114,158.29	4,840.00
200,000	Pennsylvania R.R. Eq. Tr.....	2½%	1956	199,789.75	(2,180.56)
153,000	Southern Pacific Co.....	4½%	198:	150,781.75	6,885.00
250,000	Southern Railway Eq. Tr.....	2⅝%	1956	249,263.26	(989.58)
	Income on bonds sold.....			.....	197.78
	Total railroad.....			$ 1,098,182.46	$14,046.04

SCHEDULE A-1—(Continued)

Par Value				*Book Value*	*Net Income*
	FINANCIAL BONDS				
$2,000,000	Associates Investment Co. Note Reg.....	3%	1964	$ 2,000,000.00	$30,000.00
500,000	Associates Investment Co. Note Reg.....	3¼%	1970	500,000.00	.....
125,000	C.I.T. Financial Corp. Note Reg.....	2¾%	1955	125,000.00	3,237.50
500,000	C.I.T. Financial Corp. Note Reg.	3½%	1959	500,000.00	17,500.00
500,000	C.I.T. Financial Corp. Note Reg.	3%	1964	500,000.00	.....
250,000	Commercial Credit Co. Reg.....	2¾%	1956	250,000.00	6,875.00
250,000	Commercial Credit Co. Reg.....	2¾%	1957	250,000.00	6,875.00
500,000	Commercial Credit Co. Reg.....	3½%	1965	495,000.00	17,500.00
500,000	Federal National Mortgage Assoc. Note.....	2½%	1958	500,000.00	(156.25)
1,000,000	General Motors Accept. Corp. Deb.....	4%	1958	1,000,000.00	40,000.00
1,600,000	General Motors Accept. Corp. Reg. Note Sub.	3%	1959	1,590,000.00	40,200.00
1,000,000	General Motors Accept. Corp. Deb.....	3%	1960	1,000,000.00	(90.34)
1,500,000	General Motors Accept. Corp. Deb.....	3⅛%	1961	1,508,500.00	56,625.00
1,195,000	General Motors Accept. Corp. Deb.....	2¾%	1964	1,183,112.53	15,126.52
235,000	General Motors Accept. Corp. Deb.....	3%	1969	235,700.00	6,859.59
300,000	General Motors Accept. Corp. Deb.....	3½%	1972	300,600.00	(315.27)
500,000	General Motors Accept. Corp. Junior Sub. Reg. Note.....	3¾%	1973	500,000.00	.....

SCHEDULE A-1—(Continued)

Par Value		*Book Value*	*Net Income*
	FINANCIAL BONDS—(*Continued*)		
$ 300,000	International Bk. for Recon. & Dev. Call..... 3% 1976	$ 300,000.00	$ 9,000.00
	Income from bonds sold.....	.....	48,275.30
	Total financial.....	$12,737,912.53	$297,512.05
	SMALL HOLDINGS.....	$ 2,100.00	2.50
	Income from bonds sold.....	.....	$42.17
	Total small holdings.....	$ 2,100.00	$44.67
Shares	PREFERRED STOCKS		
900	Arthur D. Little, Inc. Non-Cum. 6% Pfd.....	$ 90,000.00	$ 5,400.00
602	Merck & Co. $4 Cum. Conv. 2nd Pfd.....	64,373.97	2,408.00
1,500	Tropical Gas Co., Inc. $5.24 Cum. Pfd.....	150,000.00	6,300.00
100	Armstrong Furnace Co. 5% Cum. Pfd. Ser. B.....	10,000.00	500.00
1,422	Lennox Furnance Co. 4% Cum. Pfd. $10 Par.....	14,220.00	568.80
100	H. K. Webster Co. 5% Cum. Pfd.	10,000.00	500.00
	Small holding	1,000.00	70.00
	Income from preferred stocks sold	.....	$ 1,581.88
	Total preferred stocks.....	$ 339,593.97	$ 17,328.68
	INDUSTRIAL COMMON STOCKS		
	Agricultural Equipment		
3,000	International Harvester.....	$ 39,956.12	$ 6,000.00
	Automobile		
3,000	Chrysler Corporation.....	105,364.64	9,000.00
65,411	General Motors Corp.....	3,126,014.04	292,733.00
	Building Supplies		
7,000	Johns-Manville Corp.....	256,304.86	29,750.00
12,604	National Lead Co.....	118,223.14	28,989.20
7,000	Pittsburgh Plate Glass Co.....	138,604.46	16,450.00
600	Sherwin Williams Co.....	30,296.42	2,400.00

SCHEDULE A-1—(Continued)

Shares		*Book Value*	*Net Income*
	INDUSTRIAL COMMON STOCKS—(*Continued*)		
	Chemical and Drugs		
4,008	Allied Chemical & Dye Corp....	$ 169,777.26	$ 12,625.20
338	Christiana Securities Corp.....	1,495,174.35	129,764.00
5,268	Dow Chemical Co.....	102,412.70	5,268.00
1,706	E. I. du Pont de Nemours & Co.	226,872.70	5,642.00
9,000	Hercules Powder Co.....	443,519.94	27,900.00
18,060	Merck & Co., Inc.....	108,717.47	14,448.00
4,166	Monsanto Chemical Co.....	102,743.58	10,415.00
14,212	Union Carbide & Carbon Corp...	306,515.85	35,530.00
	Containers		
16,426	American Can Co.....	454,858.99	25,457.75
5,000	Owens-Illinois Glass Co.....	286,673.89	23,210.00
	Electrical Equipment		
16,868	Thomas A. Edison, Inc. B.....	180,000.00	19,679.63
28,301	General Electric Co.....	276,983.92	45,038.40
6,440	General Radio Co., Conv.....	74,830.00	1,610.00
6,000	Westinghouse Electric Corp.....	107,827.11	15,000.00
	Food and Beverages		
3,150	Liquid Carbonic Corp.....	53,551.11	4,410.00
6,000	United Fruit Co.....	104,379.52	17,850.00
	Machinery		
8,653	Caterpillar Tractor Co.....	92,204.43	11,164.60
6,000	Draper Corp.....	96,132.10	8,400.00
4,500	United Shoe Machinery Corp. ..	264,255.41	11,250.00
	Non-Ferrous Metal		
4,000	International Nickel Co. of Canada, Ltd.....	134,488.60	12,000.00
3,943	Kennecott Copper Corp.....	245,819.30	23,658.00
	Office Equipment		
1,575	Int'l Business Machines Corp. ..	49,997.96	6,300.00
10,509	Nat'l Cash Register Co.....	96,785.73	10,756.35
	Oil		
3,750	Commonwealth Oil Refining Co., Inc.....	4,500.00	.....
353	Continental Oil Co.....	24,998.31	647.10
7,875	Gulf Oil Corporation.....	184,939.60	15,447.00
5,000	LaGloria Oil & Gas Co.....	1.00	.....
10,070	Ohio Oil Company.....	190,394.75	15,078.75
10,172	Phillips Petroleum Co.....	439,078.34	23,481.80
16,337	Socony Mobil Oil Co., Inc.....	303,277.00	36,753.75
11,919	Standard Oil Co. of California...	343,865.63	35,327.25
14,518	Standard Oil Co. (Indiana).....	299,378.70	31,274.78
34,130	Standard Oil Co. (New Jersey)..	871,051.60	151,132.86
5,222	Texas Co.....	172,288.05	19,534.50
21,000	Tropical Gas Co., Inc.....	5,250.00	.....
	Paper		
11,560	International Paper Co.....	180,544.61	34,266.34

SCHEDULE A-1—(Continued)

Shares		*Book Value*	*Net Income*
	INDUSTRIAL COMMON STOCKS—(*Continued*)		
	Retail Trade		
5,125	J. C. Penney Co.	$ 165,618.55	$ 18,643.75
7,174	Sears, Roebuck & Co.	175,267.79	21,363.60
	Rubber		
300	B. F. Goodrich Co.	14,325.00	375.00
	Soap		
7,652	Procter & Gamble Co.	274,196.10	26,782.00
	Steel		
6,000	Inland Steel Co.	198,474.49	22,500.00
6,600	National Steel Corp.	149,488.34	19,800.00
	Tobacco		
1,000	American Tobacco Co.	72,380.87	4,400.00
1,500	Liggett & Myers Tobacco Co.	104,917.80	7,500.00
	Miscellaneous		
2,500	Consolidated Rendering Co.	169,500.00	10,625.00
31,794	Eastman Kodak Co.	382,128.55	63,585.90
5,216	Minnesota Mining & Mfg. Co.	142,468.00	7,824.00
	Income on stocks sold	.....	58,491.05
	Total industrial common stocks..	$14,157,618.68	$1,487,533.56
	PUBLIC UTILITY COMMON STOCKS		
18,239	American Gas & Electric Co.	$ 351,397.32	$ 32,100.64
1,101	American Tel & Telephone Co.	137,820.69	9,909.00
4,240	Boston Edison Co.	155,396.99	11,872.00
7,000	Commonwealth Edison Co., Ill.	173,802.17	19,240.08
6,400	General Public Utilities Corp.	182,475.34	10,880.00
5,000	Illinois Power Co.	200,001.83	10,175.00
10,600	Middle South Utilities, Inc.	293,301.33	14,977.25
5,000	Montana Power Co.	169,075.59	7,360.00
1,785	Pacific Northwest Pipeline Co.	21,420.00	.....
4,000	Public Service Co. of N. H.	70,750.00	.....
4,000	Southern California Edison Co.	138,089.14	8,400.00
2,100	Southern Co.	31,895.00	1,785.00
6,242	Texas Gas Trans. Corp.	102,742.00	6,181.00
19,644	Virginia Electric & Power Co. $10 Par	460,201.48	27,192.20
	Income on stocks sold	.....	3,056.95
	Total public utility	$ 2,488,368.88	$163,129.12

SCHEDULE A-1—(Continued)

Shares		*Book Value*	*Net Income*
	RAILROAD COMMON STOCKS		
4,296	Atchison, Topeka & Santa Fe Ry.	$ 207,203.11	$ 30,072.00
2,000	Great Northern Railway Co. . . .	48,780.06	4,400.00
	Income on stocks sold.		6,256.20
	Total railroad.	$ 255,983.17	$ 40,728.20
	BANK COMMON STOCKS		
3,750	Bankers Trust Co., N.Y.	$ 189,613.75	$ 9,000.00
3,031	Continental Illinois Nat'l Bk. & Trust Co., Chicago.	174,542.92	12,124.00
5,549	First National Bank of Boston. .	307,790.41	14,337.90
7,189	First National City Bank of N.Y.	295,919.04	16,894.15
6,012	Guaranty Trust Co., N. Y.	339,143.79	21,841.05
5,711	Hanover Bank, N. Y.	233,521.57	10,565.50
	Income on stocks sold.		12,000.00
	Total bank	$ 1,540,531.48	$ 96,762.60
	INSURANCE COMMON STOCKS		
8,334	Boston Insurance Co.	$ 197,914.51	$ 12,501.00
2,125	Continental Ins. Co. of N.Y. . . .	68,383.05	6,375.00
8,652	Fireman's Fund Ins. Co., Cal. . .	209,379.20	15,573.60
3,720	Hartford Fire Ins. Co., Conn. . . .	127,949.44	8,859.75
7,680	Ins. Co. of North America.	161,635.55	19,200.00
	Total insurance	$ 765,261.75	$ 62,509.35
	OTHER COMMON STOCKS		
10,250	Bond Inv. Trust of America. . . .	$ 195,881.50	$ 11,070.00
12,177	Century Shares Trust.	192,474.48	6,088.50
360	Cochran Foil Co.	6,680.00	504.00
27,536	Colonial Fund, Inc.	204,240.96	18,999.84
300	Diamond Alkali Co.	10,200.00	375.00
200	Minneapolis-Honeywell Regulator Co.	10,500.00	130.00
1,000	National Research Corp.	30,000.00	. . . . .
781	Photon, Inc.	12,276.28	. . . . .
500	Rockwell Mfg. Co.	10,000.00	1,000.00
575	Sprague Electric Co.	33,000.00	387.50
735	J. P. Stevens & Co., Inc.	25,325.00	735.00
1,000	Stone & Webster, Inc.	29,507.65	2,000.00
1,000	Texas Instruments, Inc.	12,672.57	. . . . .
430	Winn and Lovett Grocery Co. . . .	10,212.50	43.00
	Small holdings	17,569.05	473.00
	Income on stocks sold.		429.62
	Total other stocks.	$ 800,539.99	$ 42,235.46

SCHEDULE A-1—(Continued)

	Book Value	*Net Income*
MORTGAGE NOTES		
Common Street, Belmont	$ 4,640.00	$ 165.03
Bay State Road, Boston	8,000.00	432.01
Collincote Street, Stoneham	500.00	20.00
Maude Terrace, Watertown	1,611.01	78.83
Mt. Auburn Street, Watertown	25,000.20	1,247.20
Park Avenue, Arlington	6,170.22	291.81
Summer Street, Watertown	4,311.98	203.68
Alpha Tau Omega	7,100.00	354.99
Beta Theta Pi	13,500.00	700.00
Delta Kappa Epsilon	6,047.98	362.99
Kappa Sigma	7,000.00	337.50
Lambda Chi Alpha	9,225.30	501.92
Pi Lambda Phi	2,000.00	162.50
Phi Kappa	11,275.00	604.38
Phi Mu Delta	3,000.00	150.00
Sigma Chi	3,500.00	175.00
Income on paid up mortgages	.....	141.18
Total mortgage notes	$ 112,881.69	$ 5,929.02
REAL ESTATE DEVOTED TO INSTITUTE USE		
Dormitories and Housing		
120 Bay State Road, Boston	$ 26,000.00	$ 675.00
Graduate House	647,951.94	2,000.00
Baker House	2,064,180.53	5,000.00
Burton House	1,453,380.37*	.....
Westgate Veterans' Housing	459,492.60	10,000.00
Total dormitories and housing	$ 4,651,005.44	$ 17,675.00
Research		
565 Memorial Drive, Cambridge.	$ 200,560.50	$ 11,031.00
209 Mass. Ave., Cambridge	100,000.00	5,500.00
Wood Street, Lexington, Mass.	67,424.04	4,488.00
68–92 Albany Street, Cambridge.	100,000.00	6,875.00
Total research	$ 467,984.54	$ 27,894.00

*Not including first mortgage of $352,885.

SCHEDULE A-1—(Continued)

				Book Value	*Net Income*
	OTHER REAL ESTATE				
	36–44 Memorial Drive, Cambridge			$ 1,182,682.99	$ 55,765.47
	80 Memorial Drive, Cambridge			863,165.85	43,077.00
	100 Memorial Drive, Cambridge			153,510.85	6,399.96
	333 Memorial Drive, Cambridge			40,000.00	.....
	500 Memorial Drive, Cambridge (building and fixtures).....			64,700.95	3,318.25
	540–550 Memorial Drive, Cambridge (land).....			351,524.51	15,207.83
	640 Memorial Drive, Cambridge.			9,211.94	.....
	Gloversville, N. Y.....			219,671.51	11,019.69
	New London, Conn.....			215,456.01	9,949.30
	Plattsburg, N. Y.....			152,418.36	6,909.44
	Taunton, Mass.....			176,147.31	8,034.92
	Waltham, Mass.....			633,464.99	31,756.60
	Willimantic, Conn.....			144,554.21	6,589.26
	Main Street, Worcester, Mass...			174,507.06	7,958.93
	Federal Street, Worcester, Mass.			329,272.20	15,992.93
	Bexley Hall, Cambridge.....			130,280.61	8,228.19
	76–94 Mass. Ave., Cambridge...			423,678.74	1,175.52
	Income on property sold.....			.....	6,808.88
	Total other real estate.....			$ 5,264,248.09	$ 238,192.17
Par Value					
	COMMERCIAL PAPER				
$1,000,000	Assoc. Invest. Co. (Indiana).	1⅜%	1955	$ 992,781.25	.....
500,000	Dow Chem. Co..	1⅞%	1955	498,437.50	.....
520,000	Dow Chem. Co..	1⅞%	1955	517,743.75	.....
115,000	Gen. Electric Supply Co....	2%	1955	114,060.83	.....
1,000,000	Gen. Electric Supply Co....	2%	1955	990,277.78	.....
75,000	General Motors Accept. Corp..	1¾%	1955	74,022.92	.....
	Income from maturities.....			.....	$ 43,939.13
	Total commercial paper.....			$ 3,187,324.03	$ 43,939.13
	Total general investments.....			$65,727,010.43	$3,007,867.79

(Schedule A)

SCHEDULE A-2

INVESTMENTS OF FUNDS SEPARATELY INVESTED

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	$ 1,800.00
	BABSON FUND		
$ 2,000	U. S. Treasury 2¼s 1956–59	$ 2,000.00	$ 45.00
1,000	U. S. Savings "G" 2½s 1961	1,000.00	25.00
1,000	U. S. Savings "G" 2½s 1963	1,000.00	25.00
2,000	U. S. Treasury 2½s 1963	2,000.00	.....
1,950	U. S. Treasury 2½s 1967–72	1,906.13	4.85
80	United Stores, Corp. $6 Cum. Conv. Pfd.	8,034.54	480.00
80	United Stores, Corp. $4.20 Pfd.	1,284.62	64.00
20	E. I. duPont de Nemours & Co.	1,722.86	120.00
60	Standard Oil Co. (Indiana)	1,413.36	126.30
	Income from bonds sold	.....	20.00
	Total Babson Fund	$ 20,361.51	$ 910.15
	CLASS OF 1919 FUND		
$ 4,025	U. S. Savings "F" 1955–57	$ 2,978.50	$ 162.50
	RICHARD LEE RUSSEL FUND		
$ 2,000	Mortgage notes (participation)	$ 2,000.00	$ 61.04
20	General Electric Co.	930.00	16.00
30	General Public Utilities	1,038.75	25.50
10	Standard Oil Co. of N. J.	1,095.00	25.17
	Income from mortgage paid up	.....	91.18
	Total Russel Fund	$ 5,063.75	$ 218.89
	SOLAR ENERGY FUND		
$ 50,000	U. S. Treasury Bonds 2⅛s 1960	$ 50,000.00	$ 796.85
37,000	U. S. Treasury Notes "C" .. 2s 1957	37,000.00	(7.97)
5,000	Godfrey L. Cabot, Inc.	647,700.00	40,000.00
1,950	General Electric Company	32,468.22	3,120.00
324	Mission Corporation	6,291.00	1,197.13
	Income from bonds sold	.....	1,499.80
	Total Solar Energy Fund	$ 773,459.22	$ 46,605.81

SCHEDULE A-2 — (Continued)

Par Value or Shares				*Book Value*	*Net Income*
	RESEARCH FUND, SCHOOL OF INDUSTRIAL MANAGEMENT				
$ 29,000	General Motors Acceptance Corp. Note	1¾s	1955	$ 28,622.19	.....
21,000	General Motors Corporation			1,075,000.00	$101,000.00
	Income from commercial paper			.....	739.62
	Total Research Fund, S.I.M.			$1,103,622.19	$101,739.62
	JONATHAN WHITNEY FUND				
$131,000	U. S. Savings "G"	2½s	1956–58	$ 131,000.00	$ 3,275.00
50,000	U. S. Savings "K"	2.76	1966	50,000.00	690.00
90,000	U. S. Treasury Notes "C"	2s		90,000.00	(42.19)
40,000	Am. Tel. & Tel. Co. Deb.	3¼s	1984	40,900.00	487.83
40,000	General Motors Acceptance Corp. of Canada	4¾s	1969	41,000.00	1,646.31
40,000	Pacific Gas & Elec. Co.	3s	1974	40,000.00	1,200.00
410	Bankers Trust Co., N. Y.			18,937.50	984.00
200	Boston Edison Company			7,405.22	560.00
748	Boston Insurance Company			19,145.78	1,122.00
300	Chrysler Corporation			16,594.85	900.00
400	E. I. duPont de Nemours & Co.			15,279.10	2,400.00
270	First National Bank of Boston			11,465.90	702.00
468	First National City Bank, N. Y.			20,641.73	1,099.80
1,500	General Electric Company			13,188.05	2,400.00
330	Guaranty Trust Co. of N. Y.			18,087.30	1,204.50
400	Inland Steel Company			16,120.12	1,500.00
867	International Paper Company			14,708.60	2,568.94
644	Standard Oil Co. (New Jersey)			12,311.87	3,166.81
450	United Fruit Company			10,690.25	1,350.00
	Income from bonds sold			.....	3,700.20
	Total Whitney Fund			$ 587,476.27	$ 30,915.20
	CLASS OF 1920 FUND				
$ 3,150	U. S. Savings "F"		1957	$ 2,331.00	.....
2,175	U. S. Savings "F"		1958	1,609.50	.....
	Total Class 1920 Fund			$ 3,940.50	.....
	DRAPER FUND				
$ 24,000	U. S. Treas. Notes, Ser. C	2s	1957	$ 24,000.00	$ (11.25)
10,000	U. S. Savings "G"	2½s	1959	10,000.00	250.00
21,000	U. S. Savings "G"	2½s	1960	21,000.00	525.00
5,000	Baltimore & Ohio R.R.	4s	1975	5,000.00	200.00
5,000	Northern Pacific R.R.	4s	1997	4,598.31	200.00
5,000	Southern Pacific Co.	4½s	1981	5,000.00	225.00
30,000	General Motors Acceptance Corp. of Canada	4¾s	1969	30,600.00	1,259.74
100	E. I. duPont de Nemours & Co.			4,731.05	600.00
60	Standard Oil Co. (New Jersey)			2,010.78	295.04
	Income from bonds sold			.....	600.00
	Total Draper Fund			$ 106,940.14	$ 4,143.53

SCHEDULE A-2 — (Continued)

Par Value				*Book Value*	*Net Income*
	TECHNOLOGY LOAN FUND				
$ 50,000	U.S.A. Cert. of Indebt. D	1⅛s	1955	$ 50,000.00	.....
400,000	U. S. Savings "G"	2½s	1954–60	400,000.00	$ 10,000.00
50,000	U. S. Savings "K"	2.76s	1966	50,000.00	690.00
96,000	U. S. Treasury	2¼s	1962–59	96,000.00	2,160.00
35,000	Am. Tel. & Tel. Co.	2¾s	1980	35,000.00	962.50
15,000	Pacific Gas & Elec. Co.	3s	1974	15,000.00	450.00
30,000	Dow Chem. Co. Notes	1⅞s	1955	29,857.81	.....
1,980	American Can Company			40,814.83	3,069.00
2,000	Burroughs Corporation			39,830.94	1,500.00
800	E. I. duPont de Nemours & Co.			29,304.00	4,800.00
1,302	First National City Bank, N. Y.			46,228.91	3,059.70
3,000	General Electric Company			25,813.25	4,800.00
885	Guaranty Trust Company of N. Y.			50,333.82	3,230.25
1,407	Gulf Oil Corporation			32,691.98	2,759.00
835	Hartford Fire Insurance Co. (Conn.)			44,879.08	2,004.00
500	Monsanto Chemical Company			46,346.30	1,250.00
3,993	National Cash Register Company			38,458.96	4,092.83
1,000	Pittsburgh Plate Glass Company			53,780.85	2,350.00
2,250	Public Service of Indiana			61,233.06	4,500.00
750	Procter & Gamble Company			29,511.45	2,625.00
280	St. Paul Fire & Marine Ins. Company			6,737.50	287.00
1,000	Socony Mobil Oil Company			44,156.46	2,250.00
1,286	Standard Oil Company (New Jersey)			24,864.43	6,323.78
1,200	Union Carbide and Carbon Corp.			27,726.00	3,000.00
	Income from bonds and stocks sold			.....	7,089.73
	Total Technology Loan Fund			$1,318,569.63	$ 73,252.79
	JOSEPH HEWETT FUND				
$ 15,500	U. S. Treasury	2¼s	1959–62	$ 15,355.47	$ 283.94
17,000	U. S. Savings "G"	2½s	1958–61	17,000.00	425.00
15,000	Alabama Power Co.	3½s	1972	15,000.00	525.00
12,000	Baltimore & Ohio R.R.	4s	1975	12,000.00	480.00
10,000	Northern Pacific R.R.	4s	1997	10,100.00	300.00
10,000	Southern Pacific Co.	4½s	1981	10,050.00	400.00
12,000	Texas & New Orleans R.R.	3⅜s	1990	12,000.00	405.00
50,000	General Motors Accept. Corp. of Canada	4¾s	1969	50,900.00	2,032.89
440	American Can Company			8,570.00	682.00
120	Bankers Trust Company, N. Y.			4,775.00	288.00
200	E. I. duPont de Nemours & Company			8,271.55	1,200.00
900	General Electric Company			8,107.50	1,440.00
110	Guaranty Trust Co., N. Y.			5,078.70	401.50
600	National Cash Register Company			5,461.53	615.00
200	St. Paul Fire & Marine Insurance Co.			4,812.50	205.00
400	Standard Oil Company (Indiana)			9,392.40	860.83
454	Standard Oil Company (New Jersey)			9,744.51	2,229.05
300	Union Carbide and Carbon Corp.			6,944.20	750.00
300	United Fruit Company			7,120.00	900.00
	Income from bonds sold			.....	69.88
	Total Hewett Fund			$ 220,683.36	$ 14,493.09

SCHEDULE A-2 — (Continued)

Par Value or Shares				*Book Value*	*Net Income*
	GEORGE S. WITMER FUND				
$ 12,000	U. S. Savings "G"...	2½s	1959–61	$ 12,000.00	$ 300.00
5,000	Am. Tel. & Tel. Co...	2¾s	1971	4,949.55	137.50
5,000	Northern Pacific R.R.	4s	1997	4,903.79	200.00
4,000	Southern Pacific Co...	4½s	1981	3,942.68	180.00
5,000	General Motors Accept. Corp. of Canada.....	4¾s	1969	5,100.00	143.29
100	American Home Products Corp.....			5,468.00	240.00
225	The Denver & Rio Grande Western R.R. Co.....			4,500.00	412.50
100	C.I.T. Financial Corp.....			3,300.00	225.00
150	Commonwealth Edison Company....			4,421.34	391.69
200	General Public Utilities Corp.....			6,950.00	170.00
269	Middle South Utilities.....			3,241.58	335.76
180	Pacific Gas & Electric Company.....			6,675.34	396.00
300	United Gas Corporation.....			2,125.01	431.25
120	St. Paul Fire & Marine Insurance Co..			2,887.50	123.00
210	General Electric Company.....			3,235.75	336.00
95	General Motors Corporation.....			2,890.86	455.00
200	Minneapolis-Honeywell Regulator Company.....			5,494.69	280.00
100	Shell Oil Company.....			5,928.54	100.00
210	The Sperry Rand Corporation.....			2,500.00	405.00
100	Standard Oil Company (New Jersey).			2,684.08	491.74
100	Union Carbide and Carbon Corp.....			2,713.10	250.00
65	Bankers Trust Co., N. Y.....			3,071.50	156.00
110	Guaranty Trust Co. of N. Y.....			5,920.20	401.50
	Real estate, Sanford, Fla.....			3,145.19	.....
	Income from bonds and stocks sold...			.....	365.59
	Total Witmer Fund.....			$ 108,048.70	$ 6,926.82
Total funds separately invested				$4,347,343.77	$281,168.40
				(Schedule A)	

INVESTMENTS — SUMMARY

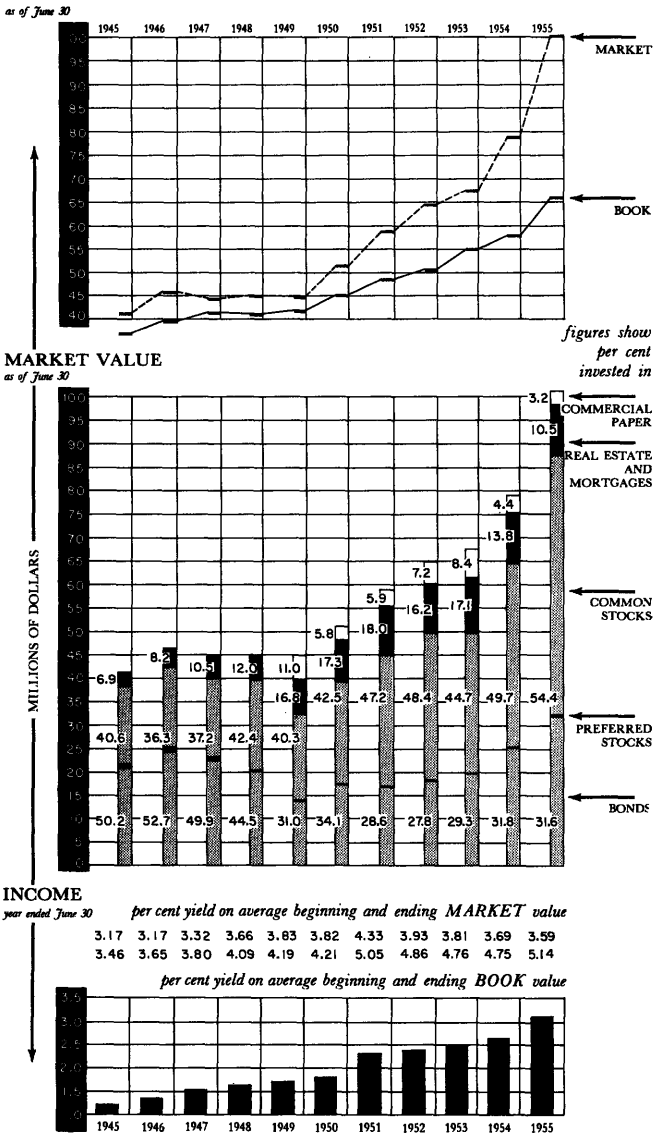
JUNE 30, 1955

General Investments	*Book Value*	*Market Value*	*Per Cent*	*Net Income*	*Per Cent*
Bonds					
U. S. Government	$11,344,147	$ 11,178,431	11.2	$ 229,148	7.6
Canadian	1,798,865	1,842,275	1.8	73,205	2.4
Industrial	2,186,999	2,224,239	2.2	76,865	2.6
Public utility	2,527,462	2,552,723	2.6	73,191	2.4
Railroad	1,098,182	1,146,674	1.1	14,046	.5
Financial	12,737,913	12,731,037	12.7	297,512	9.9
Small holdings	2,100	.....	....	45	....
Total	$31,695,668	$ 31,675,379	31.6	$ 764,012	25.4
Preferred Stocks	$ 339,594	$ 335,451	.3	$ 17,329	.6
Common Stocks					
Industrial	$14,157,619	$ 43,620,134	43.6	$ 1,487,534	49.4
Public utility	2,488,369	3,824,340	3.8	163,129	5.4
Railroad	255,983	716,410	.7	40,728	1.4
Bank	1,540,531	2,076,593	2.1	96,763	3.2
Insurance	765,262	2,815,480	2.8	62,509	2.1
Other	800,540	1,383,454	1.4	42,235	1.4
Total	$20,008,304	$ 54,436,411	54.4	$ 1,892,898	62.9
Mortgage Notes	$ 112,882	$ 112,882*	.1	$ 5,929	.2
Real Estate					
For Institute use	$ 5,118,990	$ 5,118,990*	5.1	$ 45,569	1.5
Other property	5,264,248	5,264,248*	5.3	238,192	7.9
Total	$10,383,238	$ 10,383,238	10.4	$ 283,761	9.4
Commercial paper	$ 3,187,324	$ 3,187,324	3.2	$ 43,939	1.5
Total general investments	$65,727,010	$100,130,685	100.0	$ 3,007,868	100.0
Special investments	$ 4,347,344	$ 7,456,645		$ 281,168	
Students' notes receivable	1,232,849	1,232,849		**	
Charge for financial services	.....	.....		(30,000)	
Advanced for current operations	523,526	523,526		157,156	
Total investments	$71,830,729	$109,343,705		$ 3,416,192	

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

General Investments 1945-1955

BOOK AND MARKET VALUE



SCHEDULE B-3

RESEARCH CONTRACTS

	Division of Industrial Cooperation		*Division of Defense Laboratories*	
Revenues from research contracts		$12,036,619*		$30,148,739
Less appropriations therefrom:				
Reserve for use of facilities	$ 414,020		$ 185,983	
Industrial fund	109,210		247,019	
Investment income for use of funds and amortization of facilities	132,685		76,585	
Research reserve	100,000	755,915	100,000	609,587
		$11,280,704		$29,539,152
Direct expenses on research contracts:				
Salaries and wages	$ 6,838,378		$12,526,609	
Materials and services	1,842,484		9,552,275*	
Subcontracts	89,470		3,768,940	
Travel	254,178		678,420	
Other	101,301		501,714	
	$ 9,125,811		$27,027,958	
Direct expenses of the Divisions:				
Salaries and wages	$ 211,663		$ 324,439	
Materials and services	27,957		34,286	
Travel	5,546		9,117	
Vacation allowances — hourly employees	98,000		205,910	
Depreciation on eqiupment	28,938		18,560	
Insurance	18,360		25,351	
Outside rentals	2,419		.....	
Instrumentation laboratory — expenses	.....		9,203	
Servomechanisms laboratory — expenses	15,398		.....	
Occupational medical service	19,928		24,001	
Unallowable contract expense	7,231		8,162	
Other	6,871		21,462	
	$ 442,311		$ 680,491	
Total expenses (Schedule B)		9,568,122		27,708,449
Contract allowances for expenses of administration and plant operation (total $3,543,285 Schedule B)		$ 1,712,582		$ 1,830,703

*Includes $473,805 for work performed by Division of Industrial Cooperation for the Division of Defense Laboratories.

NOTE: For the year ended June 30, 1955, Division of Defense Laboratories operations included certain contracts which formerly were in the Division of Industrial Cooperation. Total direct expenses on such contracts were approximately $5,500,000 in the year ended June 30, 1955, and $4,500,000 in the preceding year.

GIFTS, GRANTS AND BEQUESTS RECEIVED DURING THE YEAR ENDED JUNE 30, 1955

GIFTS FOR ENDOWMENT

Gift of land and buildings:

ESTATE OF H. WENDELL ENDICOTT Land and buildings, Dedham, Massachusetts .	$ 275,000.00

The income of the following gifts and bequests is for general purposes:

CLASS OF 1909 Contributions	$ 513.72
CLASS OF 1929 Contributions	9,696.82
FREDERICK M. EATON '05 For endowment	500.00
MARY ELIZABETH LADD For Charles C. Ladd ('30) Fund	175.00
ESTATE OF HARRIET P. LAWS Additional for Frank A. Laws ('89) Fund . .	897.50
CHARLES T. MAIN, INC. Charles T. ('76) and Charles R. ('09) Main Memorial Fund	500.00
ESTATE OF ALICE METCALF Additional for Leonard Metcalf '92 Fund . .	2,996.27
ESTATE OF HARRIETTE F. NEVINS Additional for George Blackburn Memorial Fund	433.44
FRANK P. WAKEFIELD TRUST For Frank P. Wakefield Fund	70,000.00
ESTATE OF EVERETT WESTCOTT Additional for Everett Westcott Fund	800.00
ESTATE OF MARION WESTCOTT Additional for Marion Westcott Fund	443.59
ESTATE OF HENRY E. WORCESTER '97 For Henry E. Worcester Fund	25,000.00
	$ 111,956.34

The income of the following gifts and bequests is for designated purposes:

ANONYMOUS Additional for the Anonymous W. Scholarship Fund	$ 2,257.50
JULIAN M. AVERY '18 Additional for Julian M. Avery Fund	7,915.42
ESTATE OF JASON S. BAILEY Additional for Jason S. Bailey Scholarship Fund	4,626.04

EVERETT MOORE BAKER MEMORIAL	
Contributions	623.85
GORDON Y. BILLARD '24	
Additional for Gordon Y. Billard Fund	1,207.50
ESTATE OF BERTRAM BREWER	
Additional for Bertram Brewer Scholarship Fund	35,890.24
CABOT FOUNDATION, INC.	
For Spectrographic Research in Geology	2,500.00
GODFREY L. CABOT '81	
For Cabot Foundation Scholarships	5,000.00
GODFREY L. CABOT, INC.	
For the Cabot Foundation Scholarship Fund.	15,000.00
MR. AND MRS. THOMAS D. CABOT	
For the Cabot Foundation Scholarships	5,000.00
WILLIAM E. CHAMBERLAIN ARCHITECTURE FUND	
Contributions	575.00
CHRIST CELLA RESTAURANTS ('01)	
For Allan Winter Rowe ('01) Fund	500.00
GEORGE CLAHANE '28	
For General Scholarship Endowment Fund	300.00
ESTATE OF WILLIAM A. CONANT '88	
Additional for William A. Conant Scholarship Fund	286.38
EDGERTON, GERMESHAUSEN AND GRIER, INC.	
For Edgerton, Germeshausen and Grier Scholarship Fund	2,400.00
ELECTRIC REGULATOR CORPORATION	
For Electric Regulator Corporation Scholarship Fund	1,000.00
WILLIAM M. FOLBERTH, JR. '41	
For Allan Winter Rowe ('01) Fund	30.00
GENERAL UNDERGRADUATE SCHOLARSHIP ENDOWMENT FUND	
Contributions	200.00
CECIL H. ('23) AND IDA GREEN	
For a research fund for Geology and Geophysics	12,875.00
INSTITUTE OF AERONAUTICAL SCIENCES	
For the Jerome C. Hunsaker ('12) Professorship	10,000.00
DUGALD C. JACKSON, JR. '21	
Additional for the Dugald C. Jackson Professorship	140.00
IRVING D. JAKOBSON, 21	
For the Allan Winter Rowe ('01) Fund	125.00
JAKOBSON SHIPYARD, INC.	
For General Undergraduate Scholarship Endowment Fund	1,000.00

STEPHEN JOHNSON	
For General Undergraduate Scholarship Endowment Fund	100.00
ROBERT S. KERR	
For the Allan Winter Rowe ('01) Fund	966.00
KRESGE FOUNDATION	
Additional for Kresge Foundation Auditorium and Chapel Fund	250,000.00
PAUL W. LITCHFIELD '96	
For the Paul W. Litchfield Scholarship Fund.	10,500.00
ESTATE OF MARY L. LODGE	
For Richard W. Lodge ('79) Scholarship Fund	5,055.94
M.I.T. BOSTON STEIN CLUB	
For the M.I.T. Boston Stein Club New England Freshman Scholarship Fund	
Owen J. McGarrahan Co.	1,000.00
Groisser and Shlager Iron Works	500.00
George Neitlich '24	100.00
Other contributions	207.00
For the M.I.T. Boston Stein Club National Freshman Scholarship Fund	
Robert G. Marcus '31	250.00
Richard J. Marcus '32	250.00
M.I.T. CLUB OF NEW YORK	
Contributions for the Scholarship Fund	801.00
MCGRAW-HILL PUBLISHING COMPANY	
For the Jerome C. Hunsaker ('12) Professorship	5,000.00
FRANCESCO MARCUCELLA '27	
Additional for the Francesco Marcucella Scholarship Fund	800.00
GLENN L. MARTIN COMPANY	
For the Jerome C. Hunsaker ('12) Professorship	10,000.00
CHARLES E. MERRILL	
For the Charles E. Merrill Scholarship Fund	10,212.50
ESTATE OF GERTRUDE NEWMAN	
Additional for the Gertrude Newman Scholarship Fund	12,048.66
ARTHUR A. NICHOLS '28	
For the Allan Winter Rowe ('01) Fund	2,000.00
BURTON I. NOYES '54	
For the Karl T. Compton Prize Fund	100.00
PHI BETA EPSILON	
For the General Scholarship Endowment Fund	100.00

ODETTE S. PRICE	
Additional for Raymond B. Price ('94) Memorial Fund for Chemistry	1,000.00
REDFIELD PROCTER '02	
Additional for the Vermont Scholarship Fund	10,000.00
REPUBLIC AVIATION CORPORATION	
For the Jerome C. Hunsaker ('12) Professorship	15,000.00
ALLAN WINTER ROWE ('01) FUND	
Contributions	925.00
ESTATE OF MAY C. W. SPEARS	
Additional for the Amasa J. Whiting Scholarship Fund	2,643.85
ESTATE OF HARRY A. STILES '03	
For the General Scholarship Endowment Fund	2,057.00
ESTATE OF ALBERT F. SULZER '01	
For the Albert F. Sulzer Scholarship Fund	3,070.20
ALBERT H. WECHSLER '21	
For the Karl T. Compton Prize Fund	475.00
ESTATE OF EDITH CARSON WILDER	
For the Stephen H. Wilder ('74) Fund	9,326.01
JOHN J WILSON '29	
For the Mary I. Wilson Scholarship Fund	10,500.00
CURTIS WRIGHT CORPORATION	
For the Jerome C. Hunsaker ('12) Professorhip	25,000.00
OTHER GIFTS	55.00
	$ 499,495.09

GIFTS FOR STUDENT LOANS

GEORGE A. CHUTTER '21	
For the William H. Timbie Loan Fund	$ 100.00
M.I.T. BOSTON STEIN CLUB FRESHMAN LOAN FUND	
For the M.I.T. Boston Stein Club Freshman Loan Fund	
Anonymous	500.00
Bernat, George A. '28 and Ruth D.	250.00
Bernstein, David W. '31 and Irene	500.00
Cooper, Benjamin '33	500.00
Gens, Morris H. '22	500.00
Fishman, Joseph '34	200.00
Hamburg, Abraham '15	100.00
Horovitz, Oscar H. '22 and Mary C.	900.00
Marcus, Richard J. '32 and Diane L.	500.00
Wechsler, Albert A. '21 and Pearl K.	500.00
	$ 4,550.00

GIFTS FOR BUILDINGS

Acushnet Process Company	
For the Karl T. Compton Laboratory	$ 1,000.00
Anonymous	
For the Karl T. Compton Laboratory	12,000.00
C. Bowen, Inc.	
For the Karl T. Compton Laboratory	100.00
Thomas D'A. Brophy '16	
For the Auditorium Organ Fund	1,000.00
William A Coolidge	
For the Karl T. Compton Laboratory	30,000.00
Harlow H Curtice	
For the Karl T. Compton Laboratory	1,000.00
Irenee du Pont '97	
For capital	766,000.00
Melville Eastham	
For the Karl T. Compton Laboratory	250.00
General Dynamics Company	
For the Karl T. Compton Laboratory	5,000.00
General Radio Company	
For the Karl T. Compton Laboratory	10,000.00
Charles Hayden ('90) Foundation	
For the Karl T. Compton Laboratory	50,000.00
Hodgman Rubber Company	
For the Karl T. Compton Laboratory	500.00
Godfrey Hyams Trust	
For the Karl T. Compton Laboratory	50,000.00
Leon A. Kolker '31	
Additional for the John Picker Kolker Room Fund	3,800.00
Lecture Series Committee	
For the Student Union Building	100.00
Lockheed Leadership Fund	
For the Karl T. Compton Laboratory	7,500.00
O Lockwood	
For the Auditorium Organ Fund	1,000.00
Alfred L Loomis	
For the Karl T. Compton Laboratory	10,000.00
George E Merryweather '34	
Additional for the Motch and Merryweather Room in the Karl T. Compton Laboratory	10,000.00
Charles E. Merrill	
For the Karl T. Compton Laboratory	5,000.00
Merrill Lynch, Pierce, Fenner and Beane	
For the Karl T. Compton Laboratory	1,000.00
Newcastle Corporation	
For capital	404,250.00

PHELPS DODGE CORPORATION	
For the Karl T. Compton Laboratory	25,000.00
RAYMOND CONCRETE PILE COMPANY	
For the Karl T. Compton Laboratory	5,000.00
MRS. LESTER G. SIGOURNEY	
For the Chapel	2,305.00
ALFRED P. SLOAN, JR. '95	
For capital	98,778.75
GEORGE A. SLOAN	
For the Auditorium Organ Fund	100.00
ESTATE OF EDWIN S. WEBSTER '88	
For the Karl T. Compton Laboratory	10,000.00
EDWIN S. WEBSTER ('88) FOUNDATION	
For the Karl T. Compton Laboratory	20,000.00
	$1,530,683.75

OTHER GIFTS — PRINCIPAL AVAILABLE

The following gifts are added to the unexpended endowment income for designated purposes:

CHARLES HAYDEN FOUNDATION	
For current use by Charles Hayden Memorial Fund	5,000.00
M.I.T. CLUB OF CHICAGO	
Contributions	1,339.50
	$ 6,339.50

The following gifts are for general purposes:

ANONYMOUS	
Additional for the Anonymous J Fund	$ 1,372.00
ANONYMOUS	
Additional for the Anonymous ST Fund . . .	2,500.00
EDMUND DANA BARBOUR TRUST	
Additional distribution of bequest for general purposes	642,292.97
ESTATE OF JOHN R. BRITTAIN '93	
Additional distribution of a bequest	180.40
CBS FOUNDATION, INC.	
For general purposes	2,000.00
CLASS OF 1901	
Contributions	364.60
CLASS OF 1927	
Contributions	100.00
KARL T. COMPTON MEMORIAL FUND	
Contributions	24,985.00
ESTATE OF ARTHUR J. CONNER '88	
Residuary interest in trust created by will . .	5,298.60

DEVELOPMENT FUND	
Contributions	42,831.82
ESTATE OF ALBERT CHAMPION GILBERT '05	
Bequest for general purposes	9,500.00
ESTATE OF EDWARD C. HALL '92	
Additional bequest for general purposes	139.88
WILLIAM T. HENRY ('70) TRUST	
Income of a trust	28,220.00
LOCKHEED AIRCRAFT COMPANY	
For Lockheed Leadership Fund	4,000.00
E. MORTIMER NEWLIN ('14) TRUST	
Income of a trust	1,113.40
RICHARD N. PALMER ('28) TRUST	
For general purposes	662.13
ESTATE OF E. H. R. GREEN	
For the H. Sylvia A. H. G. Wilks Fund	119.35
	$ 765,680.15

The following gifts are for designated purposes:

ESTATE OF CHARLES E. ADAMS	
For the Frank W. and Carl S. Adams Memorial Fund	$ 16,000.00
ALUMNI FUND	
Contributions	503,910.93
ANONYMOUS	
For the Dean Fuller Memorial Fund	543.56
ANONYMOUS	
For the Anonymous RS Fund for research	20,000.00
SAMUEL BERKE '15	
For the Samuel Berke Humanities Fund	5,000.00
CLASS OF 1898	
Contributions	300.00
CLASS OF 1918	
Contribution	89.54
BENJAMIN COOPER '23	
For the M.I.T. Boston Stein Club—Benjamin Cooper Fellowship	4,202.50
RALPH E. CURTIS '15	
Additional for the Ralph E. Curtis Scholarship Fund	500.00
GENERAL COMMUNICATIONS COMPANY	
For Industrial Fellowship in Electronics	5,000.00
GENERAL FOODS CORPORATION	
For the Food Technology Research Fund	10,000.00
GERBER BABY FOODS FUND	
For the Food Technology Research Fund	5,000.00
LAWRENCE F. HARRIS '30	
Additional for Research Laboratory of Electronics	40.00

INDUSTRIAL RELATIONS FUND	
Contributions from industrial concerns	17,800.00
INTERNATIONAL BUSINESS MACHINES CORPORATION	
For Industrial Fellowship in Economics . . .	1,000.00
JOHN W. KILDUFF '18	
For the John W. Kilduff Fund	1,000.00
JOHN R. MACOMBER '97	
For the John R. Macomber Fund	2,417.25
OSCAR MAYER & COMPANY	
For the Food Technology Research Fund . .	10,000.00
M.I.T. BOSTON STEIN CLUB	
For the M.I.T. Boston Stein Club Technion Fund	175.00
MERRILL LYNCH, PIERCE, FENNER AND BEANE	
For Urban and Regional Studies	1,000.00
ESTATE OF C. LILLIAN MOORE	
Additional for the John A. Grimmons ('21) Fund	5,820.00
ROCKEFELLER FOUNDATION	
For Humanities Course XXI	300,000.00
STEARNS CHARITABLE TRUST	
For use at the Endicott House	10,000.00
WESTINGHOUSE EDUCATIONAL FOUNDATION	
For Industrial Fellowship in Economics . . .	2,500.00
	$ 922,298.78

UNINVESTED FUNDS

SUPPORT OF THE INDUSTRIAL LIAISON PROGRAM . . . . $ 817,490.00

A partial list of companies making payments in 1954-55:

Allegheny-Ludlum Steel Corporation
Aluminum Company of America
American Can Company
American Machine and Foundry Company
Anaconda Copper Mining Company
The Budd Company
Chance Vought Aircraft, Inc.
Cities Service Research and Development Company
Continental Can Company, Inc.
Continental Motors Corporation
Continental Oil Company
The Dow Chemical Corporation
Electrolux Corporation
Gulf Research and Development Company
John Hancock Mutual Life Insurance Company
Latrobe Steel Company
Lever Brothers Company
Merck and Company, Inc.
Merrill Lynch, Pierce, Fenner and Beane
Norton Company

Owens-Corning Fibreglas Corporation
Philco Corporation
Radio Corporation of America
Raytheon Manufacturing Company
A. O. Smith Corporation
Socony-Mobil Oil Company, Inc.
Sperry Gyroscope Company
Standard Oil Company of California
Sylvania Electric Products, Inc.
Texas Company
United Aircraft Corporation
Whirlpool Corporation

The following gifts are for student aid:

THE ALCOA FOUNDATION	
For undergraduate scholarship	$ 500.00
ALLOY STEEL PRODUCTS COMPANY	
For undergraduate scholarship	1,200.00
AMERICAN ASSOCIATION OF METALS FOUNDATION	
For undergraduate scholarship	400.00
AMERICAN BRAKE SHOE COMPANY	
For undergraduate scholarship	1,800.00
AMERICAN SMELTING AND REFINING COMPANY	
For undergraduate scholarship	1,000.00
AMERICAN SOCIETY FOR METALS	
For undergraduate scholarship	300.00
AMERICAN SOCIETY OF TOOL ENGINEERS	
For undergraduate scholarship	250.00
ANONYMOUS	
For the Foreign Student Aid Fund	3,000.00
ARMCO FOUNDATION	
For undergraduate scholarship	1,800.00
ATLAS POWDER COMPANY	
For undergraduate scholarship	1,000.00
CARBIDE AND CARBON CHEMICAL COMPANY	
For undergraduate scholarship	1,100.00
CLARK FOUNDATION	
For undergraduate scholarship	4,100.00
CLERITE FOUNDATION	
For undergraduate scholarship	500.00
THOMAS C. DESMOND '09	
For undergraduate scholarship	1,200.00
DOW CORNING CORPORATION	
For undergraduate scholarship	900.00
PHILIP B. DOWNING TRUST	
For the Philip B. Downing Scholarship	415.00
OLIVER H. GALE	
For undergraduate scholarship	250.00

ERNEST A. GRUNSFELD FOUNDATION	
For the Grunsfeld European Fellowship . . .	2,700.00
HOUSTON ENDOWMENT, INC.	
For the William S. Knudson Fellowship . . .	2,500.00
ROSCOE HUPPER	
For the Hupper loan fund	1,300.00
H. G. HUTCHINSON	
For undergraduate scholarship	500.00
RICHARD W. INCE	
For undergraduate scholarship	1,700.00
KENNECOTT COPPER COMPANY	
For the Kennecott Copper Company Scholarship	2,000.00
C. O. KIENBUSCH	
For undergraduate scholarship	1,000.00
KNAPP FUND	
For undergraduate scholarship	1,500.00
LOCKHEED LEADERSHIP FUND	
For undergraduate scholarship	3,800.00
M.I.T. CLUB OF CALIFORNIA	
For undergraduate scholarship	500.00
M.I.T. ALUMNI OF CLEVELAND	
For undergraduate scholarship	500.00
M.I.T. CLUB OF NORTHERN NEW JERSEY	
For undergraduate scholarship	662.00
M.I.T. CLUB OF ROCHESTER	
For undergraduate scholarship	550.00
JAMES C. MELVIN TRUST	
For the Melvin Trust Scholarship	9,450.00
NATIONAL ASSOCIATION OF ENGINE AND BOAT MANUFACTURERS	
For undergraduate scholarship	1,800.00
NATIONAL DISTRIBUTORS ASSOCIATION OF CHICAGO	
For undergraduate scholarship	500.00
NEW ENGLAND FOUNDRYMEN'S ASSOCIATION	
For undergraduate scholarship	1,000.00
ERNEST L. OSBORNE '14	
For Ernest L. Osborne Scholarship Fund . .	100.00
JULIE V. L. PENROSE	
For the Penrose Loan Fund	1,000.00
THEODORE & MARJORIE RHODES FOUNDATION	
For undergraduate scholarship	300.00
SKIDMORE, OWINGS & MERRILL	
For undergraduate scholarship	1,200.00
ALFRED P. SLOAN ('95) FOUNDATION, INC.	
For student travel	900.00
For Sloan National Scholarships	49,950.00
SYMINGTON GOULD CORPORATION	
For undergraduate scholarship	1,500.00

TEAGLE FOUNDATION, INC.	
For scholarships	10,600.00
TRANSPARENT PACKAGE COMPANY FOUNDATION	
For undergraduate scholarship	900.00
UNION CARBIDE & CARBON COMPANY	
For undergraduate scholarship	1,100.00
WESTINGHOUSE EDUCATIONAL FOUNDATION	
For Science Teachers' Fellowships	20,000.00
MRS. GRANGER WHITNEY	
For undergraduate scholarship	200.00
OTHER GIFT	
For undergraduate scholarship	5.00
	$ 139,432.00

The following gifts are for designated purposes:

A C SPARK PLUG DIVISION	
For fellowship in aeronautical engineering	$ 4,000.00
ALLIED CHEMICAL AND DYE CORPORATION	
For fellowship in chemical engineering	2,400.00
ALLIS-CHALMERS MANUFACTURING COMPANY	
For comminution research in metallurgy	2,500.00
For general purposes	500.00
ALLISON DIVISION – GENERAL MOTORS CORPORATION	
For turbo machine research	20,000.00
AMERADA PETROLEUM COMPANY	
For geophysical analysis research in geophysics	3,600.00
AMERICAN BRAKE SHOE COMPANY	
For research in metallurgy	3,500.00
AMERICAN CAN COMPANY	
For general purposes	500.00
AMERICAN CANCER SOCIETY	
For research in biology	7,020.00
AMERICAN CHEMICAL SOCIETY	
For petroleum research in chemistry	6,650.00
AMERICAN CYANAMID COMPANY	
For soil stabilization research in civil engineering	5,000.03
For fellowship in chemical engineering	2,700.00
AMERICAN FOUNDRYMEN'S SOCIETY	
For research in metallurgy	2,500.00
AMERICAN IRON AND STEEL INSTITUTE	
For research in metallurgy	20,000.00
AMERICAN OIL COMPANY	
For fellowship in chemical engineering practice school	2,500.00
AMERICAN PAPER BOX COMPANY	
For the School of Industrial Management	22.71

AMERICAN PHILOSOPHICAL SOCIETY	
For equipment in chemistry	1,000.00
AMERICAN SOCIETY OF MECHANICAL ENGINEERS	
For research in chemistry	2,893.71
AMERICAN SOCIETY OF REFRIGERATING ENGINEERS	
For research in mechanical engineering	500.00
AMERICAN SOCIETY OF TOOL ENGINEERS	
For research in mechanical engineering	6,240.00
AMERICAN WELDING SOCIETY	
For equipment in metallurgy	52.00
ANONYMOUS	
For the School of Industrial Management	100.00
ANONYMOUS (C)	
For the School of Industrial Management	2,000.00
ANONYMOUS	
For the Electrical Engineering Department	3,000.00
ANONYMOUS	
For general purposes	400.00
ANONYMOUS	
For the Campbell Special Fund in food technology	260.00
ANONYMOUS	
For the preparation of a Karl T. Compton biography	1,250.00
ANONYMOUS	
For the Office of Sponsored Research	200.00
ARMCO FOUNDATION	
For fellowship in metallurgy	3,600.00
ARMOUR & CO.	
For research in biology	13,334.00
For research in food technology	5,000.00
AVIATION WEEK (through McGraw-Hill Publishing Co.)	
For fellowship in aeronautical engineering	4,300.00
BARIUM STEEL COMPANY	
For fellowship in mechanical engineering	6,000.00
WALTER J. BEADLE '17	
For Foreign Student Summer Project	250.00
PROFESSOR CHARLES B. BREED '97	
For the Charles B. Breed fund	200.00
BRISTOL LABORATORIES, INCORPORATED	
For research in chemistry	13,000.00
BUFFALO ELECTRO-CHEMICAL COMPANY	
For soil stabilization research in civil engineering	5,000.00
JABEZ BURNS & SONS, INCORPORATED	
For research in metallurgy	2,500.00
BUSH FOUNDATION	
For Bush Foundation fund in mechanical engineering	5,000.00

CABOT FOUNDATION	
For Karl T. Compton Portrait fund	3,110.00
GODFREY L. CABOT, INCORPORATED	
For the Foreign Student Summer Project . .	500.00
CAMPBELL SOUP COMPANY	
For research in food technology	2,000.00
CARBIDE AND CARBON CHEMICAL COMPANY	
For a fellowship in chemical engineering . . .	2,600.00
CHANCE VOUGHT AIRCRAFT, INCORPORATED	
For scholarship overhead for general purposes.	500.00
CHILDREN'S MEDICAL CENTER	
For research in biology	300.00
E. L. COCHRANE '20	
For naval architecture department	500.00
COFFEE BREWING INSTITUTE	
For fellowship in food technology	2,500.00
For research in food technology	15,000.00
COLONIAL PROVISION COMPANY	
For food technology department	1,000.00
COMMONWEALTH FUND	
For research in biology	35,000.00
For medical fellowships	12,000.00
CONSOLIDATED METAL PRODUCTS CORPORATION	
For equipment in metallurgy	500.00
CONSUMERS UNION OF U. S., INCORPORATED	
For fellowship in chemistry	2,000.00
ADMIRAL LUIS DEFLOREZ '11	
For prize fund in mechanical engineering . .	100.00
DEWEY AND ALMY CHEMICAL COMPANY	
For research in chemical engineering	413.92
DOUGLAS AIRCRAFT COMPANY	
For fellowship in aeronautical engineering . .	2,000.00
E. I. DU PONT DE NEMOURS AND COMPANY, INCORPORATED	
For fellowship in chemical engineering	4,425.00
For instructorship in chemistry	4,040.00
For research in chemistry	15,000.00
For fellowship in mechanical engineering . . .	3,600.00
For fellowship in physics	4,200.00
EASTMAN KODAK COMPANY	
For fellowship in chemical engineering	3,300.00
For fellowship in chemistry	4,000.00
PROFESSOR H. E. EDGERTON '27	
For film research	950.00
ELECTRO METALLURGICAL COMPANY	
For research in metallurgy	3,300.00
For fellowship in metallurgy	3,300.00
THE ENGINEERING FOUNDATION	
For research in metallurgy — comminution .	3,000.00
For research in metallurgy — corrosion . . .	3,000.00

ETHICON SUTURES LABORATORY, INCORPORATED	
For research in biology	5,000.00
ETHYL CORPORATION	
For research in chemistry	4,320.00
For research in mechanical engineering	16,000.00
For fellowship in mechanical engineering	3,725.00
For research in mechanical engineering	3,000.00
EXECUTIVE DEVELOPMENT PROGRAM – FEES	
Contributions from employers of program participants	69,596.31
EXOMET, INCORPORATED	
For research in metallurgy	6,900.00
FEDERAL RESERVE BANK OF BOSTON	
For study in city planning	1,500.00
FIRST NATIONAL STORES, INCORPORATED	
For research in food technology	3,000.00
FOOD MACHINERY AND CHEMICAL FOUNDATION	
For overseas study fund	12,500.00
FOREIGN STUDENT SUMMER PROJECT	
Contributions	406.05
FORD MOTOR COMPANY	
For scholarship overhead for general purposes.	500.00
FOUNDRY EDUCATIONAL FOUNDATION	
For scholarship in metallurgy	4,500.00
For research in metallurgy	500.00
CHARLES N. FREY	
For food technology department	25.00
WILLIAM GEISLER	
For food technology department	100.00
GENERAL ELECTRIC COMPANY	
For research in aeronautical engineering	10,000.00
For general purposes	750.00
GENERAL ELECTRIC EDUCATIONAL FOUNDATION	
For fellowship in chemistry	3,300.00
For electrical engineering	50,000.00
For fellowship in metallurgy	3,300.00
GENERAL FOODS CORPORATION	
For fellowship in biochemistry	2,500.00
GENERAL MILLS, INCORPORATED	
For research in food technology	10,000.00
GENERAL MOTORS CORPORATION	
For fellowship in chemical engineering	6,000.00
For fellowship in mechanical engineering	3,000.00
GIVAUDAN CORPORATION	
For research in biology	4,000.00
For research in chemistry	3,000.00
GOODYEAR TIRE AND RUBBER COMPANY	
For fellowship in aeronautical engineering	2,500.00

CRAWFORD H. GREENEWALT '22	
For Edgerton research in electrical engineering	1,000.00
MILLARD M. GREER '26	
For Greer rowing equipment	130.00
EARLE A. GRISWOLD '23	
For the Proctor Portrait fund	100.00
MERRILL GRISWOLD	
For the Foreign Student Summer Project	25.00
HERBERT GRUNFELD TRUST	
For equipment in metallurgy	250.00
GYPSUM LIME AND ALABASTINE, CANADA, LTD.	
For research in civil engineering	500.00
HENLEY REGATTA	
Contributions	5,112.21
HOME BUILDING ASSOCIATION	
Large lot study in city planning	1,775.00
HUMBLE OIL AND REFINING COMPANY	
For fellowship in chemical engineering	2,700.00
PROFESSOR JEROME C. HUNSAKER '12	
For aeronautical engineering department	1,000.00
GODFREY M. HYAMS TRUST	
For research in radiation	16,000.00
SCHOOL OF INDUSTRIAL MANAGEMENT	
Contributions for the School of Industrial Management	1,096.51
ELMER C. INGRAHAM '26	
For the Research Laboratory of Electronics	2,000.00
INSTITUTE OF FOOD TECHNOLOGISTS	
For fellowship in food technology	4,000.00
DEXTER M. KEEZER	
For the School of Industrial Management	47.28
CARL T. KELLER	
For the library	800.00
M. W. KELLOGG COMPANY	
For research in mechanical engineering	10,000.00
KENNECOTT COPPER COMPANY	
For fellowship in metallurgy	8,000.00
CHARLES F. KETTERING FOUNDATION	
For research in chemistry	10,000.00
KEYSTONE CHARITABLE FOUNDATION	
For the S. L. Sholley Fund in Industrial Management	1,000.00
KIMBERLY CLARK FOUNDATION	
For fellowship in chemical engineering	2,520.00
ESTATES OF CHARLES A. KING '96 AND MARJORIE KING	
For research in biology	10,000.00
LIFE INSURANCE MEDICAL RESEARCH FUND	
For research in biochemistry	500.00

ELI LILLY COMPANY	
For research in biology	13,000.00
ARTHUR D. LITTLE, INCORPORATED	
For research in chemistry	7,300.00
LORD MANUFACTURING COMPANY	
For research in civil engineering	13,200.00
MCCLINTIC ENDOWMENT	
For fellowship in civil engineering	2,400.00
MANUFACTURING CHEMISTS' ASSOCIATION, INCORPORATED	
For research in building engineering and construction	20,000.00
MARBLEHEAD LIME COMPANY	
For research in building engineering and construction	500.00
NEWMAN M. MARSILLUS '17	
For the School of Industrial Management	1,000.00
COMMONWEALTH OF MASSACHUSETTS	
For highway project in civil engineering	30,000.00
MASSACHUSETTS FEDERATION OF PLANNING BOARDS	
Large lot study in city planning	600.00
MASSACHUSETTS GENERAL HOSPITAL	
For research in biology	550.00
For research in textiles	100.00
MAYMAR CORPORATION	
For the Samuel Marx ('07) fund in architecture	1,000.00
NICHOLAS A. MILAS	
For research in chemistry	7,094.32
MILLER AND COMMONS ROOM IN MECHANICAL ENGINEERING	
Contributions	1,220.00
MINNEAPOLIS-HONEYWELL REGULATOR COMPANY	
For fellowship in electrical engineering	2,700.00
MONSANTO CHEMICAL COMPANY	
For research in plastics in city planning	11,000.00
For fellowship in chemistry	3,400.00
MONSANTO CHEMICAL COMPANY CHARITABLE TRUST	
For fellowship in chemical engineering	3,400.00
HENRY MORGENTHAU, JR.	
For Morgenthau fund in humanities	6,200.00
MUCHNIC FOUNDATION	
For fellowship in metallurgy	3,000.00
MUSCULAR DYSTROPHY ASSOCIATION OF AMERICA, INCORPORATED	
For research in biochemistry	4,586.30
NATIONAL ACADEMY OF SCIENCES	
For research in chemistry	500.00
NATIONAL FOUNDATION FOR INFANTILE PARALYSIS	
For research in biology	2,000.00
For research in biology	1,000.00

NATIONAL GEOGRAPHIC SOCIETY	
For Edgerton film research	12,000.00
NATIONAL GYPSUM COMPANY	
For comminution research in metallurgy	2,500.00
NATIONAL INSTITUTES OF HEALTH	
For research in biology	500.00
For medical fellowship	5,400.00
NATIONAL LIME ASSOCIATION	
For research in civil engineering	7,000.00
NATIONAL PNEUMATIC COMPANY	
For research in electrical engineering	5,000.00
NATIONAL SCIENCE FOUNDATION	
For research in chemistry	3,800.00
NELCO METALS, INCORPORATED	
For fellowship in metallurgy	5,000.00
NEW ENGLAND SURVEY SERVICE, INCORPORATED	
For Charles B. Breed fund in civil engineering	300.00
NOVA SCOTIA RESEARCH FOUNDATION	
For research in geology	2,700.00
OFFNER PRODUCTS COMPANY	
For the Research Laboratory of Electronics	1,000.00
OLIN MATHIESON CHEMICAL CORPORATION	
For soil stabilization in civil engineering	5,000.00
OWENS ILLINOIS GLASS COMPANY	
For research in chemistry	7,600.00
PANTEX MANUFACTURING COMPANY	
For research in mechanical engineering	532.00
PIONEER PARACHUTE COMPANY, INCORPORATED	
For textile research in mechanical engineering	12,000.00
PITNEY-BOWES, INCORPORATED	
For scholarship overhead for general purposes	500.00
PITTSBURGH CONSOLIDATION COAL COMPANY	
For research in chemical engineering	3,200.00
PRATT & WHITNEY AIRCRAFT COMPANY	
For research in mechanical engineering	8,000.00
For scholarship overhead for general purposes	2,000.00
PROFESSOR BERNARD E. PROCTER '23	
For food technology department	100.00
PROCTER AND GAMBLE COMPANY	
For fellowship in chemical engineering	4,200.00
For research in food technology	14,000.00
For scholarship in food technology	1,800.00
For fellowship in mechanical engineering	2,600.00

UNIVERSITY OF PUERTO RICO	
For Puerto Rico economics relations study in city planning	5,740.00
REEVES INSTRUMENT CORPORATION	
For fellowship in aeronautical engineering	2,500.00
RESEARCH CORPORATION	
For research in chemistry	7,200.00
RESOURCES FOR THE FUTURE, INCORPORATED	
For research in city planning	17,250.00
H. H. ROBERTSON SERVICE	
For economics — seminar room	500.00
ROBNETT MEMORIAL	
Contributions	173.00
ROCKEFELLER FOUNDATION	
For research in chemistry	12,750.29
For research in city planning	18,000.00
For research in geology	2,025.00
For research in modern languages	11,019.24
ROHM AND HAAS COMPANY	
For soil stabilization in civil engineering	2,000.00
DAMON RUNYON MEMORIAL FOUNDATION	
For research in biochemistry	5,000.00
PROFESSOR JOSEPH N. SCANLON	
For economics seminar room	1,500.00
SHARPE & DOHME, INCORPORATED	
For research in chemistry	4,000.00
SHELL FELLOWSHIP COMMITTEE	
For fellowships	6,800.00
For research	22,500.00
H. NELSON SLATER, JR. '50	
For the School of Industrial Management	100.00
ALFRED P. SLOAN ('95) FOUNDATION, INCORPORATED	
For Executive Development Program	180,000.00
For Executive Development Program — contingency	15,000.00
For executive research	50,000.00
For Foreign Student Summer Project	68,500.00
SMITH, KLINE, AND FRENCH FOUNDATION	
For research in chemistry	6,000.00
SOCIAL SCIENCE RESEARCH COUNCIL	
For research in history	1,500.00
SOCIETY OF NAVAL ARCHITECTS AND MARINE ENGINEERS	
For research in naval architecture	3,500.00
SPRAGUE ELECTRIC COMPANY	
For general purposes	250.00
STANDARD OIL COMPANY (New Jersey)	
For general purposes	5,000.00
STANDARD OIL FOUNDATION, INCORPORATED	
For fellowship in chemical engineering	4,700.00

STEEL FOUNDERS' SOCIETY OF AMERICA	
For research in metallurgy	15,775.00
STOP AND SHOP, INCORPORATED	
For research in food technology	190.00
STROMBERG CARLSON COMPANY	
For economics — seminar room	500.00
TEXAS INSTRUMENTS — GEOPHYSICAL SCIENTIFIC INSTRUMENTS FOUNDATION	
For research in geophysics	1,000.00
TIMKEN ROLLER BEARING COMPANY	
For research in metallurgy	5,000.00
TITANIUM ALLOY MANUFACTURING COMPANY	
For research in metallurgy	1,500.00
TROPIC FOODS COMPANY	
For research in food technology	4,000.00
UNION CARBIDE & CARBON COMPANY	
For fellowship in chemistry	2,600.00
For research in electrical engineering	5,000.00
UNITED ENGINEERING AND CONSTRUCTORS, INCORPORATED	
For preceptorship in chemical engineering . .	1,000.00
UNITED ENGINEERING TRUSTEES	
For research in metallurgy	2,500.00
UNITED STATES RUBBER COMPANY	
For fellowship in chemistry	2,600.00
VANADIUM ALLOY STEEL COMPANY	
For fellowship in metallurgy	3,500.00
VISKING CORPORATION	
For fellowship in chemical engineering	2,500.00
VOORHEES, WALKER AND FOLEY	
For department of architecture	2,500.00
WEIRTON STEEL COMPANY	
For research in metallurgy	12,000.00
WESTINGHOUSE EDUCATIONAL FOUNDATION	
For Westinghouse Professorship in mechanical engineering	15,000.00
WEYERHAEUSER TIMBER COMPANY	
For general purposes	1,400.00
F. L. WHITE	
For the Foreign Student Summer Project . .	500.00
HOWARD D. WILLIAMS '11	
For the School of Industrial Management . .	500.00
YALE UNIVERSITY	
For Stimson Fund in industrial management .	8,000.00
	$1,383,644.88

OTHER GIFTS

The following gifts are added to agency funds held by the Institute for investment purposes:

E SHERMAN CHASE '06	
For Class of 1906	$ 2,456.25
CLASS OF 1905	
Contributions of class members	1,979.78
CLASS OF 1909	
Contributions of class members	1,001.66
CLASS OF 1910	
Contributions of class members	1,035.00
CLASS OF 1917	
Contributions of class members	3,907.84
CLASS OF 1933	
Contributions of class members	513.62
CLASS OF 1935	
Contributions of class members	3.52
CLASS OF 1937	
Contributions of class members	742.70
CLASS OF 1944	
Contributions of class members	508.95
CLASS OF 1948	
Contributions of class members	18.71
CLASS OF 1949	
Contributions of class members	419.88
CLASS OF 1950	
Contributions of class members	93.25
W. F. HARRINGTON '05	
Additional for the Class of 1905 fund	122,325.00
CHARLES FRANCIS PARK ('92) MEMORIAL COMMITTEE	
For the Charles Francis Park Memorial fund.	2,500.00
SAILING PAVILION FUND	
Contributions	92.00
	$ 137,598.16

The following gifts are added to annuity funds:

KNIGHT W WHEELER '06	
Additional for Knight W. Wheeler Fund	50,000.00
GEORGE S. WITMER '09	
Additional for the George S. Witmer Fund	5,688.40
	$ 55,688.40

SUMMARY OF GIFTS, GRANTS AND BEQUESTS RECEIVED

	1955	*1954*	*1953*	*1952*	*1951*
Gifts for endowment:					
Real Estate	$ 275,000	.....	.....	.....	.....
Funds for general purposes	111,956	$ 82,558	$ 50,128	$ 7,740	$ 86,586
Funds for designated purposes	499,495	677,230	538,077	340,532	523,599
Gifts for student loans	4,550	9	905	2,973	227,756
Gifts for building funds	1,530,684	274,400	15,004	40,308	3,797,212
Other gifts:					
Unexpended balances of endowment fund income	6,340	7,786	5,800	5,425	5,775
Funds for general purposes — invested	765,680	391,881	1,403,533	2,850,889	2,206,364
Funds for designated purposes — invested	922,299	293,548	1,108,931	1,537,653	554,665
Funds for designated purposes — not invested	2,340,567	2,881,835	2,796,288	2,093,875	1,657,399
	$6,456,571	$4,609,247	$5,918,666	$6,879,395	$9,059,356
Miscellaneous gifts:					
Agency funds	$ 137,598	$ 26,171	$ 38,728	$ 45,711	$ 38,751
Annuity funds	55,688	6,625	24,500	28,000	47,000
	$ 193,286	$ 32,796	$ 63,228	$ 73,711	$ 85,751
Total	$6,649,857	$4,642,043	$5,981,894	$6,953,106	$9,145,107

Report of the Dean of Students

During the year 1954-55, students, Faculty, and Administration, both separately and cooperatively, began a concerted attack on the basic problems of the non-curricular program. Student government completed its reorganization and then sought more effective ways of working closely with the Faculty. The Faculty Committee on Environment defined its responsibilities and then started to work on problems of dormitories, commuters, and student life. The Dean of Students' Council was formed and became a strong vehicle of communication

and cooperation. Out of the Dormitory Council's leadership conference and the Dean's Council came the Troost Committee, a committee of students and Faculty working at the dormitory level. The Graduate Student Council began to face the problems of expanded community facilities for graduate students; Dean Harold L. Hazen of the Graduate School formed an ad hoc committee for the same purpose. The Liaison Council, bringing together key undergraduates and ranking members of the Faculty and administration, was formed. The Student-Faculty Committee became the Undergraduate Committee on Educational Policy. The Long Range Planning Committee began to study in detail the dual problem of developing the West Campus and of providing for badly needed classroom and administrative space. At the same time, well organized groups of students, or of students and Faculty, were developing soundly thought-out plans for immediate action — plans which were clearly involved in long-term basic policy decisions and which in many cases called for administrative approval or disapproval which we were not prepared to give.

Out of this very concerted, imaginative, and persistent activity came two things, one comparatively unimportant but inevitable, one deeply significant to the future of M.I.T. First, there was a sense of confusion, frustration, and in some quarters irritation, when it seemed impossible to move in small matters along what appeared to be obvious lines; secondly, connected with the first, it became apparent that the administration was faced with complex decisions of administrative and financial policy arising out of this unleashed tide of community creativity along the lines of a broadened, dynamic educational philosophy responsive to the deep human needs and concerns of our times. To advise him in these matters the president

appointed a new kind of ad hoc committee representing Corporation, Faculty, alumni, and students and chaired by Edwin D. Ryer, member of the Corporation, alumnus, and former parent. The magnitude of the committee's task has become apparent in its first meetings, and its deliberations in the coming year will be of utmost importance to the future of the Institute.

Against this broad background picture, there is presented below a brief summary of activity in each area of the Dean's Office responsibility.

Guidance and counseling.

The year has been marked not so much by innovation as by improvement and development of programs and procedures already under way. Dean William Speer, responsible for student counseling, and Dean Ruth L. Bean, serving the Freshman Advisory Council, summarize the nature of our present program:

Dean Speer reports: "In the field of student counseling, the Institute is more than ever convinced that guidance and stimulation best occur in the fruitful relationship of student and Faculty member and of younger student with older student. The success of the Institute's efforts can be estimated, if not measured, by the extent to which students want counseling of a specialized nature because of anxiety or depression; the less of the latter, the better. To many of those engaged in specialized counseling, the year seemed to be marked by a considerable decrease in the number of students whose efficiency in academic work was seriously hampered by emotional stress. The credit for this would appear to lie in the greater freedom of the first-year curriculum, the widespread effectiveness of the Faculty and student advisers, the ever increasing efforts of

student government — particularly its Dormitory Committee, and the many activities in which relationships between students and Faculty occur in the professional work of the departments."

Miss Bean reports: "For the third successive year, the Freshman Advisory Council has increased both in number and in the quality of its counseling of freshmen. Under the chairmanship of Professor Norman Dahl, the Council continues to play a leading role in the evolution of the new educational philosophy of the Institute, especially as it directly concerns the freshmen. The Faculty who are members of the Council seem to be more accessible to all students, understand more clearly a student's emotional problems, and are thus likely to be more tolerant and sympathetic teachers.

"For the first time, during the Freshman Weekend activities of the current academic year, each adviser took his group of freshmen to his home or to a restaurant for dinner. From the favorable comments received this appears to be one of the most successful undertakings since the advent of the Council. In many instances, student counselors were included as well as the advisers' families, so that the freshman immediately had a more friendly tie with his Faculty adviser. The planning of the entire Freshman Weekend program was handled jointly by students and the Freshman Advisory Council.

"One other event, held for the first time this fall, was a dinner given by Dr. Killian prior to Freshman Weekend for members of the Freshman Advisory Council and the student counselors. This did much to strengthen student-Faculty relations and to make each group more aware of the place of the other in the whole educational process.

"The second Freshman Advisory Council conference was held in March. Principal discussions centered around

groups led by Professors Roland Greeley, John R. Coleman, and Milton Shaw. The agenda included the disqualification of freshmen, tutoring, a reading course, and some aspects of the counseling process. The freshman curriculum was discussed and specific recommendations were made.

"Several times during the year representatives of the Council met with the Committee on the First Two Years to examine the freshman curriculum and freshman electives in particular. The Council chairman has been in close touch with all activities concerning freshmen. This year he appointed a member of the Executive Committee of the Council to assume complete responsibility for a program to assist the first-year student in selecting a professional course. Thus Professor Charles H. Blake of the Biology Department organized the entire orientation schedule and worked closely with the departments to set up dates for lectures, teas, and open-house events where students could consult Faculty about their choices. In order that all freshmen might be familiar with the entire effort being made on their behalf, a Convocation was held in the Kresge Auditorium at which Professor Blake presided and the facilities of the Institute were described by Dr. Julius A. Stratton, Professor Dahl, Professor Eugene W. Boehne, and Philip A. Stoddard, then associated with the Placement Office."

A new program to do more to assist incoming transfer students in their adjustment to the Institute was inaugurated this September by Dean Speer and Professor David A. Dudley, assistant director of admissions. As a result of recommendations from student government and the Committee on Student Environment, Roy B. Merritt — assisted by Robert Whitelaw — has agreed to serve as adviser to commuters during the coming year. It is hoped that with the cooperation of all

concerned adequate information can be obtained and full discussion stimulated among commuters themselves, so that concrete recommendations for permanent facilities for commuters may be developed for consideration by the Ryer Committee. Thus all undergraduate groups at the Institute will be provided with adequate means of communication and of counsel.

There remains one area of guidance and counseling which has become of increasing concern to this office, as well as to the Freshman Advisory Council. Dean Speer describes the situation as follows: "Inadequate provision seems to be made in the field of instruction in reading skills and in the coordination of opportunities for tutoring. The field of vocational testing is not represented at the Institute, and further study may show that greater efforts should be undertaken to provide such testing." Discussions of these problems are in process, and it is hoped specific recommendations may be made during the coming year.

Women students.

For some time this office has felt the need of an extensive study of the place of women students at the Institute and for a closer integration of women students into the whole educational program for undergraduates. The special committee appointed by the provost and chaired by Professor Leicester F. Hamilton is now at work, and its recommendations should contribute immeasurably to the general welfare of women students. Meanwhile, the women students themselves are more intensively studying their own situation in the spirit of self-analysis and reorganization permeating all of student government.

Miss Bean, who is responsible for the affairs of women

students, reports as follows: "During the past year, the number of women attending the Institute has not increased appreciably, but those in attendance continue to make a real contribution to student life. The secretary of this year's senior class was a woman (Dell Lanier, who received her degree in chemical engineering); and the president of the Association of Women Students, Doretta Binner, continues to be a representative on Institute Committee and to take an active part in student affairs. One of the more important aspects of this participation was the inclusion of the women in the student counseling group discussions.

"The Women's Advisory Board, under its able chairman, Mrs. Paul Chalmers, was most helpful to women students in many of their undertakings. The scope of the Board's influence was considerably widened and a representative of the Technology Matrons was added to the membership. To this first representative, Mrs. Martin Deutsch, we express our sincere thanks for the time and effort which she has given.

"The teas and the Christmas buffet given by Dean and Mrs. Bowditch continue to be among the main social events of the women. The speaker at one of the early teas in the fall was a young woman now associated with Stone and Webster, Inc., who received her Ph.D. from M.I.T. and who, this year, was awarded the Society of Women Engineers' National Award for the most outstanding contribution to the status of women in engineering. In addition to the teas, the girls entertained a group of children at a most successful Christmas party in the Margaret Cheney Room.

"At a Students' Night at Northeastern University, sponsored by the Boston Chapter of the Society of Women Engineers, two of M.I.T.'s undergraduate women, Jane Hodgson and Elisabeth Mertz, were members of a panel to

discuss the educational and vocational opportunities for women in science and engineering.

"During the past few years much pressure has been put on this office to increase the dormitory space for women. With the support of the Women's Advisory Board and the Alumnae Association, a location at Bay State Road near the present dormitory was chosen and preliminary arrangements were made. But, since the entering group this fall was expected to be somewhat smaller than usual and since the girls in the upper classes had already made arrangements for the coming year, the opening of another unit has been postponed for at least one year.

"May we express our sincere thanks to all in the Institute family who have indicated a real desire to assist in the solution of the problems of women students and who have been so understanding in their approach to the whole area."

Student housing.

Although residential facilities at the Institute are not adequate to meet present demand, and although there are many improvements and changes which are desired in present facilities by students and Faculty alike, it is a pleasure to report the great progress which continues to be made in our housing program. The selfless service of Dean Frederick G. Fassett, responsible for student housing, of the Faculty residents, and of members of student government reveals the deep commitment and abiding faith of the M.I.T. community in the educational worth of community living. Symbolic of the spirit prevailing was the dinner of appreciation given by residents of Baker House for Professor and Mrs. Samuel J. Mason on their retirement as residents of the House. Managed entirely by students and attended, among others, by the president

and Dr. Gordon S. Brown, head of Professor Mason's department, it symbolized the cooperation, mutual respect, and esprit de corps of a community of scholars working *and* living together.

Much progress has been made in developing separate traditions and a local "flavor" in each dormitory unit. The new honorary society, "Burcon," formed in Burton House, received one of the Compton Prizes this year and is symbolic of other decentralized activity of this kind in both dormitories and academic departments.

Through the efforts of Professors Laurens Troost and Ernst Levy particularly, a program of informal cultural activities in the dormitories has been initiated. With increasing student participation in this program and with possible use of the auditorium, even greater activity is anticipated in the future.

As indicated below in the report on student aid, the number of students working on student staffs in the dormitories and dining halls has increased greatly in the last few years. William H. Carlisle, Jr., Manager of Student Personnel, is to be highly commended for the progress made this last year in decentralizing the direction of student staffs through the dormitory superintendents and dining personnel. The resulting deep sense of local autonomy, responsibility, and cooperation has added much to the life of the dormitories and coincides with our general policies of decentralization. At the time of the "spring fever" disturbances on campus in May, the quiet, determined cooperation of student staffs with student government clearly indicated the contribution that students are making to the life of the dormitories.

It is with a deep personal sense of satisfaction that I

report the decision of Dean and Mrs. Fassett to return to Baker House this September to succeed Professor and Mrs. Mason in the position of Faculty residents. Coupled with the decision of Professor and Mrs. Troost to remain for a third year in Burton House, it indicates perhaps a new trend in dormitory development and most certainly provides continuity at a crucial period in the development of our residential program.

Deserving of special mention this year is the work of the Westgate Council and the Westgate Nursery School. Faced not only with the usual problems of operation but impending changes in the future when new quarters for married students will be built, they have worked tirelessly and cooperatively to assist in the general planning for the future. At the request of the Nursery School, the Dean's Office cooperated in setting up an advisory committee for the school composed of Robert J. Holden, general secretary of T.C.A., chairman; Professor W. Van Alan Clark, Jr.; Mr. Edward Yeomans, principal of the Shady Hill School in Cambridge; and Dr. Abigail A. Eliot, past director of the Nursery Training School at Tufts University.

The following comments are quoted from Dean Fassett:

"The academic year 1954-55 began, as far as undergraduate residence is concerned, with the largest attendance at the Inter-Fraternity Conference Rush Week on record, and we had a full house in both graduate and undergraduate residences. The unusual size of the Class of 1958 presented a problem, the result of which meant that no new college transfers could be accommodated in the undergraduate houses until the second semester.

"The problems of student government in the under-

graduate houses reflected these high numbers in inverse proportion, as is the usual experience. The several house committees and the Dormitory Council dealt directly and competently with the task of accepting, assimilating, and integrating the unusually large number of freshmen. The situation as regards the fraternities was quite comparable and was met with equal acumen and aplomb.

"The year saw the consummation of a long-term desire when Dr. and Mrs. John B. Goodenough became Faculty residents of the Faculty Houses on the East Campus, occupying a newly remodeled suite in the Crafts unit. Throughout our residence houses the Faculty residents were guides, philosophers, and friends to many of the undergraduates in the course of the year. The Faculty residence program thus has continued a dynamic and increasingly effective part of the residential philosophy of the Institute.

"A different but analogous expression of that philosophy came into being at the close of the academic year when the Undergraduate Dormitory Council published *The Dormitory Handbook: A Guide to Dormitory Living at M.I.T.* This booklet — written, edited, designed, and laid out by representatives of the Dormitory Council — was mailed in the summer to all entering freshmen, accompanying the Inter-Fraternity Conference's booklet, *Fraternities at M.I.T.*, as well as the Institute's official description of residential facilities."

Student government and student activities.

Much of the work of student government at the operating levels of the community has already been referred to and is obviously of increasing high quality. The contributions of student government are so many and so varied that

space prevents listing them all. However, special mention should be made of several matters.

The "M.I.T. National Intercollegiate Conference on Selectivity and Discrimination in American Universities," held in March, was an outstanding example of the significant work of which students are capable; favorable comments were received from college administrators across the country, all of them finding it hard to believe that this was entirely a student-run conference.

For several years it was apparent that the Public Relations Committee needed reorganization. In cooperation with the director of public relations many beneficial changes were made, high quality leadership was provided, and outstanding contributions were made in communications both within and without the Institute.

The formation of a new permanent sub-committee, the International Program Committee, brought together and into focus many matters connected with foreign students both at home and abroad. A significant meeting on programming for foreign students was held at M.I.T. under the auspices of the New England Section of the National Student Association, headed by one of our own students. Preliminary steps were taken in bringing together representatives of the Faculty, the administration, the Matrons, and others interested in foreign students and international relations. The work of this Committee should be of increasing importance to the community in the years ahead.

The Activities Council, formed a year ago when the representation on Institute Committee was changed, has begun to study intensively the whole activities program of the Institute. Plans have been made for a student-Faculty-alumni

conference on activities during the fall which should go far in focusing attention on the most neglected part of the non-curricular program at the Institute. The Dean's Office hopes that through this conference and through succeeding meetings some way may be found to reinstitute, perhaps in new form, the invaluable services performed in the past by alumni advisory councils. Although many of our activities are doing outstanding work, the educational potential of our activities program is much greater than its present achievements.

Finally, mention should be made of the increased interest of students and student government in contributing to the admissions process in cooperation with the Admissions Office, the Educational Council, and the Freshman Advisory Council. Student government is doing preliminary work with the Admissions Office and with the Educational Council. The undergraduate chapter of DeMolay is conducting a pilot operation this summer in contacting incoming students in their home communities. For several years Hillel has conducted such a program for incoming Jewish students. The potential of this kind of help from students is very great and should, we believe, be encouraged.

The Graduate Student Council.

Having completed its original organization and successfully tackled the preliminary problems of establishing the identity of graduate students in the Alumni Association and of setting up the *Graduate Student News* as a means of communication, the Graduate Student Council now approaches the next step in its development. As indicated in the introduction to this report, further development of the Council is closely related to developing plans for enriched community living for graduate students. The relative responsibilities of Faculty, students, the

dean of the Graduate School, and the dean of students in these developments are still to be worked out, as are further working relationships with undergraduate student government and activities. The student-Faculty conference being planned by the students for this fall at Endicott House should go far in clarifying the issues involved.

Religious activities.

The place of religion at M.I.T. as an integral part of the life and work of the institution has been strengthened immeasurably this last year. Three ministers to students were made formal members of the Dean of Students' Council: Reverend Robert C. Holtzapple, Jr., representing the Protestant clergy; Father J. Edward Nugent, adviser to the Technology Catholic Club; and Rabbi Herman Pollock, adviser to the M.I.T. Hillel Foundation. These men also participated actively in planning for the M.I.T. Chapel and continue to work closely with Dean Speer and Mr. Holden in evolving plans for use of the chapel and auditorium for religious services and for other activities of a religious, philosophical nature. These men and other clergy appear in classrooms with increasing frequency on invitation of members of the Faculty. The three counseling rooms provided on a rotating basis for all ministers to students have been used by increasing numbers of clergy and students. For the first time last year the programs of Institute and community religious groups were integrated with the program for Freshman Weekend.

The completion of the chapel and auditorium during the year gave focus to many plans and discussions which have been evolving over a long period. The participation of clergy of the three major faiths represented on campus in the dedication exercises of these new buildings, as well as Baccalau-

reate and at the Commissioning Exercises for members of the Class of 1955, attests to the spirit of cooperation which prevails.

As our plans mature, the Technology Christian Association, its Advisory Board, and the Dean's Office work more closely together and share responsibility for the evolving program. Mr. Holden has assumed responsibility for scheduling events in both the chapel and the auditorium and thus works even more closely with members of the Faculty, student activities, and outside groups.

Below I quote from Dean Speer's report and the annual report made by Mr. Holden to the T.C.A. Advisory Board on behalf of Dean Speer and himself.

Dean Speer writes: "The completion of the new M.I.T. Chapel in May was the significant event of the year in the religious life of the Institute. While the time remaining before the end of the term was too short for the inauguration of regular services, the chapel has been in frequent use by members of the M.I.T. community for weddings and christenings, and in the fall regular services will be begun by the Catholic, Jewish, and Protestant student groups.

"Another significant development was the creation of the United Christian Council by the Protestant student groups. In this Council the Protestant and Orthodox denominations join to undertake projects which they believe can best be done cooperatively. One of the Council's first projects was the establishment of a committee, composed of students, Faculty, and ministers, which will be responsible for the daily Protestant chapel services.

"The Institute is fortunate in the happy and effective relationships that exist with the ministers to students of all faiths. Each year the relationship has grown closer, and the

possibility offered for the first time by the chapel to have services of worship in a building of great beauty and dignity set aside for that purpose promises to give a new dimension to the religious life of the Institute community."

Mr. Holden writes: "The newly dedicated chapel and auditorium, I believe, are symbols of the common goals increasingly shared both by T.C.A. and the Institute. The chapel now stands, as T.C.A. and the on-campus religious groups stood in the past, for the growth and emergence of the things of the spirit; while the auditorium stands, as T.C.A. solely stood in the past, as a laboratory for the development of those private and social skills which help man to be most fully himself.

"I think we all realize that in this new setting and in a new time many of the student needs which formerly T.C.A. met alone, and met well, must now be provided by the modern educational institution as part of its educational offerings to students.

"Most specifically in terms of the chapel, T.C.A. at all levels has made an outstanding contribution to the developing program. During the year, students of the Religious Action Division have been active in their support and in the planning of the United Christian Council. In addition, the Religious Action Division, in maintaining its contacts with all religious groups, has the possibility of becoming an Inter-Faith Council in name, as in some respects it is already a fact.

"The Advisory Board also has helped in innumerable ways to further the work of the religious counselors, especially by its concern for and interest in their work, by placing facilities and personnel at their disposal, and by organizing a dinner meeting where they had the opportunity to meet members of

the Corporation, Faculty, and administration.

"It is my opinion that without T.C.A. the chapel program which we anticipate in the fall could not have been fully established."

Technology Christian Association.

Mr. Holden continues: "The Services and Boys' Work Divisions have this year maintained their unique tradition of rendering a multitude of varied and specific services to members of the Institute family and the wider community. Important as these services are in themselves to individuals, to groups, and to Institute morale, it is my impression that at this time the greater value is in the personal and social growth of the students who plan and execute these activities. For example: the excellent sound movie, written and filmed by the Boys' Work Department on juvenile delinquency; their three seminars on juvenile delinquency; the blood, clothing, and fund drives; the skeptics' seminars; the seminar on American Ethics conducted by Professor Morrison and Professor Potter of Yale; the leadership training seminar; and the joint working with the Matron's committee to improve married foreign students' housing — all these have helped T.C.A. members to understand and to deal with the complex realities of contemporary social, civic, and religious life. It is my opinion that these experiences have been akin to the values which the British felt were present in the so-called "Continental Grand Tour" — namely, 'To temper their insularity, and to deepen and broaden their minds and affections.' I mention these educational values especially, for in the present economic and social climate, which is different from the depression and war years, the real needs of students have changed.

"Also, I believe that this year we have moved further

along on the road toward student autonomy, with the T.C.A. staff doing less to execute the student program. In addition there has been this year a more frequent cooperative relationship between T.C.A. and other student activities, particularly between T.C.A. and Institute Committee, Hillel, Catholic Club, United Christian Council, Baker Memorial Committee, Activities Council, Alpha Phi Omega, and the International Program Committee. In this same connection, the T.C.A. program has tended toward decentralization, working in part through the Dormitory councils and the various fraternity groups.

"Similarly, the scope of my own activities has widened beyond the usual T.C.A. concerns. In addition to teaching the course in Bible and scheduling the chapel and auditorium, I have worked increasingly with student activities and student concerns in an advisory capacity.

"It is my feeling that this new sense of cooperation is indicative of a new direction in the life of student activities here at the Institute and must be considered as we plan for the future."

Miscellaneous.

Several events of major importance to the Dean's Office should be recorded at this time.

Through the School of Humanities and Social Studies another bridge between the curricular and non-curricular was built in the appointment of Professor Joseph D. Everingham as adviser to dramatic activities at the Institute. His work, and that of Professor Klaus Liepmann in music, is reported by Dean Burchard; I shall only say that the significance of this leadership in student activities is very great in enriching student life and setting standards of the highest kind for all

activities on the campus. The Kresge Auditorium, as the center for dramatics and music as well as for many other community affairs, is already having a marked effect on the life of the community.

The Corporation Committee on Student Activities met this year on March 7 with the members of the newly-formed Dean of Students' Council, thus providing the Committee its first opportunity to meet the greatly expanded group of Faculty and administration working in the non-curricular program and to hear firsthand of the many new developments taking place. It is hoped that this Committee may have a day-long meeting during the coming year.

The Faculty voted last spring to replace the dean of students as chairman of the Faculty Committee on Discipline by a member of the Faculty. The Dean's Office welcomes this change for two reasons: it signifies the Faculty's responsibility for standards of conduct, and it enables the Dean's Office to represent the interests of an accused student without at the same time serving as judge.

In appointing Richard L. Balch as director of athletics, the Institute gives recognition to the interrelatedness of the whole non-curricular program and its relation, in turn, to the curricular program. Mr. Balch will be expected to coordinate the athletic program with evolving developments in undergraduate dormitories, fraternities, graduate housing, and student activities, as well as to bring his staff into a closer relationship with the Faculty, particularly those serving as advisers.

The present remodeling of Walker Memorial and the simultaneous reorganization gradually taking place under the leadership of the Institute Committee with the assistance of

Mr. Holden should mean much in the improved effectiveness of all student affairs.

A grant from the Fund for the Advancement of Education brings to M.I.T. next year Dr. Robert S. Hartman, Associate Professor of Philosophy at Ohio State University, as a consultant to the Dean's Office. Thus will be added the voice of the philosopher to those of the clergy and the psychiatrists in further developing plans to meet the individual needs of students and to contribute to their development as "whole men." Dr. Hartman will also teach two courses. A unique experiment in college education as far as we can tell, this project developed in part out of general concern in this area by the National Association of Student Personnel Administrators.

Conclusion.

It is with deep sense of personal loss to countless students and Faculty that the death of Professor Ivan J. Geiger on January 12, 1955, is recorded. As the first director of athletics at M.I.T. he made a lasting contribution in setting the tone of a modern college athletic program designed truly to serve the welfare of students.

Special tribute is paid to Roy B. Merritt for the able, cooperative manner in which he carried on as acting director of athletics through the spring term and the summer months.

To Professor and Mrs. Mason goes the Institute's appreciation for two years' service to the residents of Baker House who have already spoken eloquently of the contributions made.

In a community the size of M.I.T. the opportunities for students and Faculty to render service to each other, to the Institute, and to the community are boundless. To the increasing numbers who are grasping these opportunities through

both formal and informal channels, we wish to pay tribute; and we sincerely believe that the lessening of tension referred to above by Dean Speer will continue as more and more students find opportunities to participate fully in the life of the M.I.T. community. Dr. Killian spoke a year or so ago of the importance of students learning not only *to do*, but *to do good*; attainment of this goal is closer day by day.

Finally, Mrs. Bowditch joins me in expressing our continued appreciation of the support and friendliness extended to us from all parts of the Institute family.

E. FRANCIS BOWDITCH.

ACTING DIRECTOR OF ATHLETICS

There have been continuing advances in the number of M.I.T. students participating in the various phases of the athletic program during the year. Most of this increase has been felt in intramural and class activities for the reason that intercollegiate sports at the Institute have, in many cases, reached a temporary "saturation point" with regard to the number of participants involved. This is, however, a temporary phase since increasingly adequate facilities and equipment in both varsity and freshman athletics will inevitably permit increased participation at both levels, as well as in the hitherto relatively unexplored realm of junior varsity competition.

The usual and perennial growing pains have been present in the continuing evolution of a satisfactory intramural program. In 1953-54 approximately 1200 M.I.T. students entered into intramural activities in the 11 different sports offered at this level. In 1954-55 two new sports were added to the intramural program; these new activities are hockey and

badminton, both highly successful and both tremendously popular. With the addition of these two sports, the participation level has risen accordingly, with a total of 419 teams competing in 13 sports. This means that an approximate total of 3577 men were involved in some 950 contests. Estimated duplication of activity is 55 to 60 per cent, which means that the actual number of participants is in the vicinity of 1436.

During the summer months the Athletic Department conducted its usual summer softball program, involving this year 10 teams and some 150-170 men. This is an important contribution to Institute living and should, perhaps, be expanded in the near future.

This past year has been the second during which we have used the Revised Athletic Requirement Plan — a plan which permits the entering freshman to amass the required number of athletic points over a three-year period rather than making each freshman complete the requirement during his first year at the Institute. It is interesting to note here that 40 per cent of the class of 1958 did complete this requirement during the 1954-55 season, while 44 per cent of the same class has amassed one-half of the required total. The sophomore class averages 80 per cent completion, a record of comparative excellence. This figure compares very favorably with those compiled during the era of compulsory one-year freshman athletics. The spreading of the load and the consequent easing of the student's academic burden has resulted in increased interest in, and enthusiasm for, this aspect of the athletic program.

The class program continues to perform a much-needed function in providing athletic activity for many who would not otherwise be interested in, or capable of, competing at a higher level. This phase of the program provides activities

of established "carry-over" value for those who may be relatively non-athletic, or, even more likely, non-competitive by nature. Classes offered include the following sports, with fundamental instruction and actual play and practice: softball, tennis, swimming, basketball, golf, volleyball, badminton, sailing, life saving, squash, and gymnastics.

Intercollegiate competition.

On the intercollegiate level, M.I.T. fielded a total of 48 teams, excluding Field Day squads. The list of sports offered is as follows: baseball, basketball, crew, cross country, fencing, golf, hockey, lacrosse, pistol, rifle, sailing, soccer, squash, swimming, tennis, track (indoor and outdoor), weight lifting, wrestling, skiing, and rugby.

Most of these sports offer varsity and freshman competition, while some offer junior varsity as well. In crew, for example, not only is there varsity and freshman competition, but there is heavyweight, lightweight, and junior varsity activity at each of these levels.

The approximate number of participants at the intercollegiate level is 800; the number of regularly scheduled contests during 1954-55 was 270, excluding those scheduled in rugby, skiing, and Field Day sports.

M.I.T.'s won-lost percentage was once again commensurate with the amount of time available to athletes and coaches. Incomplete figures, at the moment, reveal this to be in the vicinity of 45 per cent. Certain teams enjoyed an excellent year of competition, while others suffered by comparison as the customary cyclic nature of athletics again made itself felt.

Jack Frailey's Lightweight Crew brought home from England the Thames Challenge Cup for the second successive

year — a trophy symbolic of international superiority in the lightweight division; Oscar Hedlund's cross country aggregation ran away to the New England Championship of 1954; the fencing and soccer teams compiled excellent and similar records of six wins and one loss, with the fencers taking second place in the New England Championships; the freshman swimming team compiled a record of eight wins and two losses, thus bringing their record for the past three years to a very respectable 22-8 mark; and M.I.T. sailors, under Coach Walter C. Wood, again enjoyed a highly successful season, climaxing their activities by annexing both the Morss and Lipton Trophies.

Athletic facilities.

During 1954-55 there were several notable developments in facilities and equipment. Most outstanding among these is the new Briggs Field ice hockey rink which was completed in early January.

Next in importance is the new portable basketball floor for Rockwell Cage. This is a beautiful facility, and it has enabled us to transfer our center of basketball activity to the west side of the campus, where it joins most of our other sports. The floor consists of one full-length exhibition court and two cross courts. There are permanent backboards for the exhibition court and four excellent portable backboards for use in cross court action. The portable floor covers one half of Rockwell Cage, thus providing not only more adequate space for basketball but a splendid wrestling and gymnastics area as well.

M.I.T.'s trackmen also benefitted during 1954-55 since we were able to provide them with a new board track, a need which had been felt for some time.

Finally, the lightweight crew was able to fill a need when the Nichols brothers (A. A. Nichols '28 and W. H. Nichols '27) presented the Institute with a new lightweight shell in the spring. On May 3 this wonderful new piece of equipment was dedicated and appropriately christened "Willy" in honor of W. H. Nichols, Senior.

In connection with the razing of Building 18, the Barbour Field House with its locker rooms, showers, and weightlifting areas was lost to M.I.T. students. It is hoped that the losses will be compensated by the addition of new lockers between the present swimming pool locker room and the squash courts. The weightlifting team has been moved to Walker Gymnasium, a move which has yet to prove its merit. And the Athletic Department is now installed in Walker Memorial.

The staff at present consists of eight full-time members and 14 part-time men; the former carry on the class program in athletics, as well as much of the coaching for all sports. The staff is capable and well-balanced, with considerable talent and experience.

Under the chairmanship of Professor Theodore Wood, Jr., the Athletic Administrative Board has spent some time looking into the eventual development of the West Campus for various athletic areas. Their findings are embodied in the Jester Committee Report.

ROY B. MERRITT.

DIRECTOR OF STUDENT AID

More than $925,000 was made available as financial aid to our students during the year 1954-55 through resources

furnished by the Institute from scholarship endowment income and current gifts, established loan funds, and term-time jobs both on and off the campus. This gross amount represents a 10 per cent increase over last year, though the total number of students aided from these sources increased only very slightly. Furthermore, this amount does not include the financial support which a fair number of our students received from philanthropic organizations, foundations, the Veterans Administration, etc. The value of this additional help can only be estimated conservatively at about $350,000.

Increase in resources for financial aid.

It is gratifying to report that valuable and timely additions were made to our student aid program this year, though some of these will not become effective until the beginning of the September, 1955, term. Briefly, these additions are in the form of added endowment, industrial four-year undergraduate scholarships, income from the Frank W. and Carl S. Adams Fund for annual scholarship distribution, and the George J. Mead Prize Scholarships and George J. Mead Loan Fund.

Loan funds.

For the past 25 years the Technology Loan Fund has been the main source of loan help to our student body. In 1951 the Corporation of the Institute accepted a bequest of approximately $250,000 under the will of George J. Mead '16 to establish a loan and prize fund for students in aeronautical and mechanical engineering. First attempts to employ this loan fund fell far short of effective use. Early in the fall of 1954 a broader base, patterned on the operation of the Technology Loan Fund, was approved by the Institute's treasurer and

counsel for students in the two professional courses specified above. Simultaneously, approval was given for the first awards of the George J. Mead Prize Scholarships, mentioned below. This year's experience gives every indication that we have undergirded our capacity for student loans in a very substantial manner by the George J. Mead Fund.

Scholarships.

The largest increase in our scholarship program since the Sloan National Scholarships were established in 1953 came with the addition of eight new four-year grants — five College Scholarships assigned by the General Motors Corporation, two scholarships (one in science and one in engineering) established by the Procter and Gamble Company, and the William B. Ziff Memorial Scholarship in aeronautical engineering sponsored by the Ziff-Davis Publishing Company.

The capital of our scholarship funds was increased by 5 per cent during the year, and gifts from P. W. Litchfield '96, C. E. Merrill, Redfield Procter '02, J. J. Wilson '29, and the Cabot Foundation contributed materially to this gain. The Bell Foundation of Buffalo, New York, has made available an annual tuition scholarship for an entering freshman.

The first scholarship assignments were made for 1955-56 from the Frank W. and Carl S. Adams Memorial Fund; the first payment amounted to $16,000, representing the Institute's one-quarter interest in this fund. The first awards of the George J. Mead Prize Scholarship were made to four students on the recommendation of the Department of Aeronautical Engineering.

In conjunction with the General Motors College Scholarships, the General Motors Corporation also inaugurated 100 national scholarships, with selection made by a

national committee drawn from college and university administrators. Holders of General Motors National Scholarships have freedom of choice as to their college selection. It is pleasing to record that nine of these National Scholars signified that they would enter the Institute in September, 1955.

Many of these industrially sponsored scholarships, including the Sloan National Scholarships, in addition to furnishing funds for the student recipient carry grants to the Institute "to cover the cost of education." Contributions from these sources amounted to $32,700 during this past year and it is anticipated that next year there will be a marked increase in this amount.

Mention was made in last year's report of the Institute joining the College Scholarship Service in connection with our freshman financial aid program. This service proved most helpful in establishing an approximate uniform basis for the "determination of need" and the criteria on which families could be judged as to their capacity to contribute financially to their children's education.

For the first time in several years the number of freshman scholarship applications did not increase, although completed application forms totalled 1,800. However, about 2,000 financial forms were sent to us from the College Scholarship Service, which ranked the Institute fourth in nearly 100 colleges and universities using this agency. The director of student aid will continue to serve next year on the Service's Operations Committee, and the assistant director has been appointed a member of the Service's Computation Committee.

Scholarship awards and Loan Fund grants.

Gifts of $87,138 were made to our current scholarship funds by 15 foundations, 14 industrial organizations, eight

individuals and five alumni clubs. Statistics for the college year, summarized in the following table, include awards from endowment fund income and current gifts, together with grants from the Technology Loan Fund, George J. Mead Fund, and other student loan funds.

	1954–1955			*1953–1954*		
	Number	*Award*	*Total*	*Number*	*Award*	*Total*
Scholarships from M.I.T. endowment funds:						
Freshman scholarships	199	$ 94,892.00		187	$ 98,550	
Other undergraduate scholarships	291	110,598.00	$205,490.00	309	112,876	$221,426
Scholarships from outside sources:						
Freshman scholarships	30	26,308.00		30	23,975	
Other undergraduate scholarships	79	60,830.00	87,138.00	72	46,704	70,679
	599		$292,628.00	598		$292,105
Undergraduate loans:						
Technology Loan Fund	352	245,513.00		392		253,624
Mead Fund	35	21,350.00				
Other student loan funds	3	934.75	$266.897.75			
Totals	989*		$559,725.75	990*		$545,729

*Allowing for individuals receiving both scholarships and loans.

Six hundred and two applications for loans were received from both graduate and undergraduate students during 1954-55; of this number 565 were presented for consideration to the Technology Loan Fund, and 510, or 90.2 per cent, were acted upon favorably, for a total of $319,386.46. For the 1953-54 the corresponding figures were 596, 531, 89.1 per cent, and $326,312. Thirty-seven applicants were granted assistance from the George J. Mead Fund in the amount of $22,250, making a grand total of 547 loan grants totalling $341,636.46 for the year.

Student employment.

Opportunities for self-help through campus jobs con-

tinue to be an important factor in helping needy students to balance their individual budgets. Eighty members of the Class of 1958 were assigned jobs, along with scholarship grants, to help meet their needs for assistance. The summary of student employment as reported by the manager of student personnel follows:

	Number of students	*Earnings*
Student Staffs including dining and residence halls	506	$179,800
Placement of other part-time workers on and off campus during the academic year	705	114,500
	1,211	$294,300

Because of the increased volume of activity in both scholarships and loans and added office personnel, new space had to be provided for the Office of Student Personnel which had been housed in the Student Aid Center since December 1952.

Tuition Exchange Plan.

Late in August 1954, the Executive Committee of the Corporation authorized the membership of the Institute in the Faculty Children Tuition Exchange Plan (recently this title has been formally changed to Tuition Exchange Plan) and simultaneously voted remission of full tuition for sons and daughters of members of the Institute's Faculty and certain administrative officers who attend M.I.T. as undergraduates. The Executive Committee also authorized the continuation of remission of one-half tuition to children of all employees of the Institute while attending M.I.T. as registered students. The director of student aid was requested to act as liaison officer for the Tuition Exchange Plan.

All members of the Institute Faculty and administration were notified immediately of the availability of the Tuition Exchange Plan and the names of 100 colleges and universities that are members of this organization. During the year 84 more colleges and universities were added to the Plan, making a list of 184 schools in 35 states and the District of Columbia.

During the year certifications were issued for 17 children to 12 different colleges and universities, and 10 individuals were accepted on a full-tuition remission basis at Amherst College, Bowdoin College, Columbia University, Hollins College, Simmons College, the University of Rochester, and Wesleyan University. Because quotas had been filled in the spring of 1954, seven Faculty children were not accepted under this Plan. However, it should be pointed out that in the main these disappointments were experienced at women's and coeducational colleges. Nine Faculty children attended the Institute as undergraduates on full tuition remission. In summary, 19 children out of a total of 26 received this benefit.

In the parlance of the Tuition Exchange Plan, M.I.T. Faculty children who attend a college other than M.I.T. are known as "exports," and faculty children from other colleges are termed "imports" when they attend M.I.T. During this past year, as might be expected, our "imports" were quite small, amounting to a single student, with the result that our "exports" far exceeded our "imports." It is too early to forecast the final outcome for the coming academic year, but there is some evidence that the new group of "exports" and "imports" will be more nearly in balance.

For the purpose of record, seven sons and daughters of M.I.T. employees received the benefit of the half-tuition remission for 1954-55.

Veteran enrollment.

The number of students enrolled as veterans receiving benefits under Public Laws 16 and 346 has continued to decline sharply, and those receiving benefits totalled less than 100, 50 per cent less than in 1953-54. Conversely, the number of ex-servicemen with benefits under the "Korean G. I. Bill," P.L. 550, approximately doubled over the previous year.

	P.L. 16 or 346	*P.L. 550*	*Total*	*Per cent of total registration*
Fall Term	80	259	339	6.4%
Spring Term	67	267	334	6.6
Summer Term	19	99	118	7.8

It is a pleasure to report that Mr. Joe Jefferson, formerly associated with the College Entrance Examination Board, has been appointed assistant director of student aid.

T. P. PITRE.

Reports of Other Administrative Officers

SECRETARY OF THE INSTITUTE

Participation of the individual members of the Corporation in the affairs of the Institute continued at a high level during the last year. Considering other demands on their time and the fact that many members have to travel a considerable distance to reach Cambridge, attendance at the regular meetings of the Corporation and at the many Visiting Committee meetings served as a good measure of their keen interest in M.I.T. In addition to the four regular meetings of the Corporation, there were meetings of 21 Visiting Committees, some of which met for two days.

The informal morning sessions held on Corporation Day have proved to be a popular and effective way to present some of the more important educational activities that cut across departmental lines. One greatly appreciated innovation of the last year has been the inclusion of Corporation wives in the social activities. Such events as the dedication of the Kresge Auditorium and the M.I.T. Chapel afford notable opportunity to bring together representatives of every segment of the Institute family.

The Visiting Committee structure represents one of M.I.T.'s most important assets. The benefits are many: members of the Corporation get a firsthand view of the educational and research activities, the department heads seek and get valued advice on some of the more pressing operating and policy problems, and the administration has the opportunity to share intimately with the committees some questions of major educational and institutional policy in a way that is not feasible in a formal business session of the Corporation as a whole. In commenting on the values of Visiting Committees, I want to acknowledge the important contributions of the alumni and "presidential" representatives, who, with the Corporation members on the Committees, bring to bear a rich background of industrial and professional experience on educational affairs of the institution.

The Institute's administration has long sought ways of bringing the parents of students into a closer relationship with life on the M.I.T. campus. The tea for freshman parents in the fall and the luncheon in the Great Court on Commencement Day are two examples of steps already taken in this direction. But with a student body of over 5000, coming from almost every state and a host of foreign countries, it is difficult even to keep parents informed about some of the more

significant developments on campus. To help in doing this, the News Service has prepared and distributed a four-page monthly publication, *The M.I.T. Observer*, to parents of students coming from the United States and Canada. Under the editorship of Walter Milne, *The Observer* has gone far in keeping parents abreast of a variety of the Institute's activities, including technical, athletic, and social. Parents of students represent an important segment among the friends of M.I.T. and further steps will be taken to include them more intimately in the affairs of the Institute.

Educational Council.

This fourth Educational Council year has been characterized by continuing growth as well as consolidation of existing area organizations. The Council activities continue to represent one of the most important ways in which alumni contribute to the Institute's program.

In terms of growth: 104 new Council members have been appointed this year, compared with previous records of 129 in 1954 and 141 in 1953. The net total now stands at 618 and from our best estimates should stabilize at 800 members.

These alumni are in contact with one out of every ten secondary school students, through their assignments to 848 secondary schools (654 in 1954, 356 in 1953, 96 in 1952). We estimate that ultimately 2000 schools will be included.

One hundred and two distinct areas are fully organized (this means a chairman, a full complement of men, and school assignments), as compared with 88 in 1954 and 33 in 1953. In addition, 34 areas have organizations in various stages of completion. About 40 more areas are slated for organization but no alumni representatives have yet been selected.

By consolidation is meant the education and indoctrination of the members in M.I.T. as it is today, and, fully as important, in the fundamental objectives of the Council, i.e., active yet moderate public relations at every opportunity, but particularly with secondary schools and students. To insure that the better candidates apply for freshman admission, we must strive to increase the schools' confidence in M.I.T. This can be done only through continuing personal contact, which will inevitably lead to educating the responsible school representatives about M.I.T. and consequently to their freely encouraging the better students to apply.

Education of Council members takes several forms: the very well received Handbook, revisions of which were sent out in September; the monthly Bulletin, which with the advent of *The Observer* was reduced from four to two pages; and personal visits to meet with the various area organizations. In addition, of course, are the Alumni Association mailings; catalogues and brochures from the Admissions Office; and visits to cities by school-visiting personnel and other Institute representatives. In addition, education is afforded by daily correspondence which takes place between Council members and Institute offices.

With *The Observer* covering the news aspects of the Bulletin, the latter has become a more specific channel of instruction and guidance and probably will continue as such.

Personal visits were made specifically on Council business to some 34 areas throughout the country. These are most valuable, since they provide an opportunity to evaluate the effectiveness of the area operation and to make corrections in modes of communication and emphasis. The travel schedule contemplates a personal visit from the Council office every three or four years.

The Admissions Office school visitors greatly benefit the Council program because almost invariably they contact one or all of the Council members in an area.

Council members upon invitation attended 126 college nights at high schools as representatives of M.I.T. Of the applicants for September, 1954, 4500 were referred to members of the Council; 2500 actually had conferences; and 599 came in September. This latter number is 63 per cent of that part of the class which came directly from high school.

For the future: we should begin to reach a relatively stable membership by the summer of 1956, and the task of indoctrination and education will increase proportionately. Increasing effort must be applied to the latter activity, for a poorly informed or unguided membership cannot be expected to serve effectively as emissaries of the Institute.

More effort will be directed towards informing graduating seniors, as well as the Institute staff, about the Council and its functions, for there are many ways that these groups can assist the Council if only through a knowledge of its existence and purpose.

Development activities.

Under the active and inspirational leadership of Alfred P. Sloan, Jr. and Marshall B. Dalton, the Corporation Committee on Development has devoted its primary effort this year to obtaining a total of $7,000,000 for a nuclear reactor and a laboratory to house the educational and research activities in nuclear science, nuclear engineering, and electronics. The laboratory will stand as a memorial to Karl Compton. As of midsummer, more than $5,000,000 has been paid or pledged toward the total goal. This amount assures completion of the physical facilities. The extensive and intensive participation

in this campaign of individual members of the Corporation and other segments of the Institute family is but one measure of the respect and affection for Dr. Compton held by the entire Institute family.

Alumni Fund.

The Alumni Fund Board has dedicated the entire income for the last year to the Compton Memorial Program; over 11,000 alumni contributed more than $500,000, which represents a larger number of givers and more than twice the normal dollar gifts than in any year since the Fund started 15 years ago. In every other respect, there has been close liaison between the Alumni Fund and the Secretary's office through regular meetings to discuss policy and to plan fund activities.

Rather than reverting to the former policy of requesting funds for undesignated purposes, the Fund Board plans in 1955-56 to select two or three specific objectives which will have great appeal to the majority of alumni. Alumni will have the stimulation of seeing their gifts immediately put to good use. The plan of supplementing the class agents' activities by setting up special prospect solicitation and regional solicitation, both by personal as well as mail approach, has worked well; and both will be continued and extended in the coming year. The principal effort will be to increase the number of alumni participating in the Fund.

Bequest program.

In terms of the long-range building of unrestricted funds, perhaps the most important source is gifts through bequests. During the last year letters have been sent to over 4000 non-alumni inviting them to include M.I.T. as a beneficiary in their wills. This program will be continued. While it is

practically impossible to appraise the effectiveness of such a program as this in the short term, there have been indications that it is stimulating interest; for example, lawyers have written or called the Institute in increasing numbers to inquire about its legal name.

In the last few years, the "gift by will" letter has been sent to all alumni up to the Class of 1938. Plans are being made to supplement this mail approach by personal visits to selected alumni who graduated 35 or 40 years ago; in every case, this plan will be carried out with the full concurrence of the class officers and in a way to preclude any conflict with the efforts of the Alumni Fund. This plan will coordinate with the program initiated by the Class of 1928 under the leadership of Ralph Jope and followed by the quarter-century classes since 1953, of setting up a capital fund with the 25-year gift, income only to be used for general purposes. The existence of a capital fund in the name of the class may be an inducement to an alumnus to name the class fund as beneficiary in his will, even for a modest amount. Were the fund not available, the alumnus might regard his gift as too small to be worthy of inclusion in his will.

Industrial Liaison activity.

There is clearly a need to maintain close and cordial relations with the top officers of the companies that participate in the Liaison Program; the Liaison Office does a superb job of keeping the research directors and other operating personnel of the companies thoroughly informed about the Institute. For the last year, Professor Walter H. Gale has devoted his attention to the Liaison Program, with visits to presidents of participating companies and prospective participants. To maintain the necessary close communications within the

Institute, regular meetings are held with representation from the Liaison Office, the Development Office, the Office of the Treasurer, and the Vice-President in charge of Industrial and Governmental Relations. With over 75 companies in the Liaison Program, there is continuing need for close collaboration between these offices and for public relations activity of the kind being carried on by Professor Gale.

A further and detailed report of the Industrial Liaison Office appears elsewhere in this book.

Small company program.

For a number of years the Development Office has circularized a limited number of small companies inviting a year-end contribution to M.I.T. These companies have been selected for their known interest in M.I.T., such as the fact that the president or some other key officer is an alumnus. In the year just ended over $50,000 has been received from this source. We believe that many more smaller companies have an interest in M.I.T. which may be readily cultivated, and we plan to extend this program in the coming years, supplementing the mail approach with personal visits in selected cases. One important step in this program is an analysis of the I.B.M. cards used for the recent Alumni Register: the 32,000 cards are being screened for alumni who are company officers.

Parents' fund.

The number of scholarship applications indicates that many parents of our students are hard pressed financially to send their sons to the Institute. Against this, there is good reason to believe that some parents are not only able to pay a larger share of the actual cost of educating their sons but would

welcome the opportunity to do so. Indeed, it is reasonable to assume that a few parents could and would make substantial contributions if they were properly apprised of the needs of the Institute. To this end, we plan to circularize all parents this fall, pointing out some of the Institute's financial facts and inviting participation in the Parents Fund to the extent that they feel able. This plan will be extended in the future in whatever way is indicated by early experience. In this effort, we have the close cooperation of Henry B. Kane, who has extensive experience and proven ability in this kind of fund raising.

Other funds.

Mr. Jope has quietly continued solicitation of support for the Allan Winter Rowe Memorial Fund for the crew which he undertook a few years ago. To date over $26,000 has been subscribed; when the capital fund reaches $50,000, which is anticipated in a few years, there will be approximately $2000 available annually for the crew program. In addition, within the last year more than $10,000 has been contributed toward the organ in the Kresge Auditorium.

Mention in this report of specific funds and specific areas of development activity tells only part of the story. Seeking to increase the resources of an institution like M.I.T. is not the province of one man nor any one office; nor are the underlying reasons for large and small gifts alike attributable to any one department or related even to any one era of the institution's history. Rather, the task represents the coordinated efforts of many. In part, the gifts represent appreciation for the part played by M.I.T. in education; some are recognition of M.I.T.'s contribution to our industrial growth and the national welfare over the years. In part, and perhaps more

importantly, gifts represent confidence on the part of individuals, corporations, and foundations in what M.I.T. stands for in education and in improving the lot of mankind. Anyone who has the opportunity to talk with people about M.I.T.'s needs cannot help being impressed by the genuine sense of gratitude expressed by many and the confidence in the future of the Institute expressed by all.

Every member of the Corporation has readily helped in this program, and many have devoted considerable time to it. But the modest success of the program of the last year would not have been possible without the insight and enthusiasm of Mr. Sloan and Mr. Dalton; despite their obviously heavy business and other responsibilities, they have both given magnanimously of their time, thought, and energy. With this kind of demonstrated and dedicated interest, the future of M.I.T. is secure.

R. M. KIMBALL.

DEAN OF THE GRADUATE SCHOOL

The real work of the Graduate School is, of course, carried on by the departments whose Faculties provide the guidance and stimulus for advanced scholarly study and creative work, set the actual standards of performance for our degrees, and collectively produce the intellectual climate. It is the function of the Graduate School to encourage and provide a medium for mutual study of common problems, to encourage some degree of common standards in various areas, and to enable all to share the results of educational experiments.

Most important is the stimulus from exchange and debate on matters of educational objectives and philosophy

and the achievement of practical expression of these in sound working procedures. These procedures should at once promote a high minimum standard of excellence for all of our graduate students yet encourage flexibility, especially for the exceptionally gifted student.

Looking toward actual operations, the Graduate School enrollment has shown notable stability during the past five years. This is due to departmental quotas that are determined basically by the Institute endowment available for tenure Faculty appointments and to sufficient numbers of well qualified applicants to fill, indeed substantially exceed, these quotas. The number of applications for 1955-56 is appreciably larger for the larger departments than for any previous year except 1950.

Competition for college graduates is high, especially for the most promising, among an increasing number of graduate schools and (in the field of engineering) in industry. Some form of subsidy to graduate students to cover living as well as tuition is almost universal. Fellowships are increasingly important as an aid for the very good as well as the outstanding students. Sixteen new industrial fellowships at the Institute for next year are very helpful. This past year the Graduate Committee elected to allocate Whitney funds, heretofore used only for tuition scholarships, to 15 fellowships of $1000 plus tuition for new applicants who were outstanding graduates of other institutions.

In the interest of widest availability of information concerning graduate opportunities everywhere, including fellowships, the Library — in cooperation with the Graduate Committee — developed an excellent collection and index of all such information available.

A few significant statistics on the past year in the Graduate School follow:

Graduate School registration, 1954-55.

School or Department	*Summer 1954*	*Fall 1954*	*Spring 1955*
Engineering	627	1170	1087
Science	217	516	483
Architecture & City Planning	18	47	47
Economics & Social Science	6	50	50
Industrial Management	36	85	78
	904	1868	1745
U.S. or Canadian citizens	771	1592	1489
Others	113	276	256
	904	1868	1745
Regular	820	1569	1498
Special	84	299	247
	904	1868	1745
Civilian	—	1679	1562
Military	—	189	183
		1868	1745

Advanced degrees conferred, 1954-55.

	*S.M.**	*Engineer*	*Sc.D.*	*Ph.D.*	*Total*
September 1954	149	9	13	37	208
February 1955	80	5	18	26	129
June 1955	286	35	37	40	398
Total	515	49	68	103	735

*Includes M.Arch. and M.City Planning.

1954-55 awards of M.I.T. fellowships and scholarships.

	Number of awardees	*Amount*
Fellowships	146	$252,901.33
Scholarships	87	47,001.00
Staff awards	370	141,928.65
	603	$441,830.98

M.I.T. continues to attract a large fraction of the National Science Foundation Fellows, second in number only to Harvard University.

Foreign students are attracted to the Institute in large numbers; in fact, M.I.T. continues to have the highest fraction of foreign students in the country. The subject of foreign student numbers was thoroughly reviewed by a subcommittee during this past year, and as a result the Graduate Committee concluded, and reported to the Administration, that the educational opportunities offered to U.S. nationals and Canadians had not been curtailed — indeed were probably enhanced; that M.I.T.'s international prestige benefitted; and that present foreign graduate admissions policies were sound.

A new program leading to the Doctor of Science degree in the field of nuclear engineering was approved by the Faculty and Corporation. This program is administered by the Department of Chemical Engineering, although it is essentially interdepartmental in character and sufficiently flexible to accommodate those with undergraduate degrees in any of several pertinent fields.

The Graduate Student Council continues to develop and as a new activity is participating in the Institute's examination of its long-term student housing problem.

Responsive to departmental concerns regarding the limitation of educational opportunity open to academic staff appointees, a new and very liberal policy regarding staff listeners was evolved as a result of an intensive subcommittee study.

Proposals for classified theses continue to be subject to individual approval by the Graduate Committee, which thus expresses its pressure to minimize this category of work.

A careful review confirmed recent policy, justified by our cold war environment, of permitting classification if adequate Faculty supervision and appraisal are assured, if the quality of educational opportunity is comparable with that for unclassified theses, and if persuasive evidence for the necessity of classification is presented.

Appraisal of liberalizing educational opportunities in the prior education of foreign students has always been difficult and inconclusive. After experiment with various tests, the Graduate Committee decided that one or more years of residence and study in a foreign country (the United States) constitutes an acceptable, liberalizing experience comparable with that expected of graduates of United States institutions entering our Graduate School.

In May, 1955, the Committee on Graduate School Policy suffered the loss of a member beloved as an active contributor and elder statesman, Professor Walter M. Fife, who had represented the Department of Civil Engineering for almost 25 years.

HAROLD L. HAZEN.

DIRECTOR OF PUBLIC RELATIONS

The best basis for public relations is good educational and administrative policy, and the Institute's excellent relations with the public are clearly the reflection of wise and consistent policy. Devotion of the Institute to education, research, and public service has brought deserved recognition.

Perhaps the major problem of public relations in such a large institution as M.I.T. is that of communication — within its walls and with the press, the public, parents, and alumni.

Since the appointment of a director of public relations at the beginning of the calendar year, there has been an effort toward better communication.

Establishment of *The Observer*, a monthly bulletin of news about the Institute, had this purpose. Sponsored by the Secretary of the Institute, it is distributed to the parents of students and to members of the Corporation, among others. As editor, Walter L. Milne has done a splendid job of interpreting the spirit and activities of M.I.T.

Office of Publications.

In the production of printed matter for the Institute, the Office of Publications under the direction of John I. Mattill has contributed effectively to communication through clear presentation of material and typographical attractiveness. The excellence and originality of design, done by Miss Muriel Cooper and Miss Jacqueline Shepard, have won wide admiration for our publications. Mr. Mattill reports:

"One principal editorial achievement this year has been the revision of the second of three units of M.I.T.'s system of catalogues. First printing of the new edition of the Undergraduate Catalogue (*This Is M.I.T.*) arrived early in June; this book represents an extensive editorial revision and a complete redesign — the result intended to provide all the information required by a first-year student to select his college and, later, to plan the program which he will follow at M.I.T. The Summer Session Catalogue was first revised in 1954 in a format with which the Undergraduate Catalogue is now consistent; and we hope the General Catalogue may be brought into this pattern in the issue to be dated June, 1956. Other major editorial assignments have included brochures on the

Karl Taylor Compton Laboratory and the Executive Development Program.

"We have welcomed the services of a Photon photographic type-setting machine made available through the M.I.T. Photographic Service. Only five such machines are now in use, and M.I.T. is the first educational institution in the world to utilize this equipment. The use of the machine has imposed upon us and upon the M.I.T. Photographic Service a somewhat heavier production burden, which has to some extent absorbed the increase in personnel during the year. The advent of Photon has also brought us into a closer relationship to the Photographic Service, since we are able to help in specifying style and composition for many publications ordered directly through the Service which would not otherwise have been our concern.

"Just twelve months ago the Office of Publications assumed responsibility for a student-staffed mail room, established primarily to relieve the Registrar's Office of mailing issues of the Massachusetts Institute of Technology Bulletin. Our first year's experience demonstrates clearly that this work is well suited to student employment, that students can assume responsibility for it, and that while aiding students we can reduce the Institute's expenses. We have prepared at least 175,000 pieces of mail and have provided 2,285 hours of student employment."

The Office of Publications contributed to at least 95 publications during the past year, making a major editorial or design contribution to 30 of them.

News Service.

When John J. Rowlands, director of the News Service, was made an honorary member of the M.I.T. Alumni Associa-

tion in June, reference was made to a published tribute from Edward Weeks, editor of *The Atlantic Monthly:*

"In my judgment the best public relations in the college world over the past 25 years have been those maintained by James Rowlands at the Massachusetts Institute of Technology . . . Working quietly and usually anonymously, Jim has made it his business to explain to the United States what M.I.T. has contributed to the development of our science and industry and the enormous part it has played in our national defense . . . "

Activities of the News Service during the past year have demonstrated the accuracy of that judgment. Mr. Rowlands reports:

"Participation by the Institute's president and leading officers of administrative and academic divisions in national and international affairs, both governmental and industrial, produced a great deal of news during the past year. This news in turn had a feed-back effect in generating interest in many special activities within the Institute.

"The Institute's important role in developing measures for continental defense, for example, was clearly established in a number of statements of international significance.

"Interest in the Institute's increasing development of the humanities, including the new pioneering Course XXI, was high-lighted by completion of the new Kresge Auditorium and M.I.T. Chapel, both of which have attracted wide editorial and photographic interest.

"More than 500 news announcements, including an increasing number of local stories on the activities or achievements of students, were issued by the News Service during the year.

"The interest of well-known magazine writers in various engineering and scientific advances at the Institute continued to have an important bearing on public interest in M.I.T. and in increasing its prestige.

"The Calendar of Events, published under the direction of the News Service, continued to be helpful to the entire Institute community in keeping it informed on the numerous activities of the professional departments as well as the constantly increasing number of cultural activities such as plays, concerts, lectures, and exhibitions."

FRANCIS E. WYLIE.

DIRECTOR OF THE SUMMER SESSION

The 1955 Summer Session continued and extended the tri-partite pattern which has proven so successful and popular in recent years. Its activities comprised 1. a series of Special Summer Programs primarily directed toward professional adults not otherwise connected with the Institute; 2. professional conferences on specialized topics; and 3. a program of regular subjects for M.I.T. graduate and undergraduate students.

Special Summer Programs.

Since the summer of 1955 was the sixth year subsequent to the reformation in 1949 of the Institute's objectives regarding the pattern and relative emphasis of its summer activities, a brief review of the history of the Special Summer Programs is appropriate.

During this six-year period, 140 such Programs have been given, their increase and diversification among the five schools being indicated in the following summary:

School	*1950*	*1951*	*1952*	*1953*	*1954*	*1955*	*Total*
Engineering	2	11	13	16	22	20	84
Science	6	7	8	8	9	6	44
Architecture and City Planning	–	–	1	1	2	2	6
Economics and Social Science	–	–	–	–	1	1	2
Industrial Management	–	–	–	1	1	2	4
Total	8	18	22	26	35	31	140

These offerings represent 74 distinct topics, of which 8 were introduced in 1950, 13 in 1951, 12 in 1952, 12 in 1953, 14 in 1954, and 15 in 1955. The first half of this six-year period, therefore, saw 33 new Programs; the last half another 41 new topics. Certain topics are in such demand that they are repeated from time to time, and in three instances (Technique of Infrared Spectroscopy, the Westinghouse Science Teachers Program, and Food Technology) the Program has been given in every one of the six years.

The distribution of the total of 140 Programs among the component departments of the several schools is as follows: *School of Engineering:* Civil 2, Mechanical 38, Metallurgy 11, Electrical 20, Chemical 4, Aeronautical 6, Meteorology 3, total 84. *School of Science*: Chemistry 20, Biology 1, Physics 10, Mathematics 7, Food Technology 6, total 44. *School of Architecture and Planning*: Architecture 3, City Planning 3, total 6. *Department of Economics and Social Science*: 2. *School of Industrial Management*: 4.

The 31 Special Summer Programs given in 1955 were carried out by 16 different departments, as follows: Civil Engineering 1, Mechanical Engineering 7, Metallurgy 1, Architecture 1, City Planning 1, Chemistry 2, Electrical Engineering 6, Biology 1, Physics 1, Chemical Engineering 2, Economics and Social Science 1, Industrial Management 2, Aeronautical Engineering 1, Mathematics 1, Meteorology 2, and Food Tech-

nology 1. Although the total number of Special Programs (31) was slightly smaller than that (35) given in the preceding year, the number of participating departments increased from 13 in 1954 to 16 in 1955.

These 31 Special Summer Programs of 1955 attracted a total of 1,791 registrants representing an increase of 281 over the summer of 1954 and an increase of 437 over that of 1953. In addition 256 other persons also admitted subsequently found changed personal plans prevented their participation, while 33 further applications were declined for various reasons. The total number of applications in 1955 was, therefore, 2,080, as compared with 1,865 in 1954 and with 1,640 in 1953.

The 1,791 actual registrants originated primarily from industrial companies (1,001 = 55.9 per cent), the remainder drawn from government (583 = 32.6 per cent) or from other research or educational institutions (207 = 11.5 per cent). These 1,791 registrants comprised 1,742 (97.3 per cent) men and 49 (2.7 per cent) women. They came not only from 47 out of the 49 recognized geographical divisions of the continental United States, but also included 102 representatives of 14 other areas as follows: Belgian Congo 1, Belgium 2, Brazil 8, Canada 62, Cuba 7, England 6, France 1, Holland 2, India 2, Israel 1, Japan 2, Puerto Rico 6, Sweden 1, and Venezuela 1. Of the 1,689 from the continental United States, 313 (18.5 per cent) came from New England, 1,088 (64.4 per cent) others from east of the Mississippi River, 185 (11.0 per cent) from the central and mountain areas, and 103 (6.5 per cent) from the Pacific Coast.

The average age of these 1,791 registrants was 35.7 years, a slight increase over last year's 34.8. The oldest individual was 72, the youngest 21 (three cases). Registrants below the age of 25 totalled 47 (last year 56); those 50 or above numbered

113 (last year 70). The youngest average age for any one Program was 31.0 for Switching Circuits; the oldest was 40.1 for the Westinghouse Science Teachers Program.

While the professional experience of the 1,791 registrants cannot readily be measured, the extent of their previous academic training is suggested by their degrees. Of the total group 281 (15.7 per cent) held no college degree although many of them had some college training; 879 (49.1 per cent) held at least one Bachelor's degree; 410 others (22.9 per cent) also held Master's degrees, while 221 additional registrants (12.3 per cent) also held Doctor's degrees. Since the corresponding percentages last year were, respectively, 11.2, 53.0, 26.6, and 9.2 per cent, substantial increases at both ends of the scale are evident.

Conferences.

During the six years (1950-1955 inclusive) of the new type of Summer Session, there have been held in addition to the 140 Special Summer Programs a total of 26 professional conferences on 24 different subjects. The number of such conferences varies from year to year, and only one was held in 1955. This was the International Combustion Conference of the American Society of Mechanical Engineers, held June 15-17, 1955, in the new Kresge Auditorium with an attendance of about 400.

Regular Institute subjects.

Concurrent with the series of Special Summer Programs and conferences, a program of regular M.I.T. subjects was offered to both graduate and undergraduate students again in 1955. The following table represents the number of

persons so registered at the end of the first week of the Summer Session for the last few years.

	1950	*1951*	*1952*	*1953*	*1954*	*1955*
Graduate	846	938	872	919	857	857
Undergraduate	1006	923	817	660	689	685
Total	1842	1961	1689	1579	1546	1542
Number of subjects offered	235	235	235	179	115	111

Since during the course of the summer the initial registration always increases slightly, a subsequent count taken during the next to the last week of the 1955 Summer Session showed a total of 1,619 persons registered as follows (according to their Spring 1955 status): graduate 901, undergraduate 718 (comprising first year 80, second year 285, third year 270, and fourth year 83).

These subjects include those offered by the Nova Scotia Center for Geological Sciences but do not include the Foreign Student Summer Project, sponsored and administered independently by an undergraduate student committee.

Other developments.

In addition to the statistical material reported above, several more general items deserve notation. The Science Teachers Program was broadened to include not only teachers of chemistry and physics, but also for the first time those of biology. Perhaps partly as a result, the number of applications for admission to the Program greatly exceeded any previous experience. Under these circumstances, the Westinghouse Educational Foundation graciously increased their support to finance 80 (rather than the previous 50) such Westinghouse Awards and will do so again for 1956. In the other Special Summer Programs, M.I.T. made available to persons holding the rank of instructor or higher on the teaching staffs of other educational institutions a limited number of

Special Summer Program Scholarships, each representing remittance of half the published tuition fee; and 42 such were awarded. The 1955 Summer Session was the first in which the extraordinary facilities of the Kresge Auditorium have been available and they were utilized for all or part of five Programs. During the year the Faculty considered further the desirability of offering regular M.I.T. courses during one 10-week summer session rather than the two six-week periods which have been employed for many years, and subsequently such a change was approved, effective in 1956.

The experience of the last six years clearly demonstrates that M.I.T. can make an outstanding contribution to the professional development of very large numbers of people not otherwise connected with the Institute. Furthermore, not only does this effort more effectively utilize M.I.T. staff, equipment, and dormitory facilities, but without exception the staff involved in Special Summer Program activities testify to the stimulating value of their contacts with a diversified and experienced group of professional people eager to apply to their particular problems the new methods, tools, and points of view with whose development the M.I.T. staff is identified. The steady and substantial increase in Special Summer Program registration, particularly in the last half of our six-year experience in its development, suggests that the foundation has been laid for even more general participation by M.I.T. activities in the future.

ERNEST H. HUNTRESS.

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, 1955, 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, 1954*	*September, 1955*
Total applications	5,060	5,168
Admissions granted	2,011	1,822
Actual registration	994	945
Registration as per cent of admissions	49.5%	51.8%
Number of secondary schools represented	678	640

*Includes 13 former students returning and 21 college transers entering the first year.

COLLEGE TRANSERS	*September, 1954*	*September, 1955*
Total applications	676	815
Preliminary applications not followed up	231	154
Admissions granted	265	225
Actual registration	181	156
Combined Plan of Study (included in above)	23	32
Registration as per cent of admissions	68.3%	69.4%

As indicated by these figures, the rate of cancellation by applicants granted admission was less than last year though still sufficiently large to be troublesome. The number of well-qualified applicants was so large as to necessitate refusing admission to several hundred who could have been expected to cope successfully with the Institute program. This situation, which may be expected to grow rapidly more actute in the next few years, results in disappointing the normal expectation of schools, parents, and students with reference to admission and leads them to think of our admissions policy as arbitrary and unreasonable. In an increasing proportion of cases, we cannot justify a refusal by pointing to any flaw in the candidate's record; he is refused only because there are so many others with qualifications which on broad grounds of character, intellect, and achievement seem still stronger. It is

important, therefore, to educate schools and alumni to realize that acceptance depends not merely on the individual's qualifications but on a review of all those competing with him for a place in the class.

The program of visits to secondary schools by members of the Faculty, instructing staff, and administration was continued and enlarged during the past year. In addition to members of the Admissions Office staff, each of the following took part for a period of at least one week: Professors Holt Ashley, John A. Clark, W. Van Alan Clark, John R. Coleman, Robert C. Dean, Jr., William H. Dennen, Douglas W. Fuerstenau, Thomas F. Jones, Jr., James G. Kelso, Warren M. Rohsenow, Donald E. Scott, J. Lowen Shearer, Howard Simpson, Albert B. Van Rennes, and Theodore Wood, Jr.; Walter L. Milne, and Dean William Speer. A total of 511 schools was visited and a total of 5723 students seen individually or in small groups.

M.I.T. was invited to send representatives to 155 high school "college conferences" during the year, of which 126 were attended by alumni or members of the Educational Council. At these conferences, in 23 states, a total of 1202 students was seen. In all, therefore, a total of 6925 students had an opportunity to discuss their educational plans in person with a representative of M.I.T. who was actually present in the student's own school.

The Admissions Office during the year referred 4501 students to alumni members of the Educational Council near the students' homes; of these 2333 had a serious enough interest to look up a member of the Council for a personal conference, a report of which was subsequently submitted by the Council member. These conferences serve a dual purpose of guidance to students and advice to the Admissions Office in regard to

the qualification of applicants. Other details of Educational Council activity are included in the report of the Secretary of the Institute.

A total of 20 freshman entered in 1954 having completed one or more subjects of college freshman grade in secondary schools participating in the School and College Study of Admission with Advanced Standing and having taken special tests in May; eight of these received some freshman credit here, following conferences with their Faculty advisers and with department examiners. These tests are now being offered annually by the College Entrance Examination Board, and schools able to do so are thus encouraged to offer advanced work to students of unusual ability.

B. ALDEN THRESHER.

REPORT OF THE REGISTRAR.

All statistics on registration and staff are as of the fifth week of the Fall Term, except: 1943-1944 as of August 2, 1943; 1944-1945 as of November 27, 1944; 1945-1946 as of July 30, 1945.

TABLE 1. Registration of Students Since the Foundation of the Institute*

Year	Number of Students	Year	Number of Students	Year	Number of Students
1865–66	72	1895–96	1,187	1925–26	2,813
1866–67	137	1896–97	1,198	1926–27	2,671
1867–68	167	1897–98	1,198	1927–28	2,712
1868–69	172	1898–99	1,171	1928–29	2,868
1869–70	206	1899–00	1,178	1929–30	3,066
1870–71	224	1900–01	1,277	1930–31	3,209
1871–72	261	1901–02	1,415	1931–32	3,188
1872–73	348	1902–03	1,608	1932–33	2,831
1873–74	276	1903–04	1,528	1933–34	2,606
1874–75	248	1904–05	1,561	1934–35	2,507
1875–76	255	1905–06	1,466	1935–36	2,540
1876–77	215	1906–07	1,397	1936–37	2,793
1877–78	194	1907–08	1,415	1937–38	2,966
1878–79	188	1908–09	1,461	1938–39	3,093
1879–80	203	1909–10	1,479	1939–40	3,100
1880–81	253	1910–11	1,506	1940–41	3,138
1881–82	302	1911–12	1,559	1941–42	3,055
1882–83	368	1912–13	1,611	1942–43	3,048
1883–84	443	1913–14	1,685	1943–44	1,579
1884–85	579	1914–15	1,816	1944–45	1,198
1885–86	609	1915–16	1,900	1945–46	1,538
1886–87	637	1916–17	1,957	1946–47	5,172
1887–88	720	1917–18	1,698	1947–48	5,662
1888–89	827	1918–19	1,819	1948–49	5,433
1889–90	909	1919–20	3,078	1949–50	5,458
1890–91	937	1920–21	3,436	1950–51	5,171
1891–92	1,011	1921–22	3,505	1951–52	4,874
1892–93	1,060	1922–23	3,180	1952–53	5,074
1893–94	1,157	1923–24	2,949	1953–54	5,183
1894–95	1,183	1924–25	2,938	1954–55	5,348

* From 1943–46 Army and Navy Students omitted. See Table 3-B in reports for 1943–46.

TABLE 2. The Corps of Instructors

	'42	'43	'44	'45	'46	'47	'48	'49	'50	'51	'52	'53	'54
Faculty Members of the Staff	313	319	317	330	379	398	413	435	436	457	480	503	515
Professors	97	97	107	113	110	118	124	131	132	136	144	152	158
Associate Professors	104	108	105	103	128	131	131	141	137	144	149	157	155
Assistant Professors	98	99	92	101	125	137	133	138	144	154	166	170	178
Ex-Officio	8	9	10	10	11	11	10	10	8	11	10	12	14
Professors Emeriti (Lecturers)	—	—	—	—	—	—	14	13	13	10	9	10	9
Instructors	3	3	—	—	—	—	—	—	—	—	—	—	—
Technical Instructors	1	1	1	1	1	—	—	—	—	—	—	—	—
Research Associates	2	2	2	2	2	—	—	2	2	2	2	2	1
Library Fellows	—	—	—	—	2	1	1	—	—	—	—	—	—
Other Members of the Staff	370	306	222	252	694	846	824	861	940	999	1051	1092	1047
Instructors	100	97	70	82	119	154	142	151	145	139	141	144	129
Technical Instructors	7	8	6	8	14	17	15	15	13	12	13	12	13
Administrative Assistants	—	—	—	—	1	—	—	—	2	2	2	2	2
Teaching Assistants	—	1	—	—	—	—	—	—	—	186	208	222	214
Teaching Fellows	60	52	8	18	74	77	72	91	98	—	—	—	—
Fellows in Applied Math.	—	—	—	—	4	3	—	—	—	—	—	—	—
Assistants	75	49	44	47	127	137	116	124	122	—	—	—	—
Consultant	—	—	—	—	—	—	—	1	—	—	—	—	—
Lecturers	18	16	7	7	11	10	13	11	22	32	25	25	28
Research Consultant	—	1	—	—	—	—	—	—	—	—	—	—	—
Research Associates	34	23	33	39	151	176	155	120	105	86	100	97	93
Research Assistants	64	59	54	51	193	272	311	348	433	474	517	542	529
Technical Assistants	—	—	—	—	—	—	—	—	—	46	45	48	39
Carnegie Fellows	—	—	—	—	—	—	—	—	—	2	—	—	—
Fellows	—	—	—	—	—	—	—	—	—	20	—	—	—
Staff Members (D.I.C.)	12	—	—	—	—	—	—	—	—	—	—	—	—
Total	683	625	539	582	1073	1244	1237	1296	1376	1456	1531	1595	1562
Other Members of the Faculty	40	39	44	52	60	67	50	50	54	55	53	58	55
Faculty and Administrative Officers:													
Emeriti (not Lecturers)*	39	38	43	51	59	66	49	49	53	54	52	57	5
Non-Resident Professor	1	1	1	1	1	1	1	1	1	1	1	1	—

*Beginning 1948–49.

TABLE 3. Classification of Students by Courses and Years

COURSE NAME AND NUMBER	1952–53 YEAR						1953–54 YEAR						1954–55 YEAR					
	1	2	3	4	G	Total	1	2	3	4	G	Total	1	2	3	4	G	Total
Aeronautical Engineering XVI	59	31	21	19	135	265	61	55	29	20	140	305	66	40	36	34	115	291
Aeronautical Engineering (Coöperative) XVI-B	—	—	4	21	—	25	—	—	8	5	—	13	—	—	14	7	—	21
Architecture IV-A	43	19	42	29	28	161	18	40	26	33	29	146	18	25	40	30	31	144
Architecture (IV-A) Fifth Year	—	—	—	32	—	32	—	—	—	26	—	26	—	—	—	34	—	34
Biology																		
Quantitative VII	15	10	17	6	34	82	7	26	11	8	41	93	16	14	19	10	39	98
†Physical VII-A	—	—	—	3	1	4	—	—	—	2	1	3	—	—	—	—	—	—
†Chemical VII-B	—	—	—	1	2	3												
Building Engineering and Construction XVII	8	10	16	19	23	76	10	15	12	13	19	69	7	6	20	11	24	68
Business and Engineering Administration XV	44	69	96	78	—	287	43	81	81	101	—	306	40	88	93	92	—	313
Industrial Management	—	—	—	—	52	52	—	—	—	—	98	98	—	—	—	—	84	84
Chemical Engineering X	161	89	75	63	106	494	125	126	78	64	123	516	166	91	115	66	131	569
Chemical Engineering Practice X-A, X-B	—	—	—	10	18	28	—	—	—	12	25	37	—	—	—	9	20	29
Chemistry V	37	17	21	23	168	266	23	23	15	21	155	237	41	18	20	13	158	250
City Planning IV-B	—	—	1	1	24	26	—	—	—	2	22	24	—	—	—	—	18	18
Civil Engineering I	69	41	45	55	63	273	59	51	46	47	67	270	44	44	53	48	63	252
Army Engineer (in Civil Eng. Department)	—	—	—	—	6	6	—	—	—	—	7	7	—	—	—	—	10	10
Economics and Engineering XIV	2	8	9	10	54	83	4	10	6	13	44	77	1	6	14	7	49	77
Electrical Engineering VI	178	150	75	86	349	838	183	169	105	79	347	883	237	199	106	106	322	970
Electrical Engineering (Coöperative) VI-A	—	—	46	51	42	139	—	—	41	53	34	128	—	—	62	45	47	154
Food Technology																		
Food Technology XX, XX-A	5	4	4	4	26	43	3	7	2	4	30	46	6	9	4	2	37	58
Biochemical Engineering XX-B	—	—	2	1	—	3	—	—	2	—	—	2	—	—	4	2	1	7
General Engineering IX-B	5	6	16	22	—	49	3	8	13	29	—	53	13	4	15	20	—	52
General Science IX-A	4	3	4	10	—	21	3	2	3	4	—	12	3	—	6	7	—	16
Geology XII-A	2	9	8	7	} 35	82	4	7	10	8	25	54	6	6	8	11	26	57
Geophysics XII-B	1	7	3	10			—	15	6	3	24	48	3	13	12	4	18	50
Marine Transportation XIII-C	—	—	—	2	—	2	—	—	—	—	—	—	—	—	—	—	—	—
Mathematics XVIII	23	13	9	18	85	148	22	22	12	15	77	148	21	16	24	17	71	149
Mechanical Engineering II	137	103	74	75	161	550	119	144	80	82	150	575	152	117	111	84	133	597
Mechanical Engineering (Coöperative) II-B	—	—	18	25	—	43	—	—	10	17	—	27	—	—	20	11	—	31
Metallurgy III	17	28	28	30	102	205	17	24	29	32	112	214	14	22	29	25	124	214
Ceramics (in Metallurgy Department)	—	—	—	—	15	15	—	—	—	—	14	14	—	—	—	—	12	12
Meteorology XIX	1	3	6	9	74	93	1	1	1	8	60	71	3	1	1	1	43	49
Naval Architecture and Marine Eng. XIII	19	18	15	9	7	68	10	20	16	17	13	76	11	6	21	12	12	62
Naval Construction and Engineering XIII-A	—	—	—	—	80	80	—	—	—	—	89	89	—	—	—	—	83	83
Physics VIII	105	69	60	60	211	505	117	70	61	53	184	485	126	93	55	48	173	495
Sanitary Engineering XI	—	—	—	—	20	20	—	—	—	—	23	23	—	—	—	—	23	23
Science Teaching IX-C	2	1	2	2	—	7	1	3	1	—	2	7	1	1	6	1	—	9
Shipping and Shipbuilding Management XIII-B	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	2
Total	937	708	717	791*	1,921	5,074	833	919	704	771*	1,956	5,183	995	819	908	759*	1,867	5,348

* These totals include fifth year in Architecture IV-A.
† 1954–55 Discontinued.

TABLE 4-A. Classification of Students by Courses, Options and Years

COURSE No.	Name	Option	Opt.	YEAR 1 Opt.	1 Tot.	2 Opt.	2 Tot.	3 Opt.	3 Tot.	4 Opt.	4 Tot.	G Opt.	G Tot.	Total	Course Number
I	Civil Engineering	1. Theory and Design	1	—		—		30		20		63			
		2. Planning and Administration	2	—		—		4		5					
		3. Construction and Management	3	—	44	—	44	19	53	23	48		73	262	I
	Army Engineer			—		—		—		—		10			
II	Mechanical Engineering			—		—		—		—		121			
	Textile Technology			—	152	—	117	—	111	—	84	12	133	597	II
II-B	Mechanical Engineering (Cooperative)	a. At Plant	a	—		—		9		—		—			
		b. At M. I. T.	b	—	—	—	—	11	20	—	11	—	—	31	II-B
III	Metallurgy	1. Metallurgy	1	—		—		29		23		111			
		2. Mineral Engineering	2	—	14	—	22	—	29	2	25	13	136	226	III
	Ceramics			—		—		—		—		12			
IV-A	Architecture			—		—		—		30		—			
	Fifth Year			—	18	—	25	—	40	34	64	—	31	178	IV-A
IV-B	City Planning			—	—	—	—	—	—	—	—	—	18	18	IV-B
V	Chemistry			—	41	—	18	—	20	—	13	—	158	250	V
VI	Electrical Engineering			—	237	—	199	—	106	—	106	—	322	970	VI
VI-A	Electrical Engineering (Cooperative)			—	—	—	—	—	62	—	45	—	47	154	VI-A
VII	Quantitative Biology			—	16	—	14	—	19	—	10	—	39	98	VII
VIII	Physics			—	126	—	93	—	55	—	48	—	173	495	VIII
IX-A	General Science			—	3	—	—	—	6	—	7	—	—	16	IX-A
IX-B	General Engineering			—	13	—	4	—	15	—	20	—	—	52	IX-B
IX-C	Science Teaching			—	6	—	1	—	6	—	1	—	—	9	IX-C
X	Chemical Engineering			—	166	—	91	—	115	—	66	—	131	569	X
X-A	Chemical Engineering Practice — Graduate			—	—	—	—	—	—	—	—	—	20	20	X-A
X-B	Chemical Engineering Practice — Undergraduate			—	—	—	—	—	—	—	9	—	—	9	X-B
XI	Sanitary Engineering			—	—	—	—	—	—	—	—	—	23	23	XI
XII-A	Geology			—	6	—	6	—	8	—	11	—	26	57	XII-A
XII-B	Geophysics			—	3	—	13	—	12	—	4	—	18	50	XII-B
XIII	Naval Architecture and Marine Engineering			—	11	—	6	—	21	—	12	—	12	62	XIII
*XIII-A	Naval Construction and Engineering			—	—	—	—	—	—	—	—	—	83	83	*XIII-A
XIII-B	Shipping and Shipbuilding Management			—	—	—	—	—	—	—	2	—	—	— 2	XIII-B
XIV	Economics and Engineering	A. Mechanical Engineering	A	1		3		8		4		—			
		B. Electrical Engineering	B	—	1	3	6	3	14	1	7	—	49	77	XIV
		C. Chemical Engineering	C	—		—		3		2		—			
XV	Business and Engineering (Administration)	A. Physical Sciences	A	32		67		73		73		—			
		B. Chemical Sciences	B	8	40	21	88	20	93	19	92	—	84	397	XV
XVI	Aeronautical Engineering			—	66	—	40	—	36	—	34	—	115	291	XVI
XVI-B	Aeronautical Engineering (Cooperative)	a. At Plant	a	—		—		—		—		—			
		b. At M. I. T.	b	—	—	—	—	—	14	—	7	—	—	21	XVI-B
XVII	Building Engineering and Construction			—	7	—	6	—	20	—	11	—	24	68	XVII
XVIII	Mathematics			—	21	—	16	—	24	—	17	—	71	149	XVIII
XIX	Meteorology			—	3	—	1	—	1	—	1	—	43	49	XIX
XX	Food Technology			—	6	—	9	—	4	—	—	—	36	55	XX
XX-A	Food Technology			—	—	—	—	—	—	—	2	—	1	3	XX-A
XX-B	Biochemical Engineering			—	—	—	—	—	4	—	2	—	1	7	XX-B
	Total				995		819		908		**759		1867	5348	Total

* First Graduate Year, 24. Second Graduate Year, 33. Third Graduate Year, 26.

** 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	—	—	—	—	8	8	I
II	Mechanical Engineering	—	1	—	—	16	17	II
III	Metallurgy	—	—	3	—	16	19	III
IV-A	Architecture	—	—	—	5	5	10	IV-A
	Fifth Year	—	—	—	1	—	1	
V	Chemistry	—	—	1	—	5	6	V
VI	Electrical Engineering	—	—	2	5	95	102	VI
VII	Quantitative Biology	—	—	—	—	4	4	VII
VIII	Physics	1	—	—	—	18	19	VIII
IX-A	General Science	—	—	1	—	—	1	IX-A
X	Chemical Engineering	—	—	—	1	12	13	X
XI	Sanitary Engineering	—	—	—	—	1	1	XI
XII-A	Geology	1	—	—	—	1	2	XII-A
XIII	Naval Architecture and Marine Engineering	—	—	1	—	5	6	XIII
XIV	Economics and Engineering	—	—	1	1	6	8	XIV
XV	Business and Engineering Administration	—	—	1	2	14	17	XV
XVI	Aeronautical Engineering	—	—	—	—	39	39	XVI
XVII	Building Engineering and Construction	—	—	—	1	4	5	XVII
XVIII	Mathematics	—	—	—	—	22	22	XVIII
XIX	Meteorology	1	—	—	—	20	21	XIX
XX	Food Technology	—	—	—	—	13	13	XX
Total		3	1	10	16	304	334	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	—	3	3	2	10	I
II	Mechanical Engineering	—	4	3	4	5	16	II
III	Metallurgy	—	—	—	—	6	6	III
IV-A	Architecture	1	1	—	—	—	2	IV-A
	Fifth Year	—	—	—	1	—	1	
IV-B	City Planning	—	—	—	—	1	1	IV-B
V	Chemistry	—	2	—	1	—	3	V
VI	Electrical Engineering	1	5	6	4	13	29	VI
VII	Quantitative Biology	—	—	1	—	2	3	VII
VIII	Physics	—	—	—	—	6	6	VIII
IX-A	General Science	—	—	—	1	—	1	IX-A
IX-B	General Engineering	—	—	1	1	—	2	IX-B
X	Chemical Engineering	—	1	3	3	10	17	X
XI	Sanitary Engineering	—	—	—	—	1	1	XI
XII-A	Geology	—	1	1	—	—	2	XII-A
XIII	Naval Architecture and Marine Engineering	—	—	1	—	—	1	XIII
XIII-A	Naval Construction and Engineering	—	—	—	—	1	1	XIII-A
XIV	Economics and Engineering	—	1	2	2	1	6	XIV
XV	Business and Engineering Administration	—	—	6	4	1	11	XV
XVI	Aeronautical Engineering	1	1	—	1	6	9	XVI
XVII	Building Engineering and Construction	1	—	2	—	4	7	XVII
XVIII	Mathematics	—	1	3	2	—	6	XVIII
XIX	Meteorology	—	—	—	—	5	5	XIX
XX	Food Technology	—	—	—	—	1	1	XX
Total		6	17	32	27	65	147	Total

* Excludes 71 special students.

TABLE 5. CLASSIFICATION OF STUDENTS BY COURSES SINCE 1947

	1947–48	1948-49	1949–50	1950–51	1951-22	1952–53	1953–54	1954–55
School of Engineering . . . . . *Total*	4,398	4,094	4,055	3,287	3,094	3,269	3,370	3,489
Aeronautical Engineering XVI, XVI-B	346	304	274	276	246	290	318	312
Building Engineering and Construction XVII . . .	98	111	124	116	94	76	69	68
¶Business and Engineering Administration XV . . .	556	449	415	—	—	—	—	—
Chemical Engineering X, X-A, X-B	693	611	596	541	482	522	553	598
Civil Engineering I	220	258	277	277	273	279	277	262
¶Economics and Engineering XIV	69	87	81	—	—	—	—	—
Electrical Engineering VI, VI-A	1,215	1,051	996	900	908	977	1,011	1,124
General Engineering IX-B	51	57	62	44	40	49	53	52
Mechanical Engineering II, II-B	749	691	711	617	526	593	602	628
Metallurgy III	155	203	243	231	218	220	228	226
Meteorology XIX	46	66	65	71	115	93	71	49
***Naval Arch. and Marine Eng. XIII, XIII-B, XIII-C	85	92	92	101	85	70	76	64
Naval Construction and Engineering XIII-A	101	98	98	91	86	80	89	83
Sanitary Engineering XI	14	16	21	22	21	20	23	23
School of Science . . . . . *Total*	1,037	1,090	1,151	1,176	1,159	1,164	1,136	1,189
*Biology VII, VII-A, VII-B	85	77	85	89	92	89	97	98
Chemistry V	292	280	281	272	258	266	237	250
Food Technology, XX, XX-A, XX-B	41	59	46	49	43	46	48	65
General Science IX-A	6	7	10	15	20	21	12	16
**Geology and Geophysics XII-A, XII-B	38	61	86	99	82	82	102	107
Mathematics XVIII	116	137	165	140	147	148	148	149
Physics VIII	459	469	478	512	514	505	485	495
Science Teaching IX-C	—	—	—	—	3	7	7	9
School of Architecture and Planning . . . . . *Total*	179	204	202	224	205	219	196	196
Architecture IV-A	144	169	169	194	179	193	172	178
City Planning IV-B	35	35	33	30	26	26	24	18
¶*School of Humanities and Social Studies* . . . . *Total*	—	—	—	484	92	83	77	77
Business and Engineering Administration XV . . .	—	—	—	371	—	—	—	—
Economics and Engineering XIV	—	—	—	113	92	83	77	77
¶*School of Industrial Management* . . . . . *Total*	—	—	—	—	324	339	404	397
Business and Engineering Administration XV . . .	—	—	—	—	324	339	404	397
†Economics and Eng. or Natural Science, Industrial Economics, and Group Psychology . . . . . *Total*	48	45	50	—	—	—	—	—
Grand Total	5,662	5,433	5,458	5,171	4,874	5,074	5,183	5,348

* VII-A and VII-B discontinued June 1954.
† After June 1950 included in Economics and Engineering XIV.
¶ June 1950, School of Humanities and Social Studies started. Business and Engineering Administration and Economics and Engineering changed from School of Engineering to New School. 1951–52 Business and Engineering Administration changed to School of Industrial Management.
** June 1952, Geology changed to Geology Course XII-A and Geophysics Course XII-B
*** XIII-C discontinued June 1953. XIII-B started September 1954.

TABLE 6

Geographical Classification of Students since 1950

United States	1950	1951	1952	1953	1954
North Atlantic . . . . . Total	3,297	3,139	3,276	3,274	3,313
Connecticut	174	151	150	161	162
Maine	41	40	44	41	43
Massachusetts	1,523	1,542	1,547	1,466	1,447
New Hampshire	45	47	42	39	46
New Jersey	286	270	282	291	331
New York	901	824	939	990	987
Pennsylvania	258	205	199	209	238
Rhode Island	49	38	49	51	43
Vermont	20	22	24	26	16
South Atlantic . . . . . Total	319	262	269	288	318
Delaware	13	11	12	17	16
District of Columbia	44	38	40	45	39
Florida	69	52	62	60	72
Georgia	12	17	17	20	26
Maryland	61	45	43	47	53
North Carolina	20	16	14	23	20
South Carolina	8	8	9	5	12
Virginia	67	55	56	61	66
West Virginia	25	20	16	10	14
South Central . . . . . Total	175	161	148	166	178
Alabama	20	23	15	18	13
Arkansas	11	10	8	5	7
Kentucky	25	23	24	21	22
Louisiana	18	16	14	25	17
Mississippi	12	12	11	7	12
Tennessee	25	25	17	24	28
Texas	64	52	59	66	79
North Central . . . . . Total	633	597	626	665	674
Illinois	151	139	169	175	196
Indiana	41	36	28	30	29
Iowa	11	14	15	18	20
Kansas	17	14	19	23	22
Michigan	94	96	92	95	103
Minnesota	38	35	38	39	42
Missouri	48	47	45	51	53
Nebraska	20	16	18	23	15
North Dakota	2	5	4	4	8
Ohio	158	145	148	154	140
South Dakota	4	5	3	5	6
Wisconsin	49	45	47	48	40
Western . . . . . Total	284	259	272	266	287
Arizona	11	12	14	13	9
California	102	96	109	105	121
Colorado	16	20	18	23	22
Idaho	8	7	6	5	8
Montana	7	9	10	10	11
Nevada	3	2	2	2	3
New Mexico	8	5	9	14	13
Oklahoma	32	28	20	20	23
Oregon	20	20	21	19	15
Utah	14	9	8	9	10
Washington	52	44	49	40	47
Wyoming	11	7	6	6	5
Territories and Dependencies . . . . Total	28	26	19	25	27
Alaska	5	6	2	3	1
Canal Zone	5	4	2	2	2
Hawaii	12	14	12	14	16
Puerto Rico	6	2	3	6	8
Total for United States	4,736	4,444	4,610	4,684	4,797

Continued

TABLE 6 — (*Continued*)

GEOGRAPHICAL CLASSIFICATION OF STUDENTS SINCE 1950

FOREIGN COUNTRIES	1950	1951	1952	1953	1954
Total	435	430	464	499	551
Afghanistan	—	—	—	1	—
Arabia	—	—	—	—	1
Argentina	8	10	12	15	17
Australia	6	8	8	6	2
Austria	2	3	1	1	—
Azores	—	1	—	—	—
Bahamas	1	—	—	—	1
Belgian Congo	—	—	—	—	1
Belgium	5	1	4	7	3
Bolivia	2	2	1	1	1
Brazil	12	15	10	18	19
British North Borneo	—	—	—	1	1
British West Indies	5	3	2	5	5
Burma	—	1	3	5	15
Canada	80	73	74	74	78
Canary Islands	1	—	—	—	—
Chile	—	1	2	1	3
China	18	17	16	15	6
Colombia	14	12	13	16	17
Costa Rica	—	1	1	1	—
Cuba	18	17	17	12	17
Cyprus	—	—	—	1	1
Czechoslovakia	1	—	—	—	—
Denmark	1	1	1	—	1
Dominican Republic	—	—	1	2	2
Ecuador	—	2	2	2	2
Egypt	4	5	5	3	5
England	9	14	16	21	19
Ethiopia	—	1	1	1	1
Finland	4	2	3	3	5
Formosa	—	—	—	1	2
France	12	12	13	18	19
French Indochina	—	1	—	—	—
Germany	—	1	2	6	6
Greece	12	12	17	22	21
Guatemala	4	4	2	1	5
Haiti	—	—	1	1	1
Honduras	—	—	—	—	2
Hong Kong	11	14	10	1	6
Hungary	1	—	—	—	—
Iceland	3	1	2	2	—
India	34	30	37	43	44
Indonesia	3	—	—	—	2
Iran	1	2	2	2	4
Iraq	6	4	2	2	4
Ireland	1	—	1	—	1
Israel	14	19	23	21	12
Italy	7	3	1	5	7
Jamaica	—	1	—	—	—
Japan	1	6	9	10	16
Kenya	1	1	1	—	—
Korea	2	1	—	1	6
Lebanon	1	1	3	2	—
Liberia	—	—	—	—	1
Luxembourg	—	—	—	1	2
Malaya	2	1	1	1	2
Mauritius	—	—	1	1	1
Mexico	15	12	18	21	26
Morocco	—	1	—	—	1
Mozambique	2	1	1	1	1

Continued

TABLE 6 — (*Continued*)

Geographical Classification of Students since 1950

Foreign Countries	1950	1951	1952	1953	1954
Netherlands	3	3	2	1	4
Netherlands West Indies	2	2	3	1	1
New Zealand	3	2	3	2	—
Nicaragua	3	2	3	1	1
Nigeria	1	1	1	3	2
Norway	25	22	13	16	16
Pakistan	3	2	4	4	2
Panama	—	1	2	2	2
Peru	5	7	8	8	4
Philippines	10	14	16	13	16
Poland	1	—	1	—	—
Portugal	4	3	2	—	—
Salvador	—	2	1	3	3
Scotland	3	4	5	2	2
Singapore	3	2	1	1	—
Spain	1	1	3	3	2
Sweden	6	10	9	5	9
Switzerland	2	3	1	3	5
Syria	—	1	2	2	4
Tanganyika	1	1	—	—	—
Thailand	4	3	5	5	5
Timor	—	—	—	—	1
Transjordan	—	—	1	—	2
Turkey	2	2	5	4	4
Union of South Africa	7	5	2	5	7
Uruguay	7	8	5	4	4
Venezuela	15	11	25	35	35
Vietnam	—	—	—	1	1
Wales	—	—	—	—	4
Yugoslavia	—	—	1	—	—
Grand Total, United States and Foreign	5,171	4,874	5,074	5,183	5,348

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	20	5	—	5	30
Second Year	40	24	6	10	80
Third Year	3	8	30	28	69
Fourth Year	—	—	3	4	7
Graduate Year	—	5	22	426	453
Total	63	42	61	473	639

TABLE 8. Women Students Classified by Courses and Years

Course	YEAR					Total
	1	2	3	4	G	
I Civil Engineering	—	—	1	—	—	1
II Mechanical Engineering	1	—	—	—	—	1
Textile Technology	—	—	—	—	1	1
III Metallurgy	1	—	—	—	3	4
IV-A Architecture	—	3	3	4	1	11
Fifth Year	—	—	—	1	—	1
V Chemistry	1	3	2	2	7	15
VI Electrical Engineering	—	3	—	3	1	7
VII Quantitative Biology	1	—	3	3	4	11
VIII Physics	3	2	2	3	4	14
IX-A General Science	—	—	1	1	—	2
IX-B General Engineering	—	—	1	—	—	1
X Chemical Engineering	3	1	—	1	3	8
XII-A Geology	2	—	—	—	1	3
XIV Economics and Engineering	—	—	1	—	3	4
XV Business and Engineering Administration	—	—	—	2	—	2
XVI Aeronautical Engineering	—	1	—	—	2	3
XVIII Mathematics	2	2	4	1	1	10
XIX Meteorology	—	—	—	—	5	5
XX Food Technology	1	—	1	—	2	4
Total	15	15	19	21	38	108

TABLE 9. Old and New Students

Year	1949–50	1950–51	1951–52	1952–53	1953–54	1954–55
Students registered at end of last academic year (including specials)	3,639	3,461	3,251	3,130	3,361	3,395
Students who have previously attended the Institute but were not registered at end of last academic year (including specials)	189	186	204	214	212	218
New students who entered by examination	433	510	443	605	803	955
New students who entered without examination	241	206	238	304	—	—
New students who entered from other colleges as candidates for degrees	877	732	575	631	677	639
New students (specials, not candidates for degrees)	79	76	163	190	130	141
Total	5,458	5,171	4,874	5,074	5,183	5,348

TABLE 10. List of American Colleges and Universities with Number of Graduates Attending the Institute

College		College		College	
Akron University	2	Fisk University	2	Mississippi, University of	1
Alabama Polytechnic Inst.	3	Fordham University	1	Missouri School of Mines and Metallurgy	3
Alabama, University of	2	Franklin and Marshall Coll.	1	Missouri, University of	2
Alfred University	4	Furman University	1	Monmouth College	1
Allegheny College	2			Montana School of Mines	1
Amherst College	15	General Motors Institute	4	Montana State University	2
Amos Tuck School of Business Administration & Finance	1	Georgetown University	2	Mount Holyoke College	1
Antioch College	6	George Washington Univ.	2		
Arkansas, University of	1	Georgia Institute of Tech.	17	Nebraska, University of	2
		Gettysburg College	4	Nevada, University of	2
Barnard College	1	Goddard College	1	Newark Coll. of Engineering	6
Bethany College	2	Grove City College	1	New Hampshire, Univ. of	8
Boston College	16			New Mexico College of Agric. and Mech. Arts	1
Boston University	12	Hamilton College	1	New York State Maritime College	1
Bowdoin College	5	Hamline University	1	New York University	15
Brandeis University	3	Harvard College	49	Niagara University	1
Brigham Young University	2	Haverford College	1	North Carolina State Coll.	6
Brooklyn College	4	Holy Cross, College of	4	North Carolina, Univ. of	1
Brown University	17	Holy Cross Seminary	1	North Dakota Agric. Coll.	3
Bucknell University	4	Hope College	2	Northeastern University	30
Buffalo, University of	2			North Texas State College	1
		Idaho, University of	1	Northwestern University	7
California Inst. of Tech.	12	Illinois Inst. of Technology	8	Norwich University	2
California, University of	26	Illinois, University of	31	Notre Dame, University of	10
Carleton College	1	Indiana University	3		
Carnegie Institute of Tech.	10	Iowa State College	7	Oberlin College	8
Carson-Newman College	1	Iowa Wesleyan College	1	Occidental College	1
Case Inst. of Technology	5			Ohio State University	5
Catholic University of America	3	Jackson College	1	Ohio University	1
Central Michigan College of Education	1	Johns Hopkins University	9	Ohio Wesleyan University	2
Centre College of Kentucky	1	Juniata College	2	Oklahoma Agric. and Mech. College	2
Chicago, University of	13			Oklahoma, University of	7
Cincinnati, University of	9	Kansas State College of Agric. and Applied Science	3	Oregon State College	2
Citadel, The	3	Kansas, University of	3		
City College, The (N.Y.)	24	Kent State University	1	Pacific Union College	1
Clarkson College of Tech.	3	Kentucky, University of	2	Pembroke College	1
Clemson College	2			Pennsylvania State College	10
Colby College	2	Lafayette College	1	Pennsylvania, University of	14
Colgate University	1	Lawrence Institute of Tech.	1	Pittsburgh, University of	3
College of Puget Sound	1	Lebanon Valley College	1	Polytechnic Institute of Brooklyn	9
College of Wooster	7	Lehigh University	16	Pomona College	3
Colorado Agriculture and Mechanical College	2	Lincoln University	1	Pratt Institute	2
Colorado School of Mines	1	Louisiana State University and Agric. and Mech. Coll.	7	Princeton University	18
Colorado State College of Education	1	Louisville, University of	2	Principia College	2
Colorado, University of	5	Lowell Technological Inst.	4	Purdue University	18
Columbia College	3	Lowell Textile Institute	2		
Columbia University (N.Y.)	17	Loyola University (Ill.)	2	Queen's College (N.Y.)	1
Concordia College	1				
Connecticut, University of	3	Macalester College	1	Radcliffe College	3
Cooper Union, The	5	Maine, University of	10	Reed College	2
Cornell University	25	Manhattan College	1	Regis College	2
		Marquette University	5	Rensselaer Polytechnic Inst.	41
Dartmouth College	8	Maryland, University of	2	Rhode Island School of Design	1
Davidson College	1	Massachusetts Institute of Technology	607	Rhode Island, University of	1
Davis and Elkins College	1	Massachusetts Maritime Academy	1	Rice Institute	5
Delaware, University of	4	Massachusetts School of Art	1	Ripon College	4
Denver, University of	4	Massachusetts, University of	11	Rochester, University of	6
DePauw University	2	Mercer University	1	Rose Polytechnic Institute	2
Detroit, University of	1	Merrimack College	2	Rutgers University	11
Drew University	2	Miami University (Ohio)	4		
Drexel Institute of Tech.	6	Michigan College of Mining and Technology	5	Sacramento State College	1
Duke University	7	Michigan State College	9	St. Bonaventure University	1
Duquesne University	3	Michigan, University of	25	St. John's College (N.Y.)	1
		Middlebury College	5	St. John's Univ. (Minn.)	1
Eastern Nazarene College	1	Minnesota, University of	15	St. Lawrence University	3
Emmanuel College	4	Mississippi State College	2		
Evansville College	2				

Continued

TABLE 10. LIST OF AMERICAN COLLEGES AND UNIVERSITIES WITH NUMBER OF GRADUATES ATTENDING THE INSTITUTE (*Continued*)

College		*College*		*College*	
St. Louis University	2	Tri-State College	3	Washington, University of	10
St. Mary's University	1	Tufts College	17	Washington University	7
St. Olaf College	1	Tulane University of Louisiana	5	Wayne University	6
San Diego State College	2	Union College (N.Y.)	8	Webb Inst. of Naval Arch.	4
Seminary College of Jewish Study of Jewish Theology	1	Ursinus College	1	Wellesley College	2
Smith College	4	U.S. Coast Guard Academy	27	Wesleyan University	2
South Carolina, Univ. of	2	U.S. Merchant Marine Academy	3	Western Reserve University	1
South Dakota School of Mines and Technology	1	U.S. Military Academy	24	West Virginia, University of	2
Southern California, Univ. of	2	U.S. Naval Academy	75	Wheaton College	1
Southern Methodist Univ.	1	U.S. Naval Postgraduate School	14	Wichita, Municipal Univ. of	2
Southwestern Louisiana Inst.	1	Utah, University of	7	Willamette University	2
Stanford University	11	Utica College of Syracuse	1	Williams College	15
State Inst. of Architecture	1	Valparaiso University	1	Wisconsin, University of	14
State University of Iowa	1	Vanderbilt University	3	Worcester Polytechnic Inst.	6
Stevens Inst. of Technology	2	Vassar College	2	Wyoming, University of	1
Swarthmore College	7	Vermont, University of	1	Yale University	21
Syracuse University	5	Villanova College	2	Yeshiva College	1
Temple University	4	Virginia Military Institute	2	Total	1941
Tennessee Polytechnic Inst.	1	Virginia Polytechnic Inst.	7		
Tennessee, University of	3	Virginia, University of	3	Number of American Colleges Represented	246
Texas Agric. and Mech. Coll.	4	Washington and Jefferson College	1	Number of Foreign Colleges Represented (not listed)	163
Texas Christian University	1	Washington, State College of	4	Total	409
Texas Technological College	6				
Texas, University of	12				
Texas Western College	1				
Trinity College	5				

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. 1954		Previous Years					
	Sept. 1954	Previous Years	Total	Undergrad.	Grad.	Undergrad.	Grad.	Total	S.B. Degree 1954	Other Graduates	Total
Aeronautical Engineering XVI	7	17	24	2	23	—	27	52	11	15	26
Architecture IV-A	13	17	30	4	17	12	9	42	—	—	—
Biology VII	—	2	2	—	6	—	22	28	2	5	7
Building Engineering and Construction XVII	4	6	10	3	7	1	9	20	1	3	4
Business and Engineering Administration XV	5	23	28	1	49	2	17	69	—	4	4
Chemical Engineering X, X-A, X-B	15	13	28	—	38	2	61	101	15	25	40
Chemistry V	1	1	2	—	42	—	101	143	1	9	10
City Planning IV-B	—	—	—	—	9	—	8	17	—	1	1
Civil Engineering I	8	20	28	5	29	3	18	55	8	10	18
Economics and Engineering XIV	—	1	1	1	16	1	22	40	1	4	5
Electrical Engineering VI, VI-A	49	51	100	8	55	11	121	195	60	38	98
Food Technology XX, XX-A, XX-B	—	1	1	—	4	—	11	15	3	7	10
General Engineering IX-B	1	4	5	1	—	2	—	3	—	—	—
General Science IX-A	—	2	2	—	—	—	—	—	—	—	—
Geology XII-A	—	1	1	1	13	—	8	22	3	1	4
Geophysics XII-B	2	3	5	—	3	—	6	9	1	8	9
Mathematics XVIII	3	4	7	—	12	—	25	37	—	12	12
Mechanical Engineering II	25	40	65	6	40	7	34	87	19	24	43
Metallurgy III	3	3	6	2	23	2	55	82	7	35	42
Meteorology XIX	—	—	—	—	6	—	11	17	1	5	6
Naval Architecture and Marine Eng. XIII	2	10	12	2	4	2	1	9	1	1	2
Naval Construction and Engineering XIII-A	—	—	—	—	23	—	60	83	—	—	—
Physics VIII	10	16	26	2	23	2	82	109	9	41	50
Sanitary Engineering XI	—	—	—	—	11	—	11	22	—	—	—
Science Teaching IX-C	—	1	1	—	—	—	—	—	—	—	—
Total	148	236	384	38	453	47	719	1,257	143	248	391

TABLE 12. NUMBER OF DEGREES AWARDED IN SEPTEMBER 1954, FEBRUARY 1955, AND JUNE 1955

Name of Course	S.B.			B.Arch.and B.C.P.			S.M.			M.Arch. and M.C.P.			Adv.Eng.			Ph.D.			Sc.D.			Total		
	Sept.	Feb.	June	Sept.	Feb.	June	Sept.	Feb.	June	Sept.	Feb.	June	Sept.	Feb.	June	Sept.	Feb.	June	Sept.	Feb.	June	Sept.	Feb.	June
Aeronautical Engineering	2	1	29	—	—	—	4	4	23	—	—	—	1	—	3	—	—	—	—	—	3	7	5	58
Architecture	—	—	—	4	1	26	—	—	—	7	6	2	—	—	—	—	—	—	—	—	—	11	7	28
Biochemical Engineering	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	—	—	3
Biology	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	1	5	—	—	—	2	1	5
Building Eng. and Constr.	1	—	7	—	—	—	1	2	4	—	—	—	—	—	1	—	—	—	—	—	—	2	2	12
Business and Eng. Admin.	8	7	69	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	8	7	69
Ceramics	—	—	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	1	2	3
Chemical Biology	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	2	2	—	—	—
Chemical Engineering	3	3	57	—	—	—	10	11	9	—	—	—	1	—	2	—	—	—	4	4	3	18	18	71
Chemical Engineering Practice	—	—	8	—	—	—	2	—	15	—	—	—	—	—	—	—	—	—	—	—	—	2	—	23
Chemistry	2	1	11	—	—	—	2	—	1	—	—	—	—	—	—	11	7	11	—	—	—	15	8	23
City Planning	—	—	—	—	—	—	—	—	—	3	—	4	—	—	—	—	—	—	1	2	1	3	—	4
Civil Engineering	6	2	39	—	—	—	11	4	25	—	—	—	1	—	—	—	—	—	—	—	—	19	8	65
Economics and Engineering	1	3	6	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	1	3	6
Electrical Engineering	18	17	116	—	—	—	36	25	55	—	—	—	2	1	4	—	—	—	3	1	10	59	44	185
Food Technology	—	—	1	—	—	—	—	1	3	—	—	—	—	—	—	—	—	1	—	1	—	—	2	5
General Engineering	5	3	13	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	5	3	13
General Science	—	—	4	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	4
Geology	—	—	10	—	—	—	—	—	1	—	—	—	—	—	—	3	—	4	1	—	—	4	—	4
Geology and Geophysics	—	—	—	—	—	—	2	—	1	—	—	—	—	—	—	—	—	—	—	—	—	2	—	4
Geophysics	—	—	3	—	—	—	—	2	—	—	—	—	—	—	—	1	2	2	—	—	—	1	4	2
Industrial Economics	—	—	—	—	—	—	5	2	42	—	—	—	—	—	—	—	—	—	—	—	—	5	2	42
Industrial Management	—	—	—	—	—	—	5	2	1	—	—	—	—	—	—	5	—	5	—	—	—	10	2	17
Mathematics	—	—	11	—	—	—	21	7	20	—	—	—	2	3	—	—	—	—	—	4	6	36	22	101
Mechanical Engineering	13	8	75	—	—	—	11	4	11	—	—	—	—	—	—	—	—	—	3	3	9	17	7	42
Metallurgy	3	—	22	—	—	—	4	4	2	—	—	—	—	—	—	—	—	—	—	1	2	4	5	5
Meteorology	—	—	1	—	—	—	3	—	6	—	—	—	1	1	25	—	—	—	—	—	—	4	1	42
Naval Arch. and Marine Eng.	—	—	11	—	—	—	4	1	8	—	—	—	—	—	—	—	—	—	—	—	—	4	1	8
Nuclear Engineering	—	—	—	—	—	—	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—	2	—	—
Physical Biology	1	—	—	—	—	—	3	—	8	—	—	—	—	—	—	15	16	12	—	—	—	19	17	60
Physics	1	1	40	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	8
Quantitative Biology	—	—	8	—	—	—	2	—	10	—	—	—	1	—	—	—	—	—	—	—	—	3	—	10
Sanitary Engineering	—	—	—	—	—	—	2	1	4	—	—	—	—	—	—	—	—	—	—	—	—	2	1	4
Textile Technology	—	—	—	—	—	—	10	3	31	—	—	—	—	—	—	—	—	—	—	—	—	10	3	31
Without Course Classification	—	—	—	—	—	—																		
Total	64	46	543	4	1	26	139	74	280	10	6	6	9	5	35	37	26	40	13	18	37	276	176	967

* Includes 1 in Psychology.

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 and Engineering	Electrical Eng. (Inc. VI-A)	Electrochemical Engineering*	Food Technology	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	—	—	—	—	—	—	—	—	—	6	—	—	—	—	—	1	—	—	1	—	—	—	6	—	—	—	14	
1869	—	—	—	—	—	—	—	—	1	2	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	5	
1870	—	—	—	—	—	—	—	—	1	4	—	—	—	—	—	1	—	—	2	—	—	—	2	—	—	—	10	29
1871	—	—	—	—	—	—	—	—	2	8	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	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

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 and Engineering	Electrical Eng. (Inc. VI-A)	Electrochemical Engineering*	Food Technology	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	—	—	—	—	—	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	1	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 17)

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 and Engineering	Electrical Eng. (Inc. VI-A)	Electrochemical Engineering	Food Technology & Biochemical Eng.	General Eng.	General Science or General Course	Geol. & Geophysics	Mathematics	Mechanical Eng. (Inc. II-A)	Metallurgy**	Meteorology	Military Eng.	Mining Eng. and Metallurgy	Naval Arch. and Marine Eng.	Physics	Sanitary Eng.	Total	Total by Decades
1931	39	10	18	16	15	68	32	10	12	49	—	83	6	—	22	5	3	4	70	—	—	—	12	13	7	2	496	
1932	27	16	5	15	18	70	45	7	15	38	—	74	4	—	29	3	2	3	68	—	—	4	21	16	21	4	505	
1933	27	9	—	13	9	56	38	3	18	47	—	86	8	—	16	3	2	7	86	—	—	—	14	13	14	2	471	
1934	26	10	—	16	13	78	48	6	15	35	—	82	7	—	8	9	1	8	50	—	—	—	26	25	28	5	496	
1935	27	8	—	18	8	74	43	5	15	18	—	57	8	—	19	4	1	3	45	—	—	—	14	14	19	1	401	
1936	27	3	—	13	12	63	31	20	16	23	—	68	5	—	25	6	2	8	47	—	—	—	10	18	11	2	410	
1937	30	3	—	9	4	61	34	9	13	15	—	67	5	—	20	4	—	4	46	—	—	—	19	19	17	1	380	
1938	25	3	—	11	4	56	51	6	14	22	—	62	4	—	28	6	1	2	50	10	—	—	5	23	14	2	399	
1939	30	2	—	6	7	56	53	12	25	23	—	67	7	—	19	13	4	2	72	20	—	—	9	8	17	1	453	
1940	29	—	—	12	9	59	59	12	23	14	—	73	2	—	36	20	6	7	68	22	—	—	7	24	22	—	504	4,515
1941	36	—	—	6	7	59	54	8	28	22	—	79	—	—	23	5	8	6	90	29	—	—	—	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	30	—	—	8	7	76	60	8	12	41	9	133	—	3	16	4	13	11	83	22	1	—	—	11	41	—	589	
Total	1,054	172	865	430	344	3,025	2,665	355	1,169	2,804	131	4,806	301	65	785	305	185	213	4,722	404	85	5	880	837	870	264	27,741	

** Prior to 1938 included in Mining Engineering and Metallurgy
§ Includes only February 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	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	—	—	—	—	—	—	—	—	—	—	—	—	—	—	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	—	—	—	—	—	—	—	—	15
1920	—	—	—	—	—	—	—	—	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	—	—	—	—	2	5	20	2	2	—	60	—	3	—	6	1	—	—	12	—	—	—	25	142
1927	9	—	1	—	—	—	2	26	4	6	—	54	—	6	1	13	—	—	—	6	—	1	—	32	161
1928	9	—	—	—	—	—	5	14	2	8	—	63	—	—	2	13	—	—	—	9	—	1	—	43	169
1929	5	—	—	—	—	2	3	21	4	6	—	79	—	4	2	16	—	—	—	6	—	2	1	45	196
1930	3	—	—	—	1	—	7	22	5	9	—	51	—	1	2	5	3	—	1	5	—	1	1	53	170

Continued

TABLE 14 — (*Continued*)

Degrees of Master of Science Awarded

Class (Calendar Year)	Aeronautical Engineering	Architecture	Biol. & P. H. (Inc. VII-A,B)	Bldg. & Eng. Constr.	Bus. & Eng. Admin. & Ind. Man.	Ceramics	Chem. Eng. & Nuclear Eng.	Chem. Eng. Practice X-A	Chemistry	Civil Engineering	Economics and Engineering or Natural Science	Electrical Eng. (Inc. VI-A)	Food Technology	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	27	—	—	6	44	1	29	15	1	29	2	80	4	2	3	32	15	6	6	—	—	8	10	34	354
Total	624	84	79	49	371	8	709	871	198	602	36	2,032	28	77	121	925	243	203	118	478	5	175	119	866	9,021

Total of degrees in discontinued courses, Architectural Engineering, Electrochemical Engineering, Fuel and Gas Engineering, General Science, Mining Engineering, Naval Construction (Foreign Students), and Railroad Operation (see 1940–41 Report)	126
Grand Total	9,147

* Includes only February 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	27	—	8	4
Total	416	31	297	148

* Includes only February and June degrees.
†From 1915 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	1	—	2	5	1	3	—	—	—	25	—	40
Total .	17	3	3	7	43	1	50	9	2	2	208	5	350

* Includes only February and June degrees.

TABLE 18

Degrees of Doctor of Philosophy Awarded

Class (Calendar Year)	Biology	Chemistry	Electrical Engineering	Food Technology	Geology	Industrial Economics	Mathematics	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
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	6	18	—	1	4	4	5	28	—	66
Total	67	552	2	12	96	55	101	368	9	1,262

* Includes only February and June degrees.
† Includes one 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 Technology	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

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 Technology	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	7	—	3	11	—	2	—	—	10	12	3	—	—	—	—	—	55
Total	48	40	267	12	56	141	2	8	14	6	110	188	45	5	2	1	41	16	1,002

* Includes only February and June degrees.

TABLE 20

DEGREES OF DOCTOR OF PUBLIC HEALTH AWARDED
(Discontinued after 1944)

Class (Calendar Year)	Number
1924	1
1927	1
1928	1
1930	1
1939	1
1942	1
1944	3
Total	9

TABLE 21

DEGREES OF DOCTOR OF ENGINEERING AWARDED
(Discontinued after 1918)

Class (Calendar Year)	Electrical Engineering	Elecrtochemical Engineering	Total
1910	1	—	1
1914	1	—	1
1916	1	—	1
1917	—	1	1
Total	3	1	4

TABLE 22

SUMMARY OF DEGREES AWARDED (1868–1955)

Bachelor of Science	27,741
Bachelor in Architecture	416
Bachelor in City Planning	31
Master of Science	9,147
Master in Architecture	297
Master in City Planning	148
Master in Public Health (Discontinued after 1944)	104
Advanced Engineering	350
Doctor of Philosophy	1,262
Doctor of Science	1,002
Doctor of Public Health (Discontinued after 1944)	9
Doctor of Engineering (Discontinued after 1918)	4
Grand Total	40,511

JOSEPH C. MACKINNON

DIRECTOR OF THE REGISTRY OF GUESTS

The Registry of Guests, an adjunct to the office of the President, is a focus of cordiality in tendering hospitality to visitors and guests on behalf of the Faculty and administrative officers. In so far as possible, the visitor's interests and objectives are ascertained and appointments appropriate thereto are scheduled in advance. In this way, the Registry endeavors to reconcile the wishes and convenience of our guests with interim availability of their hosts and to reduce the delays and disappointments that are otherwise likely to occur.

Tours of inspection arranged in engineering, science, architecture, or other special fields are conducted by graduate student members of the Corps of Presidential Guides. At specified facilities to be visited a competent staff member is prepared in advance to explain and discuss that which is on display.

Initial inquiries from those desiring to visit the Institute for various purposes and varying lengths of time, when referred to the Registry, are promptly answered with a suggestion of dates when appropriate reception can be made available for the proposed visit. During the stay of a visitor this office is at his service for general information; in behalf of foreign visitors it can often aid in securing information on governmental regulations concerning immigration visas, exit permits, income tax liabilities, and like matters. Continuing and close contact is maintained with the Federal agencies concerned with visitors from other lands and with the Institute of International Education.

As a clearing house of information for and about visitors, the Registry maintains up-to-date files on the whereabouts and the occupations of visiting teachers, official guests,

and visiting fellows, as well as a record of transient visitors referred to it.

By vote of the Executive Committee of the Corporation the President of the Institute is authorized to invite members of instructing staffs of other educational institutions (including secondary schools) and, in special cases, other qualified persons to attend specified lectures and other Institute exercises as auditors without payment of fees, provided this attendance is approved by a professor in charge of a subject and by his department head and with the understanding that for such attendance no academic credit will be given by the Institute.

The categories of other than transient visitors under which this permission is granted are as follows:

GUEST OF THE INSTITUTE: A colleague of academic rank of full professor or of equivalent professional attainment attending the Institute for observation, study, research, or other investigations. He may share all facilities available to a staff member without academic credit, without fees, and without remuneration.

VISITING FELLOW: A colleague of academic rank less than that of full professor or a person of at least equivalent professional standing, qualified for advanced study or research. He may not become a candidate for a degree but may audit lectures or engage in research in so far as facilities are available, without fee, or if enrolled as a special graduate student for academic credit, at specified fees; if an alien with appropriate visa, he may accept staff employment with compensation.

During the year ending June 30, 1955, this office has been privileged to assist the following temporary members of the Institute community:

Guests of the Institute	24
Visiting fellows	74
Visitors	602
Visiting professors, lecturers, etc.	168
Total	868

JOHN W. M. BUNKER.

ADVISER TO FOREIGN STUDENTS

For many years the Institute has been involved in an increasingly heavy flow of students and staff to and from foreign countries. This flow has been greatly accelerated since the close of World War II. A measure of this increase is found in the fact that when, in 1944, the office of Adviser to Foreign Students was founded at the Institute, there were about 200 foreign students in attendance at M.I.T. In 1954 there were over 600.

This increase is a reflection of a similar growth in foreign student population in this country as a whole, and particularly in her leading institutions. Last year 1254 foreign students registered at Columbia University, 1238 at University of California, 946 at New York University, 810 at University of Michigan, and 721 at Harvard University. As in the past, the Institute has been the most cosmopolitan campus in the country. Foreign students at M.I.T. are 11.6 per cent of the total enrollment; at Cornell and at Harvard, 7 per cent; at Columbia, 5 per cent; and at the University of Michigan, 4 per cent.

The increase in foreign students at M.I.T. is also testimony to the prestige of the Institute abroad. In 1914, applications from foreign students numbered 907; in 1954 they numbered 2428. This excess of applicants over places permits a high degree of selectivity in the admissions process.

The end result is an outstanding group of students who, in spite of great difficulties of language and adjustment to a strange country, perform equally as well as their American peers.

Academic personnel from other countries is by no means confined to students. Of particular interest in the post-war era is the great and increasing extent of the exchange across national boundaries of teachers, lecturers, and research workers. Counting only those with staff appointments, there were 635 from abroad last year on U.S. campuses. Further details of this interesting and significant phenomenon as it relates to M.I.T. will be found in the report of the Registry of Guests.

As customary for the last seven years, an important addition to the numbers of students who come to the Institute for course work in term time is the group of young engineers and scientists brought to M.I.T. by the Foreign Student Summer Project. F.S.S.P. 1955 numbers 59 young men and women. The student co-chairmen are Edward A. Bryan '55 and Richard H. Maehl '55. The chief support of the project continues to come from the Alfred P. Sloan Foundation.

The flow of students and staff is, of course, not all one way. It is estimated that nearly 7000 American students studied abroad last year and that over 1000 U.S. faculty members were abroad on various educational assignments. Institute students and staff were part of this movement. The most important of the organized programs is that of the Fulbright Scholarships, which have made a notable contribution in stimulating and supporting study abroad by American students and teachers. Twenty-one M.I.T. students, for 1955-56, received nominations for Fulbright awards. These were recommended to the Fulbright Commission by a selection

committee of Institute staff, the chairman of which is Professor David A. Dudley, Fulbright adviser.

From an Institute point of view, perhaps the most interesting program sending M.I.T. students abroad is the Overseas Fellowship Program, since this has resulted entirely from the initiative of the Institute staff and very largely from that of its first chairman, Professor Norman J. Padelford. For the summer of 1955, twenty-five graduate students were provided with paid employment abroad which permitted them study and observation in industry and in research centers. In addition, they were awarded Fellowships to help with their transportation expenses which came from funds generously provided by the Food Machinery and Chemical Corporation. For 1954-55 the nominal chairman of this committee was Paul M. Chalmers, but the effective work of the program was carried on by his deputy, Professor James G. Kelso.

Professor David A. Dudley, in addition to his duties as Fulbright adviser, has acted as assistant to the adviser to foreign students. He has given considerable time to counselling foreign students. For the next academic year a division will be made in the duties of the adviser; Professor Dudley will handle all correspondence from applicants from the Latin-American countries, will be responsible for their selection, and will be their counsellor after admission.

The undersigned has been nominated by the National Association of Foreign Student Advisers and appointed by the American Council on Education as a consultant to the A.C.E.'s Commission on Education and International Affairs.

PAUL M. CHALMERS.

DIRECTOR OF LIBRARIES

The Charles Hayden Memorial Library was originally conceived as a library and humanities center for the Institute. When it was completed and occupied in 1950, the Dewey Library of economics, social studies, and industrial relations was assigned the choice ground floor south wing location; the Humanities Library was installed in the north wing while the Central Library, with administrative offices, processing, reference, and circulation departments, and the union catalogue, was located on the second floor; the basement stacks housed many of the books from the old library in Building 10. A Music Library, the Boston Stein Club Map Room, the Exhibition Gallery, all on the ground floor around the courtyard, and the Dard Hunter Paper Museum beneath the gallery contributed amenities that were in themselves almost innovations. There were, in addition, seven other branch libraries — in aeronautical engineering; biology-food technology; graduate mathematics, physics, and chemistry (the Eastman Library); engineering and naval architecture; electrical engineering (the Vail Library); geology, metallurgy, and ceramics (the Lindgren Library); and architecture and planning (the Rotch Library). In 1950 the book stock totaled 450,479 volumes; 15,325 volumes were added; 2,506 periodicals were received.

Five years later the picture is entirely different, demonstrating perhaps that a library is not created by the act of constructing an edifice but is a tangible manifestation of the intellectual vitality of a community. Presently the library comprises a General and five divisional units. General and Humanities share the second floor of the Hayden with the north wing a passageway and reserve book room. Dewey has gone to new

quarters in the Sloan Building as the library center for the School of Industrial Management and sections of the School of Humanities. Its former location on the ground floor, south wing of Hayden now houses a new Science Library comprising the physical sciences, the earth sciences, and the life sciences derived from the former Eastman, Lindgren, and biology-food technology branch libraries. In the dome of building 10 there is a new divisional Engineering Library made up of the Vail Library, the engineering and naval architecture branch library, and (as a dependency still in building 33) the aeronautics collection. The Rotch Library of architecture and planning as a division library remains substantially as before. The Music Library, the Boston Stein Club Map Room and the Gallery have more than met the expectations that motivated their creation. The Dard Hunter Museum of handmade paper and early printing has been transferred to the Institute of Paper Chemistry in Appleton, Wisconsin (1954), in accordance with the policy that material belongs where it can best be used regardless of its attractiveness and pre-eminence in a specialized field not now within the scope of Institute interest.

This year the official count of volumes in the library is 557,120, including 33,907 volumes added — an abnormally high figure brought about largely by the incorporation of a backlog of serials. There are 2,736 periodicals currently received, and 718 bound theses were added during the year. In five years the library collections have increased roughly 106,000 volumes, which could mean with the year 1950 as a base that the book collection will double somewhere in between 1965 and 1970. But this statistic should occasion neither complacency nor alarm.

The catalysts which brought about the reorientation of the library around divisional "school" libraries were two-

fold: 1. The generous gifts of the Alfred P. Sloan Foundation for a new School of Industrial Management, which in the process of organization was allowed its own library in the building purchased to house the School; and 2. A survey of the M.I.T. Libraries made in 1951 by Dr. Keyes D. Metcalf of Harvard University and implemented by the activities of the Executive Board of the Faculty Committee on the Library. It would be meaningless to detail the combinations, separations, relocations, transfers, rearrangements, reorganizations, and ordered confusion of the past five years. It is enough to say that an entirely new library and equally novel concepts of the uses of a library have evolved coincidentally with the emergence of M.I.T. as an entirely different kind of educational institution. Perhaps the Institute and its library are a prototype of future higher educational facilities.

New needs and approaches.

The manifold readjustments of the period under discussion have served to emphasize new needs and even more the need for a new approach to library problems. In technology, blended as it is with non-traditional humanities, the trend is away from the book and even from periodicals in the extended sense. Widely selected readings guide the exploration of the humanities, while scientists and engineers use the periodical as food for immediate consumption, the book for needed staple literature, and the research report, fragmentary as it often is, for seasoning and inspiration. The files of research reports from the Atomic Energy Commission and its Canadian equivalent, the Rand Corporation Reports, and others have been assembled, coordinated, and made approximately equal to increasing demands. An official report file, which for the first time embraces reports of research originating at the Institute, was

begun and is concept coded experimentally to enable access from a variety of approaches. With the cooperation of the dean of the Graduate School, a similar information file was coded to supply the ever-present demand by students and Faculty for information about available scholarships and fellowships.

In 1955 the library is more intensively used than ever before, but to measure its use in quantitative terms is no easier than it was in 1950. With the cooperation of Professor Philip M. Morse and his Operations Research Group, an attempt was made to find out how library use can be measured in as busy and active a part of the system as the Science Library. On five successive days questionnaires were given to 2700 visitors, and the 1900 replies received were tabulated. The results are not yet fully available and will be separately reported as a joint Project-Library study. It is evident that the Science Library is more heavily used even than its librarians believed and that actual use in this library is from five to ten times greater than the recorded circulation. Library use varies widely between fields of study; the pattern is not yet clear. In some fields the *dynamic* use factor — current day to day use — is of infinitely greater importance than the *potential* use factor. Older books, while important for an historian of physics, for the working physicist are worse than out-of-date; they are erroneous and therefore harmful. These and other indications can only serve at this time to point the way toward profitable further investigation. Mechanization, a natural part of the thinking of a technological institution, may or may not be a natural answer to the needs of that institution.

Indiscriminate use of a library can become as much an embarrassment as lack of use. The M.I.T. Library is intended to serve the needs of Faculty, staff, students and alumni, and

those in the area who have real need to employ its resources for serious study. The Executive Board of the Faculty Committee on the Library as one of its principal activities of the year reviewed the Rules and Regulations for the Use of the M.I.T. Library. New regulations that will become effective with the 1955 Fall Term, outline the rights, privileges, and responsibilities of uses of the library; for the first time provision is made for those without M.I.T. connections to use the library fully and to withdraw books. These regulations are briefed in the following paragraphs:

Regulations for the Use of the M.I.T. Libraries.

The M.I.T. Library is an educational and research facility maintained for the benefit of the entire Institute community. Its books and collections are valuable and users assume the obligation of preserving and maintaining them. Material that is damaged, defaced, or withdrawn from the library and not returned must be replaced at the expense of the borrower. The following rules and regulations drawn up and approved by the Executive Board of the Faculty Committee on the Library apply to all users:

I. The library reading rooms, collections and facilities may be used only by authorized persons.

II. IDENTIFICATION – Each user of the library must be prepared to identify himself when requested to do so. Students may use the Bursar's Card; other users will be supplied with the appropriate Library Identification Card.

III. USERS

A. Members of the Faculty, staff members with rank of instructor or above, and official guests of the Institute of faculty rank will be supplied with the *Faculty Identification Card.*

B. Officially enrolled students, staff members with rank below instructor, D.I.C. and D.D.L. personnel, all categories of non-staff employees: Students will use the Bursar's Card; others will be supplied with the *Staff Identification Card.*

C. Alumni are entitled to use library reading rooms. To withdraw books, visiting alumni may apply for a Temporary Card; resident alumni making

constant use of the library are expected to provide themselves with a *Library Privilege Card* as defined below.

D. Persons not connected with the Institute who have need to use the library for serious study may apply to the Director of Libraries to purchase a *Library Privilege Card* which, at a cost of $10.00, allows the use of the library reading rooms and the privilege of withdrawing up to 50 books within any one year. Whenever 50 books have been withdrawn or a year has elapsed, a new card is required.

E. Visiting scholars, or students of neighboring institutions who present a letter of request from the librarian of their institution, may be permitted to use the libraries for a brief period not including the privilege of withdrawing books.

IV. CIRCULATION — The Director of Libraries is authorized to determine the period of loan for any library material.

A. Members of the Faculty and staff members with academic rank of instructor or above may withdraw regular two-week material for a period not to exceed one term. New books, reserves, and special use materials may not be kept beyond the loan period. Materials are subject to recall to meet specific needs of other borrowers.

B. All other categories of authorized users may borrow material in conformity with specified loan periods, i.e. overnight, three days, one week, two weeks.

V. FINES AND PENALTIES

A. Regular one- and two-week books — 5 cents per day past due until returned.

B. Reserve books borrowed for overnight use — 25 cents per book if not returned by 10 a.m. on date due, 10 cents per hour until returned.

Note: The maximum charge for categories A and B — cost of replacement, including processing charges.

C. Failure to return books when notified — Borrowers who refuse to return material recalled for other users after notification become liable for the cost of replacing the materials including cost of processing.

D. Overdue books must be returned to the library from which they were borrowed. Penalties continue until the book is returned to the appropriate library.

E. Unpaid fines and the costs of replacing missing books are filed with the Bursar as obligations of record for collection.

Other landmarks.

Even though necessarily brief, this report could not be considered complete without fitting acknowledgement to the Friends of the M.I.T. Library and to others whose generous

gifts of books and money have served to enrich the collections. Similarly, mention should be made of an important conference on the use of libraries by industrial firms, bringing representatives of industrial companies for a one-day symposium on November 30; this meeting was organized and carried out by the library in cooperation with the Industrial Liaison Office. The library staff participated in many professional meetings, one of which, the Association of Research Libraries symposium at Allerton House (University of Illinois), has resulted in the publication of an important book, *Problems and Prospects of the Research Library*. Finally, a comprehensive bibliography of the writings of our late President, Dr. Karl T. Compton, was compiled and published in the *Technology Review*.

A year in a great library could be fancifully compared to an overnight steamboat voyage down a great river. The throbbing sensation of movement, the presence of many people with different ultimate destinations, and the tense urgency of progress are everywhere evident. Courteous and efficient service by a capable crew contribute a sense of reassurance and well being. Landmarks are in view intermittently, but it is only with the coming of morning that one becomes aware of the distance that has been traversed. The logical extension, that all of the passengers were asleep, would destroy the comparison, for this would by no means be true.

VERNON D. TATE.

MEDICAL DIRECTOR

This year has been an interregnum for the Medical Department. During eight years as medical director, Dr. Dana

L. Farnsworth had broadened the scope of the Department's activities and focused them on the positive promotion of health rather than on the mere treatment of illness. He had introduced a goodly sprinkling of full-time doctors and built up the approach to emotional problems and mental hygiene. Under his leadership a distinguished sub-department of occupational medicine was developed by Dr. Harriet L. Hardy. Dr. Farnsworth also integrated the work of the Medical Department with that of the dean of students and related psychiatry to the educational process and to the counselling of students. His tour of duty here resulted in a brilliant evolution of the Department's usefulness to the Institute on several fronts.

During 1954-55 no changes in policy have been put into effect; the objective has merely been to hold all of Dr. Farnsworth's gains until his successor, Dr. James M. Faulkner, shall have taken over (July 1, 1955).

There has, however, been much thought and discussion of future plans in which Dr. Faulkner has actively participated. Ever since his acceptance of the directorship, Dr. Faulkner has come to M.I.T. once a week or oftener to study the Medical Department and to discuss its affairs with many members of its staff and other key people. This means that when he takes charge on July first, he will be thoroughly conversant with the Department's affairs and operations.

Integrating education, research, and practice.

The possible future developments which have been discussed include such items as making the Medical Department a teaching department, the establishment of a two-year medical school at the Institute, and the development of a comprehensive prepaid medical care plan for the whole M.I.T. community. It is believed that the Institute offers an ideal

opportunity to effect an integration of medical education, research, and practice which would be superior to any now existing in the country. It could set a pattern which would be widely copied. An anology is perceived between the education of the engineer and that of the physician. This is an added reason why the latter should be an appropriate activity for M.I.T.

If the medical course and the comprehensive medical care plan were set up simultaneously, each would provide a source of strength to the other. The medical students would be given responsibilities in the health plan which would enhance the quality of their training, and the health plan would be the gainer by virtue of their services. Moreover, the health plan should be self-supporting and therefore no added financial burden to the Institute. Also, if the medical school were set up, its contribution to the country's health forces should be one in which the Institute could take satisfaction. There is at present a real need for new two-year medical schools. Two-year medical schools have supplied transfer students to the third-year classes of those four-year schools having greater student capacity in their clinical years. Most of the two-year schools have now extended their work to four years, thus cutting down the available supply of transfer students. In this situation there is an exciting challenge for M.I.T.

More specifically, during the year we have focussed attention on the problem of coronary heart disease. We have studied the findings of the Faculty health survey, now in its fourth year, and have consulted various experts, both clinical and in the basic sciences. There is no reason to believe that the M.I.T. Faculty is any worse off with respect to coronary heart disease than are those of other comparable institutions, but it seems to be true that the United States is worse off than other

countries, and that the United States is worse off today than it was twenty years ago. It also seems to be true that white collar classes suffer more from coronary diseases than do manual laborers and, finally, that men are harder hit than women. The why of all these facts we have not yet come by, but who can doubt that they are related in some way to our manner of living?

The general health of the Faculty seems to be of a high order. Undoubtedly most members would benefit by more leisure and relaxation. Some would benefit by losing some weight, but in other ways we can take comfort in our relatively good physical and mental condition.

Occupational Medicine.

For occupational medicine Dr. Hardy makes the following report:

"We have had one notable change in our staff. Dr. Martin Lubin has taken the place of Dr. Ivan Frantz, serving as a physician and a consultant in biophysics. Dr. Lubin has been fulfilling his duties to our great satisfaction.

"Because of the distance and manifold activities at the Lincoln Laboratory, we have found it necessary to engage the services of an assistant occupational hygiene engineer to work under our supervision. This has proved a helpful move and may or may not need to continue, depending on the activities of the Lincoln Laboratory in the future.

"During the year there have been several potential hazards which have engaged our skill and time. I refer to the possible production of cataracts of the eyes in certain exposures to microwave radiation which might be encountered in the

work at the Lincoln Laboratory. Search of the literature, and our own experience, reveals that there is no adequate instrument for measuring this form of energy, and we are currently working with certain members of the Department of Electrical Engineering to develop such an instrument. With this, a survey will be made of the energy ranges to which the workers' eyes might be exposed. Meanwhile, routine base line examinations of the individuals have been done to include careful study of their eyes.

"Secondly, we have completed a study of the potential hazards of the burning out of selenium rectifiers, which are in such wide current use in the Institute and more especially at the Lincoln Laboratory. From these studies, certain recommendations have been developed and distributed.

"A third activity of interest has been the study of the damage caused by exposure to methyl alcohol encountered in high concentrations in the fluid used in ditto machines. This has been an Institute-wide project, and we find all departments are using this type of equipment. We have had the voluntary services of a graduate student from Professor Rolf Eliassen's laboratory, Lieutenant Jay Grumbling, who with the aid and supervision of our staff has been studying the commercial preparations on the market and the present method of handling them here at the Institute. Again, certain recommendations have been distributed to the users of this material.

"Other activities are similar to previous years. It is worth mentioning that we continue to do a fair amount of teaching on a very informal basis from department to department. Perhaps the greatest number of requests go to Mr. Levin for instruction in radiological safety."

Psychiatric Department.

Dr. Harris submits the following statement concerning activities in the field of psychiatry:

"The Psychiatric Department has continued to expand its group discussion activities with lectures to some classes on group dynamics by members of the staff and with an increasing number of discussion groups of younger Faculty members and students. In all, about eighteen groups have been operative during this year, and the results seem to be uniformly encouraging. A paper on teaching techniques learned from participation in group discussions with a psychiatrist, written by F. D. Ezekiel, instructor in mechanical engineering, has been accepted by the *Journal of Engineering Education.* Efforts are to be made in the future to evaluate discussion groups of this type, and the groups themselves are being questioned as to possible methods of evaluation. There appears if anything to be a slight decrease in the total number of referrals for psychotherapy to the psychiatric staff; this is to be expected in view of the more active group program and the increasing activities of the Faculty and student counselling programs."

Also in connection with psychiatry, it can be noted that last autumn (1954) we had the good fortune to secure for the Department the part-time services of Dr. Stanley Cobb, former psychiatrist-in-chief of the Massachusetts General Hospital. As a scholar in this field in our midst, he gives added strength and distinction to the Department.

Director of Sanitation.

One innovation of the current academic year has been that Dr. Murray P. Horwood, Professor of Sanitary Science in the Department of Civil and Sanitary Engineering,

has become affiliated with the Medical Department as director of sanitation for the whole Institute. The principal task under this category consists in supervising the sanitary operation of the seven dining services found at Walker Memorial, Graduate House, Baker House, Burton House, Homberg Infirmary, and the Faculty Club. Detailed sanitary surveys are made once a month and general surveys are made daily. In addition, samples of all eating and drinking utensils in use, as well as milks and creams, are collected once a week and examined bacteriologically. Reports, including recommendations, are made to the director of the M.I.T. Dining Services and to the superintendent of each dining service. Weekly bacterial supervision is also maintained over the Cambridge water supply and the water in Alumni Pool.

At the beginning of the year Dr. Horwood conducted separate educational programs with the full-time help and student personnel employed in each dining service. Excellent and intelligent cooperation has resulted, although it is evident that the maintenance of satisfactory sanitary standards is due in part to the knowledge that a system of careful supervision is in existence and is functioning regularly. The absence of any outbreak of gastroenteritis among the patrons of the M.I.T. Dining Services since 1944 due to food infections or food intoxications is an indication of the value of this supervisory service in protecting the health of the M.I.T. community.

Dr. Horwood has also considered environmental sanitation in the M.I.T. dormitories. In addition, he has served as a member of the M.I.T. Committee on Safety and has been an active participant in the weekly staff meetings of Dr. Hardy's group in occupational medicine.

During 1954-55 the several routine services previously established have been maintained, it is believed at their customary high levels of performance. Included in these are the first aid station, the Infirmary, the out-patient clinics, both general and special, dental and X-ray service, clinical pathology, Faculty health survey, and routine physical examinations of students and employees.

Personnel changes during the year include the resignation on January 1, 1955, of Miss Rose Scalora who had served excellently as chief nurse in the Infirmary since October 14, 1952. She has been succeeded by Mrs. Bertha O'Sullivan who has served the Infirmary as nurse since February 2, 1951. There is no doubt whatever that the fine quality of nursing characteristic of our Infirmary will continue under her leadership.

F. H. MEANS, M.D.

DEPARTMENTS OF MILITARY AND AIR SCIENCE

President Killian proclaimed May 10, 1955, as Military Day at M.I.T. A joint Army-Air Force R.O.T.C. military review and awards ceremony was held on that date, with approximately 1600 M.I.T. R.O.T.C. cadets participating. Distinguished military guests included Major General Charles E. Loucks, Deputy Chief of the Army Chemical Corps, and Brigadier General Einar B. Gjelsteen, Commanding General, Fort Devens, Massachusetts. During the awards ceremony, 16 Army R.O.T.C. cadets received awards for outstanding leadership and military proficiency.

On June 9, 1955, 89 advanced course students in the Army and 55 in the Air Force who had completed their R.O.T.C. training were commissioned as Second Lieutenants in the respective services. In addition, 21 air science and 22

military science students will be commissioned upon later completion of degree requirements and/or summer training. Formal presentation of commissions was made in an impressive commissioning ceremony held in the Kresge Auditorium, at which Vice Admiral Edward L. Cochrane, Vice President of M.I.T.; Brigadier General Gjelsteen; and Brigadier General Kurt M. Landon, Deputy Commander, Air Research and Development Command, Baltimore, Maryland, were the principal speakers.

During the year the National Society of the Scabbard and Blade conducted a survey among the military and air science students to assist both departments in improving their programs. The suggestions made by the Society as a result of the survey were found to be very worthwhile and are being incorporated into the programs. One surprising result of the survey is that even with our increased emphasis on discipline 37 per cent of the students expressed the opinion that they are receiving too little discipline.

Department of Military Science and Tactics.

A total of 897 undergraduates were enrolled in the Army R.O.T.C. program at M.I.T. during the 1954-55 academic year. Of this number, 271 were advanced course students.

There was one major organizational change in the Department during the year: the establishment of the Common Course Unit. This Unit is responsible for the conduct of all MS-1 instruction; for all training in leadership, drill, and the exercise of command; and for all those subjects in the MS-2 curriculum which are common to all branches of the service. The establishment of this Unit has resulted in closer coordination and supervision of instruction in the basic military arts.

During the year this Department instituted a program designed to afford each M.I.T. R.O.T.C. student the opportunity voluntarily to increase his knowledge of the military and to assist him in making the abrupt transition from college student to army officer. This program included two major innovations: the conduct of a series of seminars on military subjects, and the establishment of a military library-lounge within the Military Science Department. The series of seminars covered military subjects chosen by the students. Attendance at these seminars was completely voluntary, and the response of the students was gratifying. It was agreed by students and instructors alike that the seminar program was most beneficial and should be continued and expanded during the coming year. The military library-lounge was established within the Military Science Department as a facility for the R.O.T.C. students where they could have ready access to military publications and periodicals. This attractive library-lounge is available for individual study and meetings of student military organizations.

During the 1954-55 school year, continuing progress was made on developing those qualities of leadership so essential to the military service. Emphasis was placed upon improving discipline and military courtesy within the cadet corps. A demerit system, integrated into the present Army R.O.T.C. cadet evaluation, is presently under consideration with a view to possible implementation in September, 1955, as a result of studies made during the current year. CHARLES M. MCAFEE, JR.

Department of Air Science.

Colonel Glenn C. Coleman has completed his term as professor of air science and has been replaced by Colonel Harmon Lampley, Jr. Major Vincent J. Gangemi and Major

Edgar W. Nichols have also completed their tours at the Institute and have been replaced by Lt. Colonel Sidney F. Wogan and Major John A. Vanderpoel.

During the year there has been an increased emphasis on leadership and discipline. Many important improvements have been made in the drill program. The most significant change was the concentrated leadership training given to the juniors so that they will be able to perform with a maximum degree of efficiency this year as leaders of the Cadet Corps.

Building leaders is one of our most important functions. Our duty is not only to develop efficient Air Force Reserve officers but to assist the Institute in its goal of providing leaders in science and industry. We constantly point out to the student where his A.F.R.O.T.C. training will help him in his future, whether it be military or civilian.

Because the ability to speak before a group is important to the leader, we formed an "After-Dinner Speakers Club" in which approximately 40 of our students voluntarily participated. The object of the club is to improve each member's public-speaking ability by giving him an opportunity to speak before a small group. The Department is also emphasizing student participation in all classroom activities.

This year the Department was able to give orientation rides in military aircraft to over 160 students. Each student was given 15 minutes at the controls of the aircraft. The program was conducted on a voluntary basis and was enthusiastically received among the cadets. In line with our flying orientation program two air trips were accomplished during the school holidays. One trip was made to the Air Proving Grounds at Elgin Air Force Base, Florida, and one to the Air Development Center at Wright-Patterson Air Force Base,

Ohio. About 25 cadets went to Elgin and about 35 cadets went to Wright-Patterson. In addition, field trips were made to the U.S.S. Salem, to Hanscom Field, and to the Aeronautical Engineering Department.

The Air Science Department ended the year with an enrollment of 345 freshmen, 246 sophomores, 58 juniors, and 78 seniors. Of the 55 seniors commissioned 19 chose flying training and 36 will undertake non-flying assignments commensurate with their educational backgrounds.

The staff of the Department is competent and enthusiastic in working toward a better program. The facilities in general are adequate except for office space and classroom facilities. The staff of the Department is now up to its authorized strength. THEODORE R. YORK.

DIRECTOR OF THE OFFICE OF SPONSORED RESEARCH

Mr. Philip A. Stoddard, student placement officer, has been on loan to the Industrial Liaison Office for a year. We were very fortunate in persuading Professor James G. Kelso to take over the operations of this very important activity.

The Alumni Placement Office has for years needed a competent understudy to Mrs. Evelyn B. Yates. We were very fortunate in finding and securing Mrs. Guy E. Howe for this post. Mrs. Howe had for several years been administrative assistant in the Division of Industrial Cooperation and had the great advantage of knowing the Institute and its customs.

The Office of Sponsored Research became a reality the first of the year. We have the usual number of problems in connection with contract negotiation that seem to have everlasting life.

Student placement.

The volume of employment activity at the Student Placement Bureau reflected the increased demand for technically trained personnel. The pressure has caused keen competition among companies for the graduating class.

Since October, 1954, 366 separate employers have scheduled interviews at the Institute. Ninety of the current recruiting companies visited the campus twice or more this year in search of talent. In addition to this formal recruitment, 269 companies, rather than interview on campus, asked students to apply for positions by letter. The employment activity brought 671 company representatives to M.I.T., where they conducted 6145 student interviews. This meant an average of seven interviews for each student using the Placement Bureau. The results of placement activity for 1954-55 graduates are summarized in this table:

	S.B.	*S.M.*	*Professional Degree*	*Sc.D. and Ph.D.*	*Total*	
Civilian employment	42%	44%	35%	80%	47%	(621)
Graduate study	31	10	6	3	19	(256)
Armed Forces	11	23	51	2	15	(199)
Foreign students	5	10	4	5	7	(90)
Government service	2	6	2	5	4	(51)
Not yet reported	9	7	2	5	8	(105)
						(1322)

The following table lists the fields of activity of those students who reported civilian employment:

Manufacturing	61%
Education (including research)	23
Construction (including marine)	6
Communications	2
Business services	2
Architecture and allied services	2
Others (including mining, utilities, and transportation)	4

Starting salaries continued to rise, averaging a 5 per cent increase over last year's rates. The current starting salaries for Bachelor's degree graduates averaged $385.00 per month, for Master of Science graduates $450.00 per month, and for Doctor's degree holders $625.00 per month. There seems little variance between salaries offered graduates in different courses; the aeronautical and electronic industries pay the highest starting salaries.

Many opportunities for summer work were open to undergraduates. Over 100 companies, many formally recruiting on the campus for that purpose, have offered summer work, averaging $75.00 per week.

Although there is a grave shortage of technically trained personnel, companies as a rule are very selective. Competition is keen for the outstanding men, measured either in scholastic achievement or in personality. Low grades, vagueness of purpose, and general indifference have proven handicaps to some students. Unfortunately, the wide publicity given the shortage of engineers has led some students to be casual in their search for employment.

The most serious need in placement is for better guidance concerning job possibilities. More openings are needed for women graduates and foreign students. A wider participation by undergraduates in professional summer work programs would prove beneficial to both students and employers and insure better placement decisions in the future.

Alumni placement.

As the figures at the end of this paragraph indicate, jobs dropped off a little during the past year and more men became available. In general, I think our placement record is as good this year as it was last, but it has been a difficult year

in some respects. Our largest problem has been the age of the men on our active list. The companies, almost without exception, have come in or written in to say that they had all of the chiefs they needed and were desperately in need of a few Indians. The men registering, on the other hand, have long since ceased to be Indians or were very anxious to drop the roll of Indian and go on to more responsible positions. Starting salaries for new graduates are so high and the cost of establishing a home is so great that few men find advantage in moving during the first few years of employment unless, for matters of family or health, it is really necessary to do so.

	1954-1955	*1953-1954*
Number of jobs	3624	4055
Men who went on available list	912	770
Men who came off available list	713	659
Placements	159	168

There is absolutely no sign of slackening in the demand for personnel, and the demand seems to extend into all fields of engineering and science. In addition to the now-chronic shortage of mechanical and electronic engineers, there is a shortage of inorganic and physical chemists, metallurgists, and, for the first time, civil engineers and building construction men.

We have had more than the average number of calls for top executives, but companies writing to us for such people almost invariably have a real need for a man with a specific background in a certain kind of manufacturing.

I can see no signs of slackening in demand and have no reason to believe that there will be any more men available next year who had "less than five years of experience."

Division of Industrial Cooperation.

A number of changes have occurred within the Divi-

sion of Industrial Cooperation during the year. As of January 1, 1955, the research programs of the Instrumentation Laboratory and Operations Evaluation Group were transferred to the administration of the Division of Defense Laboratories, and their activities are covered in the report of that Division. The phasing out of one large program after nearly 10 years of operation was completed, another large project started during the war years was transferred to an industrial contractor at the beginning of the fiscal year, and one large laboratory closed during the year with some of its activities being continued by outside companies. The remaining research programs administered by the Division have continued at a uniform rate with, again, an appreciable increase in the dollar volume of the programs sponsored by industry and foundations.

The operations of the Division for the year ending June 30, 1955, are briefly set forth in tabular form below while a second table indicates the number of personnel employed on the research projects.

Dollar volume of D.I.C. projects.

	Fiscal Years	
	1954-55	*1953-54*
Government	$10,252,170	$16,746,500
Industrial and foundations	1,784,450	1,308,100
Total	$12,036,620	$18,054,600*

*Includes $5,322,000 from activities of the Instrumentation Laboratory and the Operations Evaluation Group.

Personnel employed on D.I.C. projects.

	As of June 30, 1955	*As of June 30, 1954*	*As of June 30, 1953*
D.I.C. Staff	418	715	770
D.I.C. Non-Staff	652	1,212	1,199
M.I.T. Staff	723	727	680
Total	1,793	2,654	2,649

The distribution of active research projects throughout the academic departments and interdepartmental laboratories, as of June 30, 1955, is shown below. Reference to the research activities of the individual laboratories has appeared in the reports of the academic deans.

	Government	*Industrial*	*Total*
Aeronautical engineering	26	5	31
Biology	11	–	11
Chemical engineering	9	3	12
Chemistry	19	2	21
Civil and sanitary engineering	23	5	28
Electrical engineering	12	3	15
Servomechanisms Laboratory	7	1	8
Food technology	11	1	12
Geology	5	–	5
Mathematics	5	–	5
Mechanical engineering	33	3	36
Metallurgy	36	7	43
Meteorology	9	–	9
Naval architecture	1	1	2
Physics	19	1	20
Acoustics Laboratory	3	–	3
Research Laboratory of Electronics	7	2	9
Laboratory for Nuclear Science	11	–	11
Center for International Studies	3	5	8
Dynamic Analysis and Control Laboratory	6	5	11
Miscellaneous	3	1	4
Totals	259	45	304

Division of Defense Laboratories.

During the 1953-54 fiscal year, operations of the Division of Defense Laboratories were primarily concerned with Lincoln Laboratory. Effective January 1, 1955, the Division assumed administrative responsibility for the Instrumentation Laboratory and the Operations Evaluation Group. In addition, a large study project was completed for the Department of the Navy. Western Electric Company

continued to support classified work at Lincoln Laboratory and new classified work was completed for the General Electric Company. The Division now seems to be clearly assuming its intended function of administration of large classified research projects at the Institute.

The appointment of Henry W. Fitzpatrick as director of defense laboratories (previously associate director) became effective July 1, 1955.

Fiscal reports, on an expenditure basis, covering the operations of the Division and a tabulation of personnel employed are set forth below. Operations of the Instrumentation Laboratory and the Operations Evaluation Group are included for the full fiscal year.

Fiscal report for year ended June 30, 1955.

	Lincoln Laboratory	*Instrumentation Laboratory*	*Operations Evaluation Group*	*Total*
Government	$21,966,567	$5,397,024	$918,074	$28,281,665
Industrial	1,561,441	305,633		1,867,074
Total	$23,528,008	$5,702,657	$918,074	$30,148,739

Personnel employed on D.D.L. projects as of June 30, 1955.

	Lincoln Laboratory	*Instrumentation Laboratory*	*Operations Evaluation Group*	*Total*
D.D.L. Staff	619	162	64	845
D.D.L. Non-staff	1197	380	33	1610
M.I.T. Staff	10	9		19
D.I.C. Non-staff	14			14
Total	1840	551	97	2488

N. McL. SAGE.

INDUSTRIAL LIAISON OFFICE

The activities of the Industrial Liaison Office continued at the high level which has characterized the maturing

of the Liaison Program over the past few years. As industrial members, Faculty, and Liaison Office staff have continued to evolve workable associations, they have made more intensive use of this Institute-industry cooperative relationship. Membership in the program includes a broad geographical and industrial representation. The number of companies remains relatively stable at 70, with new members taking the places of the few who have found it necessary to withdraw. We are in a period of considerable renewal activity resulting from the expiration of agreements made several years ago during the rapid development of the program.

The private symposia for member companies again served as an outstanding means of achieving a valuable exchange of information. Thirteen symposia were held with an average attendance of 48. Sixty-one companies participated in these meetings, sending a total of 629 representatives. This attendance exceeds last year's previous high by 25 per cent and indicates a growing interest in these conferences.

The program to keep member companies informed of new developments in research and teaching at the Institute through the forwarding of manuscript preprints, technical and progress reports, and other special material has been continued. As companies have become accustomed to receiving and using this information, we find requests for wider distribution to more points within the company. Five hundred and forty-six different publications were regularly mailed during the year with the average quantity required per company continuing to rise.

The year saw an increasing number of campus visits by company representatives. A total of 515 visitors made special visits to M.I.T. through the Industrial Liaison Office to dis-

cuss areas of mutual interest with the Faculty and staff. In arranging these visits, the Liaison Office has endeavored to broaden the base of Faculty contact. We have encouraged individual companies to avail themselves of a wider coverage of M.I.T. activities. This has provided the opportunity for more extensive participation by the Faculty. It has helped the Liaison Office to carry out its responsibility for making as reasonable and effective use of Faculty time as possible.

In addition to the more formal activities of the Liaison Program, numerous special services were rendered. For example, late in the spring several experienced and talented engineers from member companies spent a day at the Institute serving with Faculty members on a mechanical design jury judging student projects. Through the auspices of the Industrial Liaison Office, a member company chose the Institute as the setting and stimulus for an off-property company meeting of its principal research leaders. During the year, several Faculty members presented seminars at company locations. Activities such as these are proving most interesting and fruitful for both M.I.T. and our industrial friends.

Since the beginning of the Industrial Liaison Program considerable effort has been put into making the activity flexible and the benefits gained by companies as pertinent as possible to their special needs. This has taken the form of developing our relationships with member companies on a basis of personal contact.

William R. Weems, the director of the Office, was granted a leave of absence for a year effective February 1 to assist in an educational rehabilitation project in Korea, and Philip A. Stoddard, associate placement officer, was appointed acting director. Vincent A. Fulmer, Harold R. Lawrence, Dr. John O. Outwater, Jr., and Ralph L. Wentworth have

served throughout the year as Liaison officers. Eugene B. Skolnikoff remained until April working on special assignments.

PHILIP A. STODDARD.

EXECUTIVE VICE PRESIDENT OF THE ALUMNI ASSOCIATION

At the close of the fiscal year on June 30, the 1955 Alumni Fund totalled $546,745 from 11,176 contributors, thus exceeding the previous records of $243,171 and 10,631 contributors made, respectively, in 1954 and 1950. This amount, plus the munificent anonymous contribution, will make a total of $1,029,412.

During 1954-55 we held two Regional Conferences, at Dallas on January 29 and at Cleveland on February 26, each Conference being addressed by six members of the Institute Faculty and administration. At the Dallas conference, the fifth of our series which began at Chicago in 1951, the M.I.T. Club of North Texas, in cooperation with other nearby M.I.T. clubs at Fort Worth, Houston, Tulsa, New Orleans, Monterrey, and Mexico City, mustered approximately 400 alumni and guests. The Cleveland conference, under the auspices of the M.I.T. Association of Cleveland, had an attendance of 275.

It is the present intention of the Association to hold two, or possibly three, such Regional Conferences during 1955-56 under the auspices of M.I.T. clubs in other parts of the United States; and we have already scheduled a local Regional Conference to be held at the Institute in September. On this occasion, to which all officers of M.I.T. clubs and classes, honorary secretaries and other members of the Educational Council, and class agents of the Alumni Fund will be invited, the "working personnel" of the Alumni Association

and the "working personnel" of the Institute itself will have an extraordinary opportunity to exchange views.

A new M.I.T. club was established at Madrid, Spain, last August, to bring our present roster of these geographical groups to 92. Sixty-nine M.I.T. clubs are located within the continental United States, 12 are elsewhere in the Americas, and 11 are overseas in the other hemisphere. During the 12 months ended last April, 56 members of the Institute staff attended 82 meetings of 53 different M.I.T. clubs. Thus, in the past four years an average of over 60 M.I.T. clubs have had at least one annual "visitor" from Cambridge.

More than 6,300 copies of the new 1955 *Alumni Register* were delivered to advance subscribers during June, the edition being the tenth since 1909 of this periodically published "census book" of Institute alumni, Corporation, Faculty, and staff. Compressed in its 642 text-pages are alphabetical listings of: 47,210 living and 11,968 deceased alumni, 388 members of the Corporation since 1862, 9119 members of the Faculty and staff since 1865, 196 officers and Executive Committee members of the Alumni Association since 1875, and the 54 honorary members of the Association elected since 1900.

The total alumni body — 59,178 — is now 1.5 times greater than in 1940 just before World War II and four times greater than in 1915 on the eve of the Institute's removal from Boston to Cambridge.

Of the 44,274 living alumni indexed geographically, 40,899 (92.4 per cent) are in the United States and 3,182 (7.2 per cent) in foreign countries, the remaining 193 (0.4 per cent) being in U.S. territories and dependencies. Forty years ago, in 1915, there were 10,979 (94.5 per cent) in the United States and 550 (4.8 per cent) in foreign countries.

At present 40,899 alumni now live in the United States, and 10,551 (25.8 per cent) live in Massachusetts compared with 4,596 (41.8 per cent) in 1915. New York continues to hold second place among the states with 6,575 (16.1 per cent) compared with 1,562 (14.2 per cent) in 1915; and California is now third with 2,729 (6.7 per cent) compared with 374 (3.4 per cent) in 1915.

Of the 3,182 alumni now living in foreign countries, 550 (17.3 per cent) are in Canada, 167 (5.2 per cent) are in Mexico, and 149 (4.7 per cent) are in India. Forty years ago Canada was first with 204 (37.1 per cent), Mexico second with 57 (10.4 per cent), and India fifteenth with 9 (1.6 per cent).

H. E. LOBDELL.

DIRECTOR OF THE TECHNOLOGY PRESS

The year 1954-55 saw continued expansion in the program of The Technology Press in the social studies, particularly as a result of the close relationship worked out between the Center for International Studies and the Press. One consequence of this growth was the entry of the Press into the "trade" as distinct from the "text" lists. The following are the year's titles:

Published by The Technology Press

CURRENTS, FIELDS, AND PARTICLES, second and revised edition, by Francis Bitter, September, 1954.

COLLOIDAL PHENOMENA, by Ernst A. Hauser, July, 1954.

Published by The Technology Press and John Wiley & Sons, Inc.

DIELECTRIC MATERIALS AND APPLICATIONS, edited by Arthur R. von Hippel (papers by twenty-two contributors), September, 1954.

PROSPECTS FOR COMMUNIST CHINA, by W. W. Rostow in collaboration with Richard W. Hatch, Frank A. Kierman, Jr., and Alexander Eckstein, November, 1954.

NINE SOVIET PORTRAITS, by Raymond A. Bauer with the assistance of Edward Wasiolek, April, 1955.

PRINCIPLES OF ELECTRIC UTILITY ENGINEERING, by Charles A. Powel, April, 1955.

MACHINE TRANSLATION OF LANGUAGES, essays by Charles Africa, Yehoshua Bar-Hillel, A. Donald Booth, William E. Bull, Stuart C. Dodd, Leon Dostert, Kenneth E. Harper, William N. Locke, Anthony G. Oettinger, James W. Perry, Erwin Reifler, R. H. Richens, Daniel Teichroew, Warren Weaver, Alex Wundheiler, Luitgard Wundheiler, and Victor H. Yngve; edited by William N. Locke and A. Donald Booth, May, 1955.

AN AMERICAN POLICY IN ASIA, by W. W. Rostow in collaboration with Richard W. Hatch, June, 1954.

FREDERICK G. FASSETT, JR.

Principal Honors and Awards to the Staff

ADMINISTRATION.

RUTH L. BEAN
Program Chairman of the Boston Section, Society of Women Engineers.

PIETRO BELLUSCHI
Member, National Institute of Arts and Letters.

JOHN E. BURCHARD
President, American Academy of Arts and Sciences.
Chairman of the Education Committee and Member of the Executive Committee, Board of Trustees, Mount Holyoke College.
Chairman, Seventh National College English Association Institute.
Visiting Professor of Humanities, University of California.
Lecturer, Air War College, Maxwell Air Force Base.

BEVERLY DUDLEY
Vice Chairman of the Boston Section, Institute of Radio Engineers.
Representative of the Boston Section, Regional Executive Committee, Institute of Radio Engineers.

GEORGE R. HARRISON
Honorary Degree of Doctor of Laws, Middlebury College.

HAROLD L. HAZEN
Chairman of the Education Committee, Engineers' Council for Professional Development.

JAMES R. KILLIAN, JR.
Honorary Degree of Doctor of Laws, University of Chattanooga.

JOHN O. OUTWATER
Wenner-Gren Foundation Award, for a study entitled "Pre-Columbian Stone Cutting Techniques of the Mexican Plateau."

JULIUS A. STRATTON
Honorary Degree of Doctor of Engineering, New York University.

FACULTY AND STAFF.

Department of Aeronautical Engineering.

RAYMOND L. BISPLINGHOFF
Fellow, American Association for the Advancement of Science.

CHARLES S. DRAPER
President, Sigma Xi.
Wilbur Wright Memorial Lecturer for The Royal Aeronautical Society (London).

MORTON FINSTON
Chairman of the Joint Session, American Rocket Society and American Society of Mechanical Engineers.

ROBERT L. HALFMAN
Chairman of the Boston Section, Institute of the Aeronautical Sciences.

VINCENT W. HOWARD
Full Member, Institute of Aeronautical Sciences.

JEROME C. HUNSAKER
Langley Gold Medal of the Smithsonian Institution.
Honorary Degree of Doctor of Science, Adelphi College.
Advisor to the National Director of the Selective Service System.
Member, National Selective Service Scientific Advisory Group.

WALTER MCKAY
Secretary of the Boston Section, Institute of Aeronautical Sciences.

RENE H. MILLER
Technical Chairman, American Helicopter Society.

H. GUYFORD STEVER
Chief Scientist of the Air Force.

Department of Architecture.

ROBERT B. NEWMAN
Fellow, Acoustical Society of America.

Department of Biology.

CHARLES H. BLAKE
Fulbright Award for study in Jamaica.
President, Nuttall Ornithological Club.
President, Northeastern Bird-Banding Association.
Chairman, Massachusetts Conservation Council.

JOHN M. BUCHANAN
Visiting Lecturer, University of Texas.
Visiting Lecturer, Asociacion Venezolana Para el Avance de la Ciencia (Caracas, Venezuela).
Lecturer, Atomic Energy Commission Summer Course (Oak Ridge, Tenn.).
Member of the Medical Fellowship Board, National Research Council.

JEROME GROSS
Secretary, Histochemical Society.
Program Chairman, Electron Microscope Society.
Associate Editor, *Journal of Histochemistry and Cytochemistry.*

BRUCE LEVENBERG
Fellowship, U.S. Public Health Service.

J. FREDERICK WOESSNER, JR.
Lilly Postdoctoral Fellowship in the Natural Sciences.

Department of Chemical Engineering.

WILLIAM F. FURTER
Fellowship, National Research Council of Canada.

EDWIN R. GILLILAND
William H. Walker Award of the American Institute of Chemical Engineers, "in recognition of his outstanding record in the publication of original research, especially in the fields of distillation, thermodynamics, mass transport and chemical reactor technology."

WARREN K. LEWIS
Fellow, American Association for the Advancement of Science.

ARTHUR A. WASSERMAN
Fellowship, General Electric Company.

WALTER G. WHITMAN
Secretary-General of the United Nations World Conference on the Peaceful Uses of Atomic Energy.

GLENN C. WILLIAMS
Secretary and Director, The Combustion Institute.

Department of Chemistry.

ISADORE AMDUR
Fellowship, John Simon Guggenheim Memorial Foundation.

ROBERT F. BREESE
Fellowship, National Science Foundation.

CARL L. BUMGARDNER
Fellowship, U.S. Rubber Company.

ARTHUR C. COPE
Honorary Degree of Doctor of Science, Butler University.

RICHARD A. DAY
Fellowship, American Chicle Company.

LINCOLN EKSTROM
Fellowship, National Science Foundation.

DAVID N. HUME
Fellowship, John Simon Guggenheim Memorial Foundation.
Member, American Academy of Arts and Sciences.

IRVING M. GOLDMAN
Fellowship, National Institutes of Health Research.

ROBERT A. LAUDISE
Fellowship, Arthur D. Little, Inc.

MARTIN S. LONGMIRE
Fellowship, National Science Foundation.

NICHOLAS A. MILAS
Foreign Honorary Member, Croatian Chemical Society.

GEORGE R. MURRAY
Coffin Fellowship, General Electric Company.

STEPHEN M. NAGY
President of the Analytical Group, Northeastern Section, American Chemical Society.

WILLIAM H. REINMUTH
Fellowship, National Science Foundation.

ARTHUR S. OBERMAYER
Fellowship, National Science Foundation.

DEAN W. ROBINSON
DuPont Teaching Fellowship.

LOCKHART B. ROGERS
Representative of the Northeastern Section, National Council, American Chemical Society.

WALTER H. STOCKMAYER
Fellowship, John Simon Guggenheim Memorial Foundation.

GARDNER C. SWAIN
Fellowship, John Simon Guggenheim Memorial Foundation.

PHYLIS G. TOCCO
Fellowship, National Science Foundation.

JOHN W. WINCHESTER
Fellowship, National Science Foundation.

JACINTO STEINHARDT
Chairman of the Prize Committee and Member of the Council, Operations Research Society of America.

Department of City and Regional Planning.

FREDERICK J. ADAMS
Distinguished Service Award, American Institute of Planners.

JOHN T. HOWARD
President, American Institute of Planners.

WALTER ISARD
Chairman of the Organizing Committee, Regional Science Association.

BURNHAM KELLY
Chairman of the Committee on Defense Considerations, American Institute of Planners.

Department of Civil and Sanitary Engineering.

JOHN M. BIGGS
Structural Section Award, Boston Society of Civil Engineers.
Chairman of the Committee on Wind Forces, American Society of Civil Engineers.

JAMES W. DAILY
Chairman of the Hydraulic Division, American Society of Mechanical Engineers.
Chairman of the Advisory Committee on Basic Research in Underwater Ballistics, Office of Naval Research.

ALBERT G. H. DIETZ
Associate, Phi Beta Kappa.

ROLF ELIASSEN
Chairman of the Publications Committee, Federation of Sewage and Industrial Wastes Associations.
Chairman of the Corrosion Committee, American Water Works Association.

WERNER H. GUMPERTZ
Chairman of the Membership Committee, Northeastern Section, American Society of Civil Engineers.
In Charge of the Subcommittee on Concrete Admixtures, American Concrete Institute.
Secretary of the Architectural Engineering Division, American Society of Electrical Engineers.

ARTHUR T. IPPEN
Chairman of the Hydraulics Sections, Boston Society of Civil Engineers.
Member of the Council, International Association for Hydraulic Research.

T. WILLIAM LAMBE

Desmond Fitzgerald Medal of the Boston Society of Civil Engineers, for the best essay (1955) in civil engineering.

ROSS E. MCKINNEY

Chairman of the Rudolf Hering Award Committee, American Society of Civil Engineers.

Chairman of the Publications Committee, Sanitary Engineering Division, American Society of Civil Engineers.

CHARLES H. NORRIS

Director, Boston Society of Civil Engineers.

Chairman of the Structural Lecture Series Committee, Boston Society of Civil Engineers.

Member of the Executive Committee, Northeastern Section, American Society of Civil Engineers.

CLAIR N. SAWYER

Second Vice President, New England Sewage and Industrial Waste Association.

Vice Chairman, Gordon Research Conference on Stream Sanitation.

JOHN B. WILBUR

President of the Northeastern Section, American Society of Civil Engineers.

Department of Economics.

MORRIS A. ADELMAN

Member, National Committee to Study the Antitrust Laws.

NORMAN J. PADELFORD

Chairman of the Nominating Committee, American Political Science Association.

Department of Electrical Engineering.

CHARLES W. ADAMS

Member, Institute of Radio Engineers.

RICHARD B. ADLER

Premium Award of the Royal Aeronautical Society (London).

ROGER H BAUMANN

Fulbright Award for study in France.

RICHARD H. BOLT

President, International Commission on Acoustics.

Chairman of the Committee on Hearing and Bio-Acoustics, National Research Council.

Chairman of the Committee on Submarine Noise, National Research Council.

GORDON S. BROWN

Fellow, Institute of Radio Engineers.

Member of the Board of Examiners, American Institute of Electrical Engineers.

Chairman of the Visiting Committee, Thayer School of Engineering, Dartmouth College.

HAROLD E. EDGERTON

Member of the Editorial Board, Society of Photographic Engineers.

PETER ELIAS

Chairman of the Information Theory Subcommittee, Technical Committee on Information Theory and Modulation Systems, Institute of Radio Engineers.

TRUMAN S. GRAY

Chairman of the Boston Chapter, Professional Group on Nuclear Science, Institute of Radio Engineers.

Secretary of the Committee on Nucleonics, American Institute of Electrical Engineers.

Chairman of the Subcommittee on Organization, Committee on Instruments and Measurements, American Institute of Electrical Engineers.

ERNST A. GUILLEMIN

Chairman of the Basic Sciences Committee, American Institute of Electrical Engineers.

Fellow, American Academy of Arts and Sciences.

VINTON B. HAAS, JR.

Secretary of the Committee on Feedback Control Systems, Institute of Radio Engineers.

FRANK B. HILLS

Fellowship, International Business Machines Corporation.

EARL W. KELLER

Chairman of the Regional Educational Committee (Region I) and of the New England Student Activities Committee, Institute

of Radio Engineers.
Member of the Executive Committee, Boston Section, Institute of Radio Engineers.
Vice Chairman of the Communication Professional Group, Boston Section, American Institute of Electrical Engineers.

SAMUEL J. MASON
Vice Chairman of the Circuit Theory Committee, Institute of Radio Engineers.

OSMAN K. MAWARDI
Fellowship, John Simon Guggenheim Memorial Foundation.

WILLIAM H. RADFORD
Member of the Board of Educational Television, Commonwealth of Massachusetts.

J. FRANCIS REINTJES
Vice Chairman of the Subcommittee on Electronic Circuitry and Systems, American Institute of Electrical Engineers.

WALTER A. ROSENBLITH
Fellow, American Academy of Arts and Sciences.
Consultant to the Subcommittee on Noise in Industry, American Academy of Ophthalmology and Otolaryngology.
Chairman of the Subcommittee on Community Problems of Noise, American Standards Association.

ALBERT B. VAN RENNES
Secretary (1954-55), Vice Chairman and Program Chairman (1955-) of the Boston Chapter, Professional Group on Nuclear Science, Institute of Radio Engineers.

DAVID C. WHITE
Chairman of the Basic Science Committee, the Paper Committee, and the Executive Committee (Boston Section), American Institute of Electrical Engineers.

Department of Food Technology

CECIL G. DUNN
President, Boston Bacteriological Club.
Associate Editor, *Yeast Newsletter.*
Commanding Officer, 1001st Army Reserve Research and Development Group.

SAMUEL A. GOLDBLITH

Vice Chairman of the Northeast Section, Institute of Food Technologists.

National Councilor, Institute of Food Technologists.

ERNEST E. LOCKHART

Chairman of the Northeast Section, Institute of Food Technologists.

Chairman of the Committee on Taste Testing and Consumer Acceptance, Institute of Food Technologists.

BERNARD E. PROCTOR

Member of the Official Delegation for the United States to the United Nations World Conference on the Peaceful Uses of Atomic Energy.

Chairman of the Subcommittee on Radiation Sterilization of Foods, National Research Council.

Department of Geology and Geophysics

HAROLD W. FAIRBAIRN

Chairman of the Awards Committee, Mineralogical Society.

Chairman of the Nominating Committee, Volcanology Section, American Geophysical Union.

ROBERT R. SHROCK

Vice President, Society of Economic Paleontologists and Mineralogists.

Section of Graphics

DOUGLAS P. ADAMS

Chairman of the Committee on Nomography, Division on Drawing, American Society of Electrical Engineers.

Visiting Lecturer, Harvard University.

Department of Humanities

KARL W. DEUTSCH

Member of the Council and Chairman of the Committee on Acceptance of Scientific Theories, American Academy of Arts and Sciences.

Associate, University Seminar on Organization, Columbia University.

Research Associate, Center for Research on World Political In-

stitutions, Princeton University.

DAVID J. HARDY
Chairman, District VIII Committee for the National Debate Tournament.

ROBERT E. MACMASTER
Fellowship, Harvard Russian Research Center.

THOMAS F. O'DEA
Fellowship, Center for Advanced Study in the Behavioral Sciences, Stanford University.

School of Industrial Management

W. VAN ALAN CLARK, JR.
Director of the Boston Chapter, Society for the Advancement of Management.
Lybrand Award of the National Association of Cost Accountants, for a paper entitled "Avenues for Inventory Control Analysis."

DAVID DURAND
Faculty Fellowship, The Joint Committee on Education representing the American Securities Business.

BILLY E. GOETZ
Secretary-Treasurer, Academy of Management.

THOMAS M. HILL
Chairman of the Concepts and Standards Committee, American Accounting Association.

WILLIAM A. W. KREBS, JR.
Executive Secretary, New England Committee on Atomic Energy.

EDWARD LURIE
Chairman of the Committee on Libraries, History of Science Society.

Department of Mathematics

JAN L. BOAL
Danforth Teaching Fellowship.

KENKICHI IWASAWA
Fellow, American Academy of Arts and Sciences.

GEORGE B. THOMAS, JR.
Sectional Governor from New England, Board of Governors, Mathematical Association of America.

Department of Mechanical Engineering

JEROME CATZ
Secretary of the New England Section, Society for Experimental Stress Analysis.

JOHN M. COLE
International Education Award, American Society of Tool Engineers.

JACOB P. DEN HARTOG
Fulbright Award for lecturing in Japan.

JOHN A. HRONES
Chairman of the Instruments and Regulators Division, American Society of Mechanical Engineers.

JOSEPH KAYE
Fellow, American Academy of Arts and Sciences.
Honorary Member, Pi Tau Sigma.

JOSEPH H. KEENAN
Worcester Reed Warner Medal of the American Society of Mechanical Engineers, for outstanding contributions to permanent engineering literature.

WILLIAM M. MURRAY
Secretary-Treasurer, Society for Experimental Stress Analysis.

MAURICE E. SHANK
Member of the Board of Directors and the Executive Committee, New England Grenfell Association.

ANDRE W. SLEESWYK
Fellowship, Foreign Operations Administration.

ALFRED SLIBAR
Fellowship, Foreign Operations Administration.

PETER K. STEIN
Secretary of the New England Section, Society for Experimental Stress Analysis.
Secretary of the Program Committee, Boston Section, American Society of Mechanical Engineers.

Medical Department

MURRAY P. HORWOOD
Scientist Director, U.S. Public Health Service Reserve.

JAMES H. MEANS

Honorary Member of the Faculty of Medicine, National University of Cuyo (Mendoza, Argentina).

Certificate of Meritorious Service, American Goiter Association.

Department of Metallurgy

WALTER A. BACKOFEN

Vice Chairman of the New England Regional Conference Committee, American Institute of Mining and Metallurgical Engineers.

DANIEL BERMANE

Fellowship, National Academy of Sciences.

JOHN CHIPMAN

Brinell Medal of the Royal Swedish Academy of Engineering Sciences, for outstanding metallurgical research.

Bessemer Gold Medal of the Iron and Steel Institute (England), for outstanding metallurgical research.

Member, National Academy of Sciences.

MORRIS COHEN

Chairman of the Boston Chapter, American Society for Metals.

American Society for Metals Visiting Lectureship, University of Cincinnati.

Member of the Council, Metals Branch, American Institute of Mining and Metallurgical Engineers.

PHILIP L. DE BRUYN

Secretary-Treasurer of the Boston Section, American Institute of Mining and Metallurgical Engineers.

WILLIAM F. FLANAGAN

Member of the Executive Committee, Boston Chapter, American Society for Metals.

ANTOINE M. GAUDIN

Chairman of the Technical Meetings for Section 12, First World Conference on Surface Active Agents.

NICHOLAS J. GRANT

Chairman of the Boston Section, American Institute of Mining and Metallurgical Engineers.

Associate Member, Investment Castings Institute.

WILLIAM D. KINGERY
Vice Chairman of the New England Section, American Ceramic Society.
Secretary of the Basic Sciences Division, American Ceramic Society.

PETER J. KOROS
Fellowship, Allegheny Ludlum Steel Company.

FREDERICK H. NORTON
Counselor to the New England Section, American Ceramic Society.

HERBERT H. UHLIG
President, Electrochemical Society.

Department of Meteorology

ALAN C. BEMIS
Chairman of the Committee on Radio Meteorology, American Meteorological Society.

HENRY G. HOUGHTON
Secretary, American Meteorological Society.

Department of Modern Languages

WILLIAM N. LOCKE
Regional Representative for New England, American Association of Teachers of French.
President, Boston-Cambridge Alliance Francaise.

Department of Naval Architecture and Marine Engineering

JOHN H. EVANS
Chairman of the New England Section, Society of Naval Architects and Marine Engineers.

S. CURTIS POWELL
Member of the Council and of the Executive Committee, Society of Naval Architects and Marine Engineers.

LAURENS TROOST
Chairman of the Section for Skin Friction and Turbulence Stimulation, Seventh International Conference on Ship Hydrodynamics.

Department of Physics

SANBORN C. BROWN
Chairman of the Rumford Committee, American Academy of Arts and Sciences.
Alumni Member of Phi Beta Kappa, Dartmouth College.
Chairman of the Committee on Scientific Apparatus for Educational Institutions, American Association of Physics Teachers.

GORDON L. BROWNELL
Honorary Member of the Faculty, University of Cuyo (Mendosa, Argentina).

SOLOMON J. BUCHSBAUM
Electronics Fellowship, International Business Machines Corporation.

PETER A. FRANKEN
Acoustics Fellowship, Owens-Corning Fiberglas Corporation.

FRANCIS L. FRIEDMAN
Fellow, American Academy of Sciences.

JACK S. GREENBERG
Fellowship, National Research Council of Canada.
Rutherford Memorial Fellowship.

ALBERT G. HILL
Alumni Citation, Washington University (St. Louis, Missouri).

GIOVANNI LANZA
Fulbright Fellowship from Italy for study in the United States.
Smith-Mundt Fellowship.

PHILIP M. MORSE
Member, National Academy of Sciences.

BERTRAM E. WARREN
American Delegate to the Third International Congress of Crystallography.

DIVISION OF INDUSTRIAL COOPERATION

GEORGE A. BIERNSON
Vice Chairman of the Boston Section, Professional Group on Automatic Control, Institute of Radio Engineers.
Member of the Administrative Committee, Professional Group on Automatic Control, Institute of Radio Engineers.

BRADFORD DARLING
Director of the New England Section, American Rocket Society.

ARTHUR S. HOUSE
Associate Editor, *Journal of Speech and Hearing Disorders.*

HUA LIN
C. T. Loo Fellowship.

HANS M. MARK
Fellowship, National Science Foundation.

DONALD F. RICHARD
Scholarship, Associated Industries of Massachusetts.

J. RAY RUETENIK
Honorary Degree of Doctor of Engineering, The Johns Hopkins University.

JOHN E. WARD
Chairman of the Technical Committee on Feedback Control Systems, Institute of Radio Engineers.

HENRY J. WILAYTO
National Adjutant, American Defenders of Bataan and Corregidor, Inc.
Vice Chairman of the Disaster Committee, Metropolitan Boston Chapter, The American Red Cross.

DIVISION OF DEFENSE LABORATORIES

JOHN N. ACKLEY
Fellowship, National Science Foundation.

RALPH E. BEATTY, JR.
Fellow, Operations Research Society of America.

DAVID R. BROWN
Vice Chairman of the Electronic Computers Committee, Institute of Radio Engineers.
Member of the Administrative Committee, Professional Group on Electronic Computers, Institute of Radio Engineers.

RUSSELL C. COILE
Fellow, Operations Research Society of America.

JOHN M. DANSKIN
Member, Institute for Advanced Study.

ROBERT H. ELLIS
Organization Chairman of the Boston Chapter, Professional Group on Medical Electronics, Institute of Radio Engineers.

MARTIN L. ERNST
Secretary, Operations Research Society of America.

JAY W. FORRESTER
Fellow, Institute of Radio Engineers.

STEPHEN J. FRICKER
Premium Award of the Royal Aeronautical Society (London).

JOHN V. HARRINGTON
Exceptional Civilian Service Medal of the Air Force, for data transmission development.

FRANK E. HEART
Chairman of the Arrangements Committee and Secretary of the Boston Section, Professional Group on Electronic Computers, Institute of Radio Engineers.

RICHARD C. JEFFREY
Chancellor Green Fellowship.

ELAINE H. KEITH
Recording Secretary of the Boston Section, Society of Women Engineers.

EUGENE W. PIKE
Chairman of the Individual Memberships Committee, Institute of Mathematical Statistics.

ROBERT PRICE
Fulbright Award for study in Australia.

FRANCIS E. VINAL
Chairman of the New England Section, American Ceramic Society.

Publications from the Institute

PERIODICAL PUBLICATIONS, BOOKS AND REVIEWS BY THE STAFF*

Department of Aeronautical Engineering

ASHLEY, HOLT. An Approximate Aerodynamic Theory for Gust Entry of Swept Wings. *O.S.R. Technical Note* No. 55-32, December, 1954.

DRAPER, CHARLES S. Teaching Instrument Engineering. *Instrument Soc. Am. J.* 1, pp. 13-17, October, 1954.

FINSTON, MORTON. Forced Convection from Surfaces at Non-uniform Temperatures. *J. Aero. Sci.* 21, p. 779, November 1954.

*For reprints of periodical publications and reviews, consult the author; for copies of books, consult the publishers or a retail bookseller.

HUNSAKER, JEROME C. U.S. National Advisory Committee for Aeronautics. *Annual Report* 40, 1954. Washington, D.C.: Govt. Print. Office, 1954.

MARKHAM, JOHN R. Some Aspects of Supersonic Wind Tunnel Operating Techniques. *AGARD-NATO* 15, p. 6, May, 1954.

MOLLO-CHRISTENSEN, ERIK L. Characteristic Solution for Axially Symmetric Transonic Flow. *J. Aero. Sci.* 21, p. 501, July, 1954.

MOLLO-CHRISTENSEN, ERIK L. and HOLT ASHLEY. Applicability of Piston Theory to the Flow Around Wings in Unsteady Motion. *J. Aero. Sci.* 21, pp. 779-781, November, 1954.

PIAN, THEODORE H. H. and HOLT ASHLEY. A Study of Gust Entry of Sweptback Wings. In *Proceedings of the Second U.S. National Congress of Applied Mechanics*, Univ. Michigan, June, 1954, New York: Amer. Soc. Mech. Engrs. 1955.

SEAMANS, ROBERT C., JR., F. A. BARNES, T. B. GARBER and V. W. HOWARD. Recent Developments in Aircraft Control. *J. Aero. Sci.* 22, pp. 145-164, March, 1955.

STEVER, H. G. and R. L. BISPLINGHOFF. The Shock Tube in Aerodynamic and Structural Research. *Nat. Acad. Sci. Proc.* 40, pp. 557-565, July, 1954.

STEVER, HORTON GUYFORD. The Partnership of Science and the Air Force. *Aero. Eng. Rev.* 14, pp. 38-39, April, 1955.

TRILLING, LEON. On Thermally Induced Sound Fields. *Acoustical Soc. Am. J.* 27, pp. 425-431, May, 1955.

WINTER, PETER H. Measurements of Three-Dimensional Boundary Layers on Wings. *O.S.R. Technical Note* No. 55-133, March, 1955.

Department of Architecture

BELLUSCHI, PIETRO. The Challenge of St. John's Cathedral. *Arch. Forum* 107, pp. 162-163, May, 1955.

HAMILTON, RICHARD W. Prefab Houses Have a New Look. *Parents' Magazine and Family Home Guide* 30, pp, 51-54, 87-89, June, 1955.

Department of Biology

BEERS, ROLAND F., JR. and I. W. SIZER. Sulfide Inhibition of Catalase. *Science* 120, pp. 32-33, July, 1954.

BEERS, ROLAND F., JR. Equilibrium Inhibition of the Catalase-Hydrogen Peroxide System During the Steady State. *J. Phys. Chem.* 59, pp. 25-30, January, 1955.

BEERS, ROLAND F., JR. Non-Equilibrium Inhibition of the Catalase-Hydrogen Peroxide System. *J. Phys. Chem.* 59, pp. 552-556, June, 1955.

BLAKE, CHARLES H. Comments on the January-February Issue. *Eastern Bird Banding Assoc. News* 18, pp. 19-20, April, 1955.

BLAKE, CHARLES H. Comments on the July-August Issue. *Eastern Bird Banding Assoc. News* 17, pp. 4-5, October, 1954.

BLAKE, CHARLES H. Notes on the Wing Length of the Eastern Purple Finch (*Carpodacus p. purpureus*). *Bird-Banding* 25, pp. 97-101, July, 1954.

BLAKE, CHARLES H. Gape Color in Eastern Purple Finches (*Carpodacus p. purpureus*). *Bird-Banding* 25, pp. 133-136, October, 1954.

BLAKE, CHARLES H. [Letter on Age Designations of Birds.] *The Ring* 3, p. 44, May, 1955.

BROWN, GENE M., G. B. WARD and E. E. SNELL. Phosphorylation of Pantothenic Acid and Pantethine by an Enzyme from Proteus Morganii. *J. Biol. Chem.* 213, pp. 869-876, April, 1955.

BROWN, GENE M., M. IKAWA and E. E. SNELL. Synthesis and Microbiological Activity of Some Pantothenic Acid Conjugates. *J. Biol. Chem.* 213, pp. 855-867, April, 1955.

BUCHANAN, JOHN M., B. LEVENBERG, J. G. FLAKS and J. A. GLADNER. Interrelationships of Amino Acid Metabolism with Purine Biosynthesis. In *Symposium on Amino Acid Metabolism*, by W. D. McElroy and B. Glass. Baltimore: Johns Hopkins University Press, 1955.

BUCHANAN, JOHN M. Factors in the Scientific Development of the United States. *Venezuelan Soc. for Advancement of Science Proc.* 5, pp. 1-10, February, 1955.

COHEN, CAROLYN. Optical Rotation and Polypeptide Chain Configuration in Proteins. *Nature* (London) 175, p. 129, January, 1955.

COHEN, CAROLYN. Optical Rotation and Helical Polypeptide Chain Configuration in Collagen and Gelatin. *J. Biophys. & Biochm. Cytology* 1, pp. 203-214, May, 1955.

FOSTER, JOHN M. and C. A. VILLEE. Pyruvate and Acetate Metabolism in the Isolated Rat Diaphragm. *J. Biol. Chem.* 211, pp. 797-808, December, 1954.

GALLOP, PAUL M. Particle Size and Shape in a Citrate Extract of Ichthyocol. *Arch. Biochem. & Biophys.* 54, pp. 486-500, February, 1955.

GALLOP, PAUL M. Studies on a Parent Gelatin from Ichthyocol. *Arch. Biochem. & Biophys.* 54, pp. 501-512, February, 1955.

GEREN, BETTY B. The Formation from the Schwann Cell Surface of Myelin in the Peripheral Nerves of Chick Embryos. *Experimental Cell Research* 7, pp. 558-562, August, 1954.

GEREN, BETTY B. and FRANCIS O. SCHMITT. The Structure of the Schwann Cell and Its Relation to the Axon in Certain Invertebrate Nerve Fibers. *Nat. Acad. Sci. Proc.* 40, pp. 863-870, September, 1954.

GIERER, ALFRED. On the Temperature Dependence and Mechanism of Action of Alcohol Dehydrogenase. *Biochimica et Biophysica Acta* 17, p. 111, May, 1955.

GOULD, BERNARD S., NORMAN A. FRIGERIO and WALLACE B. LEBOWITZ. The Action of Bisphenolic Compounds on Succinoxidase, Cytochrome c Oxidase and Lactic Dehydrogenase of Animal Tissue. *Arch. Biochem. & Biophys.* 56, pp. 476-486, June, 1955.

GROSS, JEROME. Evaluation of Electron Microscopy in the Study of Blood Vessels. (Chapter in *Symposium on Atherosclerosis*. Nat. Acad. Sci. Publ. No. 338, 1954.)

GROSS, JEROME, J. H. HIGHBERGER and FRANCIS O. SCHMITT. Collagen Structures Considered as States of Aggregation of a Kinetic Unit. The Tropocollagen Particle. *Nat. Acad. Sci. Proc.* 40, pp. 679-688, August, 1954.

GROSS, JEROME, J. H. HIGHBERGER and FRANCIS O. SCHMITT. Extraction of Collagen from Connective Tissue by Neutral Salt Solutions. *Nat. Acad. Sci. Proc.* 41, pp. 1-7, January, 1955.

GROSS, JEROME, A. G. MATOLTSY and C. COHEN. Vitrosin: A Member of the Collagen Class. *J. Biophys. & Biochem. Cytology* 1, pp. 215-220, May, 1955.

HALL, CECIL E. Electron Densitometry of Stained Virus Particles. *J. Biophys. & Biochem. Cytology* 1, pp. 1-12, January, 1955.

HARTMAN, STANDISH C., B. LEVENBERG and JOHN M. BUCHANAN. Involvement of ATP, 5-Phosphoribosylpyrophosphate and L-Azaserine in the Enzymatic Formation of Glycinamide Ribotide Intermediates in Inosinic Acid Biosynthesis. *Am. Chem. Soc. J.* 77, pp. 501-502, January, 1955.

HARTMAN, STANDISH C. and JOSEF FELLIG. On the Mechanism of the Oxidation of Uric Acid by Alkaline Peroxide. *Amer. Chem. Soc. J.* 77, pp. 1051-52, February, 1955.

JENERICK, HOWARD P. Pre-Potentials in Frog Sartorius. *Federation Proc.* 14, pp. 79-80, March, 1955.

LAMY, FRANCOIS and DAVID F. WAUGH. Certain Physical Properties of Bovine Prothrombin. *J. Biol. Chem.* 203, pp. 489-499, July, 1953.

LAMY, FRANCOIS and DAVID F. WAUGH. Transformation of Prothrombin into Thrombin. *Physiol. Rev.* 34, pp. 722-729, October, 1954.

LEVENBERG, BRUCE, STANDISH C. HARTMAN and JOHN M. BUCHANAN. Precursors and Intermediates in Purine Biosynthesis. *Federation Proc.* 14, p. 243, March, 1955.

LEWIS, HERMAN W. Studies on a Melanoma-Producing Lethal in Drosophila. *J. Exper. Zool.* 126, pp. 235-276, July, 1954.

LEWIS, HERMAN W. Studies on a Melanoma-Producing Lethal in Drosophila. *Genetics* 39, pp. 979-980, November, 1954.

LEWIS, HERMAN W. Methods of Making Micro-Needles and Holding Larvae in Transplantation Experiments. *Drosophila Information Service* 28, pp. 170-171, November, 1954.

LEWIS, HERMAN W. Rapid Method of Preparing and Dispensing Drosophila Medium. *Drosophila Information Service* 28, p. 171, November, 1954.

LOVE, SAMUEL H. and J. S. GOTS Purine Metabolism in Bacteria. II. Factors Influencing Biosynthesis of 4-Amino-5-Imidazolecarboxamide by Escherichia Coli. *J. Biol. Chem.* 210, pp. 395-405, September, 1954.

LOVE, SAMUEL H. and J. S. GOTS. Purine Metabolism in Bacteria. III. Accumulation of a New Pentose-Containing Arylamine by a Purine Requiring Mutant of Escherichia Coli. *J. Biol. Chem.* 212, pp. 647-654, February, 1955.

MAXFIELD, MYLES. Conformity in Premedical Education. *Tech. Eng. News* 36, pp. 41-43, March, 1955.

OLMSTED, PETER S. and C. A. VILLEE. Nucleic Acid Composition of Human Liver Cell Fractions. *J. Biol. Chem.* 212, pp. 179-186, January, 1955.

SCHMITT, FRANCIS O. Foreword (In *Analytical Cytology*, edited by Robert C. Mellors. New York: McGraw-Hill Book Co., 1955.)

SCHMITT, FRANCIS O. Chapter 1: Cell Constitution in Section III — Cellular Structure and Activity. (In *Analysis of Development*, edited by B. H. Willier, P. A. Weiss, and V. Hamburger. Philadelphia: W. B. Saunders Co., 1955.)

SCHMITT, FRANCIS O. The Application of Newer Techniques to the Study of Blood Vessels. (Chapter in *Symposium on Atherosclerosis*. Nat. Acad. Sci. Publ. No. 338, 1954.)

SCOTT, JESSE F. and R. L. SINSHEIMER. Technique of Study of Biological Effects of Ultraviolet Radiation. (Chapter in *Radiation Biology*, edited by A. Hollaender. New York: McGraw-Hill Publ. Co., 1955.)

SCOTT, JESSE F. and E. B. TAFT. Quantitative Histochemical Observations on Butter-Yellow Carcinogenesis. *Am. Assoc. Cancer Research Proc.* 1, p. 43, April, 1954.

SCOTT, JESSE F. and J. RAHAL. Reversible Photochemical Degradation of N-Methyl Uracils. *Federation Proc.* 14, pp. 135-136, March, 1955.

SIZER, I. W. and ARTHUR J. GROSS. Oxidation of Tyramine and Related Compounds by Peroxidase. *Federation Proc.* 14, p. 64, March, 1955.

SNELL, FRED M. Activity Coefficients of Some Sodium and Potassium Phosphates in Aqueous Solutions. (Chapter in *Electrochemistry in Biology and Medicine*, edited by T. Shedlovsky. New York: John Wiley & Sons, 1955.)

VALLEE, BERT L., DAVID F. WAUGH and BERNARD AGRANOFF. Centrifugal Subfractionation of Polymorphonuclear Leukocytes, Lymphocytes and Erythrocytes. *Blood* 9, pp. 804-809, August, 1954.

VALLEE, BERT L. and HANS NEURATH. Carboxypeptidase, a Zinc Metalloprotein. *Am. Chem. Soc. J.* 76, p. 5006, October, 1954.

VALLEE, BERT L. A New Multichannel Flame Spectrometer for the Simultaneous Determination of Sodium, Potassium, Calcium, Magnesium, and Strontium Used for the Study of Line to Background Ratios. *Nature* 174, pp. 1050-1051, December, 1954.

VALLEE, BERT L. and S. J. ADELSTINE. Effects of Inert Gases on DC Arc Discharge. *Optical Soc. Am. J.* 45, p. 63, January, 1955.

VALLEE, BERT L. and F. L. HOCH. Yeast Alcohol Dehydrogenase, a Zinc Metalloenzyme. *Federation Proc.* 14, p. 154, March (Part I), 1955.

WAUGH, DAVID F. Protein-Protein Interactions. (In *Advances in Protein Chemistry* Vol. 9, edited by M. L. Anson and others. New York: Academic Press, 1954.)

WAUGH, DAVID F. and D. A. YPHANTIS. Transient Solute Distributions from the Basic Equation of the Ultracentrifuge. *J. Phys. Chem.* 57, pp. 312-318, March, 1953.

WAUGH, DAVID F., D. F. WILHELMSON, S. L. COMMERFORD and M. SACKLER. Studies of the Nucleation and Growth Reactions of Selected Types of Insulin Fibrils. *Am. Chem. Soc. J.* 75, p. 2592, June, 1953.

WAUGH, DAVID F. and CHARLES W. HOERR. Some Physical Characteristics of Rearranged Lard. *Am. Oil Chemists Soc. J.* 32, pp. 37-41, January, 1955.

Department of Chemical Engineering

BADDOUR, RAYMOND F., R. J. GOLDSTEIN and P. EPSTEIN. Elution from Partly Saturated Ion Exchange Columns. *Ind. Eng. Chem.* 46, pp. 2192-2195, October, 1954.

BENEDICT, MANSON. Nuclear Reactors for Research. *Chem. Eng. Prog.* 51, pp. 53F-66F, February, 1955.

FURTER, WILLIAM F., A. I. JOHNSON and T. W. BARRY. Phase Equilibrium Studies of the System: n-Octane, Propionic Acid; Water. *Canadian J. Technology* 32, pp. 179-186, September, 1954.

GILLILAND, EDWIN R. and PETER HARRIOTT. Reactivity of Deposited Carbon. *Ind. Eng. Chem.* 46, pp. 2195-2202, October, 1954.

LEWIS, WARREN K., A. RADASCH and H. C. LEWIS. Industrial Stoichiometry (Second Edition). New York: McGraw-Hill Book Co., 1954.

MICHAELS, ALAN S. and T. WILLIAM LAMBE. Soil Flocculants and Stabilizers. *J. Agriculture and Food Chem.* 1, pp. 835-843, September, 1954.

MICHAELS, ALAN S. and C. S. LIN. Effect of Counterelectroosmosis and Sodium Ion Exchange on the Permeability of Kadimite. *Ind. Eng. Chem.* 47, pp. 1249-1252, June, 1955.

MICKLEY, HAROLD S., R. C. ROSS, A. L. SQUYERS and W. E. STEWART. Heat, Mass and Momentum Transfer for Flow over a Flat Plate with Blowing or Suction. N.A.C.A. Technical Note No. 3208 (1954).

SATTERFIELD, CHARLES N. Hydrogen Peroxide. *Chem. Eng. News* 32, pp. 2726-2730, July, 1954.

SATTERFIELD, CHARLES N., R. C. REID and D. R. BRIGGS. Rate of Oxidation of Hydrogen Sulfide by Hydrogen Peroxide. *Am. Chem. Soc. J.* 76, pp. 3922-3923, August, 1954.

SATTERFIELD, CHARLES N. and T. W. STEIN. System Calcium Peroxide — Calcium Oxide — Oxygen. *Ind. Eng. Chem.* 46, pp. 1734-1736, August, 1954.

SATTERFIELD, CHARLES N., H. RESNICK and R. L. WENTWORTH. Simultaneous Heat and Mass Transfer in a Diffusion-

Controlled Chemical Reaction. Part I. Studies in a Tubular Reactor. *Chem. Eng. Progress* 50, pp. 460-466, September, 1954.

SATTERFIELD, CHARLES N. and H. RESNICK. Simultaneous Heat and Mass Transfer in a Diffusion-Controlled Chemical Reaction. Part II. Studies in a Packed Bed. *Chem. Eng. Progress* 50, pp. 504-510, October, 1954.

SATTERFIELD, CHARLES N., R. E. WILSON, R. M. LeCLAIR and R. C. REID. Analysis of Aqueous Mixtures of Hydrogen Peroxide and Aldehydes. *Anal. Chem.* 26, pp. 1792-1797, November, 1954.

SATTERFIELD, CHARLES N. and R. C. REID. Note on the Kinetics of the Reactions of the Propyl Radical with Oxygen. *J. Phys. Chem.* 59, pp. 283-284, March, 1955.

SATTERFIELD, CHARLES N., P. J. CECCOTTI and A. H. R. FELDBRUGGE. Ignition Limits of Hydrogen Peroxide Vapor. *Ind. Eng. Chem.* 47, pp. 1040-1043, May, 1955.

SHERWOOD, THOMAS K. Fresh Water from the Sea. *Technology Review* 57, pp. 15-20, November, 1954.

SHERWOOD, THOMAS K. and K. F. GORDON. Note on Additivity of Diffusional Resistances. *Am. Inst. Chem. Engrs. J.* 1, p. 129, March, 1955.

WHITMAN, WALTER G. Atomic Energy Versus Oil. *The Petroleum Engineer* 27, pp. E9-E11, May, 1955.

Department of Chemistry

AMDUR, ISADORE. Review of *Molecular Theory of Gases and Liquids*, by Joseph O. Hirschfelder, Charles F. Curtiss, and R. Byron Bird (New York: Wiley, 1954). *Chem. Processing* 18, p. 136, January, 1955.

AMDUR, ISADORE and E. A. MASON. Scattering of High Velocity Neutral Particles. V. Neon-Neon. *J. Chem. Phys.* 23, pp. 415-416, March, 1955.

ASHDOWN, AVERY A. Harry Nicholls Holms (Biographical). *The Nucleus* 32, pp. 179-180, May, 1955.

BEATTIE, JAMES A. Thermodynamic Properties of Real Gases

and Mixtures of Real Gases. (In Section C, Vol. I of *High Speed Aerodynamics and Jet Propulsion*, edited by F. D. Rossini. Princeton, N.J.: Princeton Univ. Press, 1955.)

BEATTIE, JAMES A. and H. P. JULIEN. Densities of Gaseous Argon. *Ind. Eng. Chem.* 46, pp. 1668-1669, August, 1954.

BEATTIE, JAMES A., C. M. BIRDSALL, A. C. JENKINS, F. S. DiPAOLA and C. M. APT. Compressibilities of Ozone, Oxygen, and Ozone-Oxygen Mixtures and Thermodynamic Quantities for Pure Ozone. *J. Chem. Phys.* 23, pp. 441-542, March, 1955.

BUCHI, GEORGE H., C. G. INMAN and E. S. LIPINSKY. Light Catalyzed Organic Reactions, I. The Reaction of Carbonyl Compounds with 2-Methyl-2-butene in the Presence of Ultraviolet Light. *Am. Chem. Soc. J.* 76, pp. 4327-4331, September, 1954.

BUCHI, GEORGE H. and N. C. YANG. Light Catalyzed Organic Reaction II. The Isomerization of B-Ionone. *Chemistry and Industry* 13, p. 357, March, 1955.

COPE, ARTHUR C., R. M. PIKE and D. F. RUGEN. Cyclic Polyolefins. XXXIII. Compounds Derived from Cyclooctatetraenylmethyl Alcohol. Isomerization of Cyclooctatetraenylacetonitrile. *Am. Chem. Soc. J.* 76, pp. 4945-4950, October, 1954.

COPE, ARTHUR C., E. L. WICK and F. S. FAWCETT. Cyclic Polyolefins. XXXIV. 2,4-Diphenylbicyclo[3.3.0]Octa-1,4-Diene. *Am. Chem. Soc. J.* 76, pp. 6156-6158, December, 1954.

COPE, ARTHUR C., E. S. GRAHAM and D. J. MARSHALL. Cyclic Polyolefins XXXV. Cyclooct-1-ene-1,5-Dicarboxylic Acid and Cyclooctane-*cis*- and *trans*-1,5-Dicarboxylic Acids. *Am. Chem. Soc. J.* 76, pp. 6159-6161, December, 1954.

COPE, ARTHUR C. and W. N. BAXTER. Aminoalcohols Containing the 8-Oxa-3-azabicyclo[3.2.1]octane Ring System and Their Benzoates. *Am. Chem. Soc. J.* 77, pp. 393-396, January, 1955.

COPE, ARTHUR C. and B. C. ANDERSON. Diamines and Bicyclic Amines Derived from *cis*-2,5-Bis-(hydroxymethyl)-tetrahydrofuran. *Am. Chem. Soc. J.* 77, pp. 995-998, February, 1955.

COPE, ARTHUR C., D. C. McLEAN and N. A. NELSON. Cyclic Polyolefins. XXXVI. *trans*-Cyclononene and *trans*-Cyclodecene from Cyclononyldimethylamine Oxide and Cyclodecyldimethylamine Oxide. *Am. Soc. Chem. J.* 77, pp. 1628-1631, March, 1955.

CORYELL, CHARLES D. Special Problems in the Formation of Metal Complexes. (Chapter VIII in *Chemical Specificity in Biological Interactions. Memoirs of the University Laboratory of Physical Chemistry Related to Medicine and Public Health, Harvard University*, number 3, edited by Frank R. N. Gurd. New York, N.Y.: Academic Press Inc., 1954.)

CORYELL, CHARLES D. and H. G. RICHTER. Low-Energy Photofission Yields for U^{238}. *Phys. Rev.* 95, pp. 1550-1553, September, 1954.

CORYELL, CHARLES D. and D. R. WILES. Fission Yield Fine Structure in the Mass Region 99-106. *Phys. Rev.* 96, pp. 696-702, November, 1954.

CORYELL, CHARLES D. and R. C. FIX. The Hammett Acidity Function H_0 in H_2SO_4 — SO_3 Mixtures; Superacidity. *J. Inorganic & Nuclear Chem.* 1, pp. 119-125, March, 1955.

CORYELL, CHARLES D. and P. KRUGER. Radiochemical Study of the Separation of Lanthanum from Barium by Cation Exchanger; Genetic Study of Ba^{140}-La^{140} and a La^{140} Reservoir. *J. Chem. Educ.* 32, pp. 280-284, May, 1955.

DeGEISO, RICHARD C., S. LINDENBAUM and W. RIEMAN, III. Analsis of Halide Mixtures by Ion-Exchange Chromatography. *Anal. Chem.* 26, pp. 1840-1841, November, 1954.

HALMANN, MARTIN M. The Ultraviolet Absorption of Triethylphosphite. *Chem. Soc. J.*, pp. 2158-2159, 1954.

HARRIS, LOUIS. Preparation and Infrared Properties of Aluminum Oxide Films. *Optical Soc. Am. J.* 45, pp. 27-29, January, 1955.

HARRIS, LOUIS and A. L. LOEB. Evaluation and Analysis of Optical and Electrical Constants of Thin Films as Functions of Reflectance and Transmission Data by Electronic Digital Computation. *Optical Soc. Am. J.* 45, pp. 179-188, March, 1955.

HEIDT, LAWRENCE J. Photochemistry of Cerium Perchlorates in Dilute Aqueous Perchloric Acid. (Section IX in *Solar Energy Research*, edited by Farrington Daniels and John A. Duffie. Madison, Wisconsin: Univ. of Wisc. Press, 1955.)

HEIDT, LAWRENCE J. Photostationary State Kinetics. *Am. Chem. Soc. J.* 76, pp. 5962-5968, December, 1954.

HEIDT, LAWRENCE J. and J. BERESTECKI. Optical Studies of Cerous Solutions. *Am. Chem. Soc. J.* 77, pp. 2049-2055, April, 1955.

HERBER, ROLFE H. and T. H. NORRIS. Istopic Exchange in Triethylamine-Sulfur Dioxide Solutions. *Am. Chem. Soc. J.* 76, pp. 3849-3850, July, 1954.

HERBER, ROLFE H. Some Aspects of Isotopic Exchange. *J. Chem. Educ.* 31, pp. 359-361, July, 1954.

HUME, DAVID N. and R. F. GODDU. Photometric Titration of Weak Acids. *Anal. Chem.* 26, pp. 1679-1684, November, 1954.

HUME, DAVID N. and R. F. GODDU. Photometric Titrations. *Anal. Chem.* 26, pp. 1740-1746, November, 1954.

HUME, DAVID N. and M. N. BUKHSH. Colorimetric Determination of Niobium in the Presence of Tantalum. *Anal. Chem.* 27, pp. 116-118, January, 1955.

HYATT, ASHER A., W. J. HICKINBOTTOM and M. B. SPARKE. The Synthesis and Reactions of Branched-Chain Hydrocarbons. Part III. α-Hydroxy-Ketones with Secondary and Tertiary Alkyl Groups. *Chem. Soc. J.*, pp. 2529-2533, July, 1954.

HYATT, ASHER A., W. J. HICKINBOTTOM and M. B. SPARKE. The Synthesis and Reactions of Branched-Chain Hydrocarbons. Part IV. The Synthesis of Ketones with Quaternary Carbon Atoms. *Chem. Soc. J.* Part II, pp 2533-2536, July, 1954.

HYATT, ASHER A., M. F. ANSELL and W. J. HICKINBOTTOM. The Synthesis and Reactions of Branched-Chain Hydrocarbons. Part VII. The Preparation and Pinacol Rearrangement of Some $\alpha\beta$-Acetylenic Ditertiary Glycols. *Chem. Soc. J.*, pp. 1592-1595, May, 1955.

HYATT, ASHER A., M. F. ANSELL and W. J. HICKINBOTTOM. The Synthesis and Reactions of Branched-Chain Hydrocarbons.

Part VIII. The Pinacol Rearrangement of an Aliphatic Tetraol. *Chem. Soc. J.*, pp. 1781-1784, June, 1955.

IRVINE, JOHN W., JR., G. A. BAZORGAN and CHARLES D. CORYELL. Preparation and Half-Life of Cr^{55}. *Phys. Rev.* 95, p. 781, August, 1954.

IRVINE, JOHN W., JR. Simple Efficient Shield for Well-Type Scintillation Crystals. *Nucleonics* 12, pp. 62-63, October, 1954.

KEILY, HUBERT J. and LOCKHART B. ROGERS. Instrumental Variability of a Model 7 Coleman Photonephelometer. *Anal. Chem.* 27, pp. 459-461, March, 1955.

KEILY, HUBERT J. and LOCKHART B. ROGERS. Nephelometric Determination of Sulfate Impurity in Certain Reagent Grade Salts. *Anal. Chem.* 27, pp. 759-764, May, 1955.

KEYES, FREDERICK G. Thermal Conductivity of Gases. *ASME Trans.* 76, pp. 809-816, July, 1954.

KEYES, FREDERICK G. and JOSEPH H. KEENAN. The Present Status of Steam Properties. *Mech. Eng.* 77, pp. 127-132, February, 1955.

LORD, RICHARD C., L. CORRSIN and B. J. FAX. The Vibrational Spectra of Pyridine and Pyridine-d_5. *J. Chem. Phys.* 21, pp. 1170-1176, July, 1953.

LORD, RICHARD C. and P. VENKATESWARLU. The Rotation-Vibration Spectra of Propylene and Propylene-d_6. *Optical Soc. Am. J.* 43, pp. 1079-1085, November, 1953.

LORD, RICHARD C. and C. M. STEESE. The Vibrational Spectra of Monochlorogermane and Monochlorogermane-d_3. *J. Chem. Phys.* 22, pp. 542-546, March, 1954.

LORD, RICHARD C. Rotation-Vibration Spectra and Structure of Allene Molecule. *Optical Soc. Am. J.* 44, p. 256, March, 1954.

LORD, RICHARD C. and R. W. WALKER. Vibrational Spectra and Possible Structures of the Dimers of Cyclooctatetraene. *Am. Chem. Soc. J.* 76, pp. 2518-2525, May, 1954.

LORD, RICHARD C., B. NOLIN and H. D. STIDHAM. Quantitative Study of the Bonding of Chloroform-d in Various Solvents by Infrared Spectrometry. *Am. Chem. Soc. J.* 77, pp. 1365-1368, February, 1955.

LORD, RICHARD C. and T. K. McCUBBIN, JR. High-Resolution Spectroscopy in the 3-5 Micron Region with a Small Grating Spectrometer. *Optical Soc. Am. J.* 45, pp. 441-446, June, 1955.

MILAS, NICHOLAS A. Special Oxidation Reactions of Unsaturated Hydrocarbons. (A Chapter in *The Chemistry of Petroleum Hydrocarbons*, Vol. 2, edited by B. T. Brooks, C. Boord, S. Kurtz, Jr. and L. Schmerling.) New York: Reinhold Publ. Corp., 1955.

MILAS, NICHOLAS A., PAULS DAVIS and LI-CHIN CHIANG. Some Salts of the Phosphoric Ester of Vitamin D_3. *Am. Chem. Soc. J.* 77, pp. 1640-1643, March, 1955.

MILAS, NICHOLAS A., PAULS DAVIS and JOHN T. NOLAN, JR. Organic Peroxides. XX. Peroxides from the Ozonization of Olefins in the Presence of Carbonium Ions. *Am. Chem. Soc. J.* 77, pp. 2536-2541, May, 1955.

MORTON, AVERY A., CHESTER E. CLAFF, JR. and HERBERT P. KAGEN. Potassium Hydroxide as a Metalating Agent. Fluorene. *Am. Chem. Soc. J.* 76, pp. 4556-4557, September, 1954.

MORTON, AVERY A. and CHESTER E. CLAFF, JR. Condensations by Sodium. XXXVII. The Dimetalation of Benzene, Thiophene, p-t-Butylphenol, Isopropylbenzene and sec-Butylbenzene and the Effect of Alkoxides on the meta:para Ratio for Benzene. *Am. Chem. Soc. J.* 76, pp. 4935-4938, October, 1954.

MORTON, AVERY A. and CHESTER E. CLAFF, JR. The Metalation of Toluene by Potassium and Sodium. *J. Organic Chem.* 20, pp. 440-442, April, 1955.

MORTON, AVERY A., CHESTER E. CLAFF, JR. and FRANCES W. COLLINS. Condensations by Sodium. XXXVIII. The Metalation of tert-Butylbenzene by Amylsodium and the Effects of Associated Salts. *J. Organic Chem.* 20, pp. 428-439, April, 1955.

NELSON, NORMAN A. and R. K. BROWN. 6-Aminoindole. *Am. Chem. Soc. J.* 76, pp. 5149-5150, October, 1954.

OBERMAYER, ARTHUR S. and R. LINDNER. Diffusion of Radioactive Calcium in $Ca_3Si_2O_7$. *J. Chem. Phys.* 23, p. 988, May 1955.

PARKER, STUART H. and C. EABORN. Organosilicon Compounds. Part XI. The Alkali-catalysed Cleavage of Substituted Benzyltrimethylsilanes. *Chem. Soc. J.*, pp. 126-131, January, 1955.

PURDY, WILLIAM C. and DAVID N. HUME. Colorimetric Determination of Manganese Oxidation with Bromate in Sulfuric Acid Medium. *Anal. Chem.* 27, pp. 256-258, February, 1955.

ROBINSON, DEAN W. and MARTIN J. BUERGER. The Crystal Structure and Twinning of Co_2S_3. *Nat. Acad. Sci. Proc.* 41, pp. 199-203, April, 1955.

ROGERS, LOCKHART B., R. P. BUCK and S. SINGHADEJA. Survey of the Ultraviolet Spectra of Some Inorganic Ions in Aqueous Solutions. *Anal. Chem.* 26, p. 1240, July, 1954.

ROGERS, LOCKHART B. and M. A. DeSESA. Spectrophotometric and Polarographic Determination of Soluble Silicate. *Anal. Chem.* 26, pp. 1278-1284, August, 1954.

ROGERS, LOCKHART B. and M. A. DeSESA. Spectrophotometric Determinations of Arsenic, Phosphorous and Silicon in the Presence of Each Other. *Anal. Chem.* 26, pp. 1381-1383, August, 1954.

ROGERS, LOCKHART B. and T. L. MARPLE. Coulometric and Polarographic Determinations of Trace Amounts of Lead. *Analytica Chimica Acta* 11, pp. 574-585, December, 1954.

ROGERS, LOCKHART B. and C. A. LERMOND. Experiment on Reflectance Measurements. *J. Chem. Educ.* 32, pp. 92-95, February, 1955.

ROGERS, LOCKHART B. and C. A. LERMOND. Differential Measurements of Reflectance. *Anal. Chem.* 27, pp. 340-346, March, 1955.

ROGERS, LOCKHART B. and J. W. COLLAT. Fluorimetric Determinations of Aluminum and Gallium in Mixtures of Their Oxinates. *Anal. Chem.* 27, pp. 961-965, June, 1955.

SCATCHARD, GEORGE. Transport of Ions Across Charged Membranes. (In *Ion Transport Across Membranes*, edited by H. T. Clarke and D. Nachmansohn. New York: Academic Press, 1954.)

SCATCHARD, GEORGE. Transport of Ions Across Charged Membranes. (Chapter 3 in *Electrochemistry in Biology and Medicine*, edited by T. Shedlovsky. New York, N.Y.: John Wiley and Sons, Inc., 1955.)

SCATCHARD, GEORGE and R. C. BRECKENRIDGE. Isotonic Solutions. II. The Chemical Potential of Water in Aqueous Solutions of Potassium and Sodium Phosphates and Arsenates at 25°. *J. Phys. Chem.* 58, pp. 596-602, August, 1954.

SCATCHARD, GEORGE, A. GEE and J. WEEKS. Physical Chemistry of Protein Solutions. VI. The Osmotic Pressures of Mixtures of Human Serum Albumin and gamma-Globulins in Aqueous Sodium Chloride. *J. Phys. Chem.* 58, pp. 783-787, September, 1954.

SCATCHARD, GEORGE, J. S. JOHNSON and K. A. KRAUS. Distribution of Charged Polymers at Equilibrium in a Centrifugal Field. *J. Phys. Chem.* 58, pp. 1034-1039, November, 1954.

SCHUMB, WALTER C. Review of *Titanium and Its Compounds*, by Gordon Skinner, H. L. Johnston and Charles Beckett (Columbus, Ohio: H. L. Johnston Enterprises, 1954). *Am. Chem. Soc. J.* 76, p. 4754, September, 1954.

SCHUMB, WALTER C. and R. A. LEFEVER. The Ammonolysis of Hexachlorodisiloxane. *Am. Chem. Soc. J.* 76, pp. 5882-5883, November, 1954.

SCHUMB, WALTER C. and W. J. BERNARD, JR. Thiochlorides of Silicon. *Am. Chem. Soc. J.* 77, pp. 862-863, February, 1955.

SCHUMB, WALTER C. and W. J. BERNARD, JR. The Formation of Silicon Monosulfide. *Am. Chem. Soc. J.* 77, p. 904, February, 1955.

SCHUMB, WALTER C. Review of *Handbuch der Anorganischen Chemie;* System 10, Part A3, Selenium, by Leopold Gmelin (8th Edition, Weinheim, Germany: Verlag Chemie, G.m.b.H., 1953). *J. Chem. Educ.* 32, p. 110, February; 1955.

SCHUMB, WALTER C. Review of *Technik der Experimentalchemie*, by R. Arendt and L. Dormer (6th edition, revised, by K. E. Dormer. Heidelberg: Quelle and Mayer, 1954). *J. Chem. Educ.* 32, p. 235, April, 1955.

SCHUMB, WALTER C. and D. M. SMYTH. The Partial Hydrolysis

of Germanium Tetrachloride. *Am. Chem. Soc. J.* 77, pp. 2133-2136, April, 1955.

SCHUMB, WALTER C. and D. M. SMYTH. The Reported Oxychloride of Germanium, $GeOCl_2$. *Am. Chem. Soc. J.* 77, p. 3003, June, 1955.

SHEEHAN, JOHN C. and W. L. RICHARDSON. A New Method for the Synthesis of Macrocyclic Peptides. *Am. Chem. Soc. J.* 76, p. 6329, December, 1954.

SHEEHAN, JOHN C. and G. P. HESS. A New Method of Forming Peptide Bonds. *Am. Chem. Soc. J.* 77, p. 1067, February, 1955.

SHOEMAKER, DAVID P., C. BRINK and A. FOX. Preliminary Structural Results on P Phase (Mo-Ni-Cr) and Delta Phase (Mo-Ni) and Structural Relationships of These and Other Phases to the Sigma Phase. Technical Report No. 1, Office of Ordnance Research Contract DA-19-020-ORD-1859, April, 1955.

STEINHARDT, JACINTO and E. M. ZAISER. Effect of Temperature on the Reversible pH-dependent Denaturation of Horse Ferrihemoglobin. *Am. Chem. Soc. J.* 76, pp. 2866-2871, June, 1954.

STEPHENSON, CLARK C., D. R. BENTZ and D. A. STEVENSON. The Heat Capacity of Ammonium Nitrate from 15 to 315°K. *Am. Chem. Soc. J.* 77, pp. 2161-2164, April, 1955.

STOCKMAYER, WALTER H. Chain Dimensions Near the Flory Temperature. *J. Polymer Sci.* XV, pp. 595-598, February, 1955.

STOCKMAYER, WALTER H., D. W. RICE and CLARK C. STEPHENSON. Thermodynamic Properties of Sodium Borohydride and Aqueous Borohydride Ion. *Am. Chem. Soc. J.* 77, pp. 1980-1983, April, 1955.

STOCKMAYER, WALTER H., L. D. MOORE, JR., M. FIXMAN and B. N. EPSTEIN. Copolymers in Dilute Solution. I. Preliminary Results for Styrene-Methyl Methacrylate. *J. Polymer Sci.* XVI, pp. 517-530, April, 1955.

SWAIN, C. GARDNER, J. T. McKNIGHT, M. M. LABES and V. P. KREITER. The Mechanism of Exchange of Hydrogen be-

tween Nitrogen and Oxygen Atoms. *Am. Chem. Soc. J.* 76, p. 4243, August, 1954.

SWAIN, C. GARDNER, R. CARDINAUD and A. D. KETLEY. Hydrolysis of Alkyl Halides and Sulfonium Salts by Light and Heavy Water. *Am. Chem. Soc. J.* 77, pp. 934-936, February, 1955.

SWAIN, C. GARDNER and M. M. KREEVOY. Mechanism of Anion Exchange of Triphenylmethyl Chloride in Benzene Solution. *Am. Chem. Soc. J.* 77, pp. 1122-1128, March, 1955.

Department of City and Regional Planning

ADAMS, FREDERICK J. Urban Planning Education in the United States. Cincinnati, Ohio: The Alfred Bettman Foundation, 1954.

ISARD, WALTER. Broadening the Base of Economic Research. (In *Housing and Economic Development*, Bemis Foundation Report, edited by Burnham Kelly. Cambridge: M.I.T. School of Arch. & City Planning, 1955.)

ISARD, WALTER. Comments on Input-Output Analysis of the Puerto Rican Economy. (In *Conference on Research in Income and Wealth, Input-Output Analysis: An Appraisal.* Princeton, N.J.: Princeton University Press, 1955.)

ISARD, WALTER. The Economic Consequences of the Changing Geography of American Industry. *Ind. Rela. Res. Assoc. Proc.* 6, pp. 221-225, 1954.

ISARD, WALTER and G. FREUTEL. Regional and National Product Projections and Their Interrelations. (In *Long-Range Economic Projection. Conference on Research in Income and Wealth, Studies in Income and Wealth*, Vol. 16. Princeton, N.J.: Princeton Univ. Press, 1954.)

ISARD, WALTER and R. KAVESH. Economic Structural Interrelations of Metropolitan Regions. *Am. J. Sociology* 60, pp. 152-162, September, 1954.

ISARD, WALTER and V. WHITNEY. Atoms for Peace: Pattern for America. *Nation* 180, pp. 542-548, June, 1955.

KELLY, BURNHAM. Neutra's Physiology, Review of *Survival Through Design*, edited by Richard J. Neutra (New York:

Oxford Univ. Press, 1954). *Am. Inst. Planners J.* 20, pp. 161-163, Summer, 1954.

RODWIN, LLOYD. Planned Decentralization and Regional Development. *Am. Inst. Planners J.* 21, pp. 43-49, Winter, 1955.

RODWIN, LLOYD. Measuring Housing Needs in Developing Countries. *International Federation of Housing & Town Planning* 33, pp. 8-11, August, 1954.

RODWIN, LLOYD. Housing in 1954. (In *Colliers' Yearbook*, 1955. New York: Crowell-Collier Pub. Co., 1955.)

RODWIN, LLOYD. Review of *Housebuilding in Transition*, by Sherman J. Maisel (San Francisco: University of California Press, 1954). *Town Planning Rev.* 25, pp. 288-291, January, 1955.

RODWIN, LLOYD. Review of *Urban Traffic, A Function of Land Use*, by Robert Mitchell and Chester Rapkin (New York: Columbia, University Press, 1954). *Am. Inst. Planners J.* 21, pp. 55-56, Winter, 1955.

RODWIN, LLOYD. Review of *The House and The Art of Its Design*, by Robert Woods Kennedy (New York: Reinhold Publishing Co., 1953). *Land Economics* 31, pp. 161-162, May, 1955.

Department of Civil and Sanitary Engineering

ARCHER, JOHN S. and A. LANGE. A Discussion of *Analog Computers Applied to Elastic-Plastic Systems*, by L. Schenker and G. Martin. *Am. Soc. Civil Engrs. Proc.* 80, Paper No. 528, October, 1954.

BIGGS, JOHN M. Wind Loads on Truss Bridges. *Am. Soc. Civil Engrs. Trans.* 119, pp. 879-898, 1954.

BIGGS, JOHN M. Buckling Considerations in the Design of Steel Beams and Plate Girders. *Boston Soc. Civil Engrs. J.* 41, pp. 418-447, October, 1954.

BIGGS, JOHN M., SAUL NAMYET and JIRO ADACHI. Wind Loads on Girder Bridges. *Am. Soc. Civil Engrs. Proc.* 81, Paper no. 587, January, 1955.

BREUNING, SIEGFRIED M. and ALEXANDER J. BONE. Soniscope Applied to Maintenance of Concrete Structures. *Highway Research Board Proc.* 33, pp. 210-216, 1954.

DIETZ, ALBERT G. H. Better Buildings . . . With Plastics. *Modern Plastics* 32, pp. 85-90; 216, February, 1955.

DIETZ, ALBERT G. H. Design Theory of Reinforced Plastics. (A Chapter in *Fiberglass Reinforced Plastics*, by Ralph H. Sonneborn. New York: Reinhold Publishing Co., 1954.)

DIETZ, ALBERT G. H. Engineering Properties of Plastics for Building. *Plastics Technology* 1, pp. 282-287; 302, June, 1955.

DIETZ, ALBERT G. H. and F. J. McGARRY. An Extensometer for Polymeric Materials. *Rev. Sci. Instr.* 25, pp. 740-745, August, 1954.

DIETZ, ALBERT G. H. Glass-Reinforced Polyester Molding Compounds. (In *Annual Handbook of Product Design.* New York: McGraw-Hill Publ. Co., 1954.)

DIETZ, ALBERT G. H. Physical and Engineering Properties of Plastics. Nat. Research Council, Building Research Inst., Plastics in Building Publ. 337. Washington D.C.: Nat. Research Council.

DIETZ, ALBERT G. H. Physical and Engineering Properties of Plastics. *Boston Soc. Civil Engrs. J.* 42, pp. 134-157, April, 1955.

DIETZ, ALBERT G. H. Reinforced Plastics. *Technical Aids for Small Manufacturers* (Washington, D.C.: Small Business Administration), October, 1954.

DIETZ, ALBERT G. H. Selecting Plastics for Building Uses. *Architectural Record* 117, pp. 225-231, April, 1955.

DIETZ, ALBERT G. H. and W. J. LeMESSURIER. Wood Structures for Houses. *Architectural Record* 116, pp. 213-216, October, 1954.

ELIASSEN, ROLF and JAMES C. LAMB, III. Mechanism of the Internal Corrosion of Water Pipe. *Am. Water Works Assoc. J.* 45, pp. 1281-1294, December, 1953.

ELIASSEN, ROLF. Fresh Water from Salt Seas. *World Health Organization News* 8, p. 3, February, 1955.

ELIASSEN, ROLF and JAMES C. LAMB, III. Corrosion Control with

Metaphosphate Glass. *N.E. Water Works Assoc. J.* 69, pp. 31-68, March, 1955.

ELIASSEN, ROLF and R. F. McCAULEY. Accelerating Calcium Carbonate Precipitation in Softening Plants. *Am. Water Works Assoc. J.* 47, p. 487, May, 1955.

ELIASSEN, ROLF and R. F. McCAULEY. Radioactive Strontium Removal by Lime-Soda Softening. *Am. Water Works Assoc. J.* 47, p. 494, May, 1955.

ELIASSEN, ROLF and H. ROMER. The Role of Municipal Health Department Engineers in Public Works. *Am. J. Pub. Health* 45, p. 736, June, 1955.

GUMPERTZ, WERNER H. Graduate Education in Building Engineering and Construction. *J. Eng. Educ.* 45, pp. 619-628, April, 1955.

HANSEN, ROBERT J. The Impact of Nuclear Energy on Safety and the Citizen. *Chem. Eng. Progress,* Symposium Series 50, 1954.

HARLEMAN, DONALD R. F. Effects of Baffle Piers on Stilling Basin Performance. *Boston Soc. Civil Engrs. J.* 42, pp. 84-99, April, 1955.

IPPEN, ARTHUR T. and G. KULIN. The Shoaling and Breaking of the Solitary Wave. *Proceedings of the Fifth Conference on Coastal Engrg.*, pp. 27-47, 1954.

IPPEN, ARTHUR T. and C. E. CARVER, JR. Basic Factors of Oxygen Transfer in Aeration Systems. *Sewage and Ind. Wastes* 26, pp. 813-827, July, 1954.

IPPEN, ARTHUR T. and DONALD R. F. HARLEMAN. Verification of Theory for Oblique Standing Waves. *Am. Soc. Civil Engrs. Proc.* 80, p. 17, October, 1954.

LAMB, JAMES C., III and ROLF ELIASSEN. Mechanism of Corrosion Inhibition by Sodium Metaphosphate Glass. *Am. Water Works Assoc. J.* 46, pp. 445-460, May, 1954.

LAMBE, T. WILLIAM. The Permeability of Fine Grained Soils. American Society for Testing Materials Spec. Tech. Publ. 163, June, 1955.

LeMESSURIER, W. J. and ALBERT G. H. DIETZ. Engineered Wood

Design: Stressed-Skin Plywood Panels. *Architectural Record* 116, pp. 225-229, October, 1954.

LeMESSURIER, W. J. and ALBERT G. H. DIETZ. Engineered Wood Design: Plank and Beam Construction. *Architectural Record* 117, pp. 181-185, January, 1955.

LeMESSURIER, W. J. and ALBERT G. H. DIETZ. Engineered Wood Design: Plank and Beam Construction. *Architectural Record* 117, pp. 221-225, February, 1955.

MITCHELL, JAMES K. Discussion of *Strength Characteristics of Compacted Clays*, by Gerald A. Leonards. *Am. Soc. Civil Engrs. Proc.* 80, p. 518, October, 1954.

MURRAY, JAMES A., H. C. FISCHER and L. S. ROLNICK. Shrinkage of High-Calcium Limestones During Burning. *Am. Ceramic Soc. J.* 37, pp. 323-328, July, 1954.

NORRIS, CHARLES H. and J. B. SCALZI. Local Buckling of Intermittently Welded Structural Members. *Welding J.* 19, pp. 564s-578s, November, 1954.

SAWYER, CLAIR N., F. S. HOWARD and E. R. PERSHE. Scientific Basis for Liming of Digesters. *Sewage and Ind. Wastes* 26, pp. 935-944, August, 1954.

SAWYER, CLAIR N. Biochemical Degradation of Synthetic Detergents. *Sewage and Ind. Wastes* 26, pp. 1069-1080, September, 1954.

SAWYER, CLAIR N. and WILLIAM O. LYNCH. Physical Behavior of Synthetic Detergents. I. Preliminary Studies on Frothing and Oxygen Transfer. *Sewage and Ind. Wastes* 26, pp. 1193-1201, October, 1954.

SAWYER, CLAIR N. and HAROLD E. SCHMIDT. High-Rate Sludge Digestion. *Boston Soc. Civil Engrs. J.* 42, pp. 1-17, January, 1955.

TAYLOR, DONALD C. and MURRAY B. McPHERSON. Elbow Meter Performance. *Am. Water Works Assoc. J.* 46, pp. 1087-1095, November, 1954.

WILBUR, JOHN B. Synthesis in the Education of the Engineer During Early Training Rather Than Later or Not At All. *Boston Soc. Civil Engrs. J.* 42, pp. 30-34, January, 1955.

WILBUR, JOHN B. Is Engineering Being Taught Backward? *Civil Eng.* 25, p. 57, January, 1955.

WILBUR, JOHN B. The Limitations of Logic in Engineering Education. *The Technology Review* 57, pp. 233-236, March, 1955.

Department of Economics and Social Science

ADELMAN, MORRIS A. Corporate Integration. (In *How to Comply with the Anti-Trust Laws.* New York: Commerce Clearing House, 1954.)

ADELMAN, MORRIS A. Concept and Statistical Measurement of Vertical Integration. (In *Business Concentration and Price Policy.* New York: Natl. Bureau of Econ. Research, 1955.)

ADELMAN, MORRIS A. A Note on Corporate Concentration and Turnover. *Am. Econ. Rev.* 44, pp. 392-395, June, 1954.

BALDWIN, GEORGE B., PAUL A. SAMUELSON and R. ROBINSON. Student Workbook for *Economics: An Introductory Analysis* (3rd edition), by Paul A. Samuelson. New York: McGraw-Hill Book Co., 1955.

BALDWIN, GEORGE B. Urbanization and Industrialization of the Labor Force in Underdeveloped Countries: Comments on Two Papers. *Am. Econ. Rev.* 45, pp. 185-188, May, 1955.

BROWN, E. CARY. The Corporate Income Tax in the Short Run. *Nat. Tax. J.* 7, pp. 240-241, September, 1954.

BROWN, E. CARY. Capital Maintenance and the Concept of Income: A Correction. *J. Political Econ.* 63, p. 74, February, 1955.

BROWN, E. CARY. The New Depreciation Policy Under the Income Tax: An Economic Analysis. *Nat. Tax. J.* 8, pp. 81-98, March, 1955.

ENOS, JOHN L. The High Price of Gold. (In *Public Policy*, Vol. 5, edited by C. V. Friedrich and J. K. Galbraith. Cambridge: Harvard Graduate School of Public Administration, 1955.)

HAGEN, EVERETT E. The Consumption Function: A Review Article. *Rev. Econ. Statistics* 37, pp. 48-54, February, 1955.

HAGEN, EVERETT E. Economic Development: Principles and Patterns. *World Politics* 7, pp. 448-460, April, 1955.

HERRNSTADT, IRWIN L. The Reaction of Three Local Unions to Economic Adversity. *J. Political Econ.* 42, pp. 425-439, October, 1954.

KINDLEBERGER, CHARLES P. L'Asymetrie de la Balance des Paiements et le Probleme du Dollar. *Revue Économique* 2, pp. 166-189, March, 1954.

KINDLEBERGER, CHARLES P. German Terms of Trade by Commodity Classes and Areas. *Rev. Econ. Statistics* 36, pp. 167-174, May, 1954.

KINDLEBERGER, CHARLES P. A Monetary Economist on Power Politics. *World Politics* 6, pp. 507-514, July, 1954.

KINDLEBERGER, CHARLES P. Anciens et Nouveaux Produits en Commerce International. *Économie Appliquée* 7, pp. 281-297, July-August, 1954.

KINDLEBERGER CHARLES P. Les Termes d'Echange de la Belgique Entre 1870 et 1952. *Banque Nationale de Belgique, Bulletin d'Information et de Documentation* 2, pp. 1-10, September, 1954.

KINDLEBERGER, CHARLES P. The Position and Prospects of Sterling. *J. Political Econ.* 63, pp. 70-73, February, 1955.

KINDLEBERGER, CHARLES P. Industrial Europe's Terms of Trade on Current Account, 1870-1953. *Econ. J.* 65, pp. 19-35, March, 1955.

McGILL, WILLIAM J. The Relation Between Uncertainty and Variance. (In *Proceedings of 1954 Invitational Conference on Testing Problems*. Princeton, N.J.: Educational Testing Service, 1955.)

MARILL, T. and E. G. HEINEMANN. Tilt Adaptation and Figural After-Effects. *J. Exper. Psychology* 48, pp. 468-472, 1954.

MYERS, CHARLES A. The Role of the Personnel Officer in American Industry. *Nat. Inst. Labour Management (Bombay) J.* 1, pp. 8-11, January-February-March, 1955.

MYERS, CHARLES A. and JOHN T. DUNLOP. The Industrial Relations Function in Management: Some Views on Its Organizational Status. *Personnel* 31, pp. 406-413, March, 1955.

MYERS, CHARLES A. Management's Responsibility for Effective Communication in Industry. *Industrial Relations* (Cal-

cutta), Annual Conference Number, April, 1955.

PADELFORD, NORMAN J. and GEORGE A. LINCOLN. International Politics. New York: The Macmillan Co., 1954.

PADELFORD, NORMAN J. Review of *The Challenge to American Foreign Policy*, by John J. McCloy. *Western Political Quarterly* 8, pp. 283-284, June, 1955.

PADELFORD, NORMAN J. Review of *European Union and United States Foreign Policy*, by F. S. C. Northrop (New York: The Macmillan Co., 1954). *Religion in Life* 24, pp. 452-454, Summer, 1955.

POOL, ITHIEL DeSOLA. Satellite Generals: A Study of Military Elites in The Soviet Sphere. Stanford, Calif.: Stanford University Press, 1955.

SAMUELSON, PAUL A. Current Economic Trends in the American Economy. *Sangyo Keisai Shimbun*, December, 1954.

SAMUELSON, PAUL A. Review of *John Maynard Keynes*, by Seymour Harris. *New York Herald Tribune*, March, 1955.

SAMUELSON, PAUL A., R. L. BISHOP and J. C. COLEMAN. Readings in Economics (2nd edition). New York: McGraw-Hill Book Co., 1955.

SAMUELSON, PAUL A. Economics: An Introductory Analysis (3rd edition). New York: McGraw-Hill Book Co., 1955.

SAMUELSON, PAUL A. Lessons in Policy from American Recession. *Sydney Morning Herald Financial Supplement*, September 21, 1954.

SAMUELSON, PAUL A. U.S. Economy Turns the Corner. *London Financial Times*, November 24, 1954.

SAMUELSON, PAUL A., L. R. KLEIN, J. S. DUESENBERRY, J. S. CHIPMAN, J. TINBERGEN, D. G. CHAMPERNOWNE, R. SOLOW, R. DORFMAN and T. C. KOOPMANS. Mathematics in Economics: Discussion of Mr. Novick's Article. IX. Some Psychological Aspects of Mathematics and Economics. *Rev. Econ. Statistics* 36, pp. 380-382, November, 1954.

SAMUELSON, PAUL A., L. R. KLEIN, J. S. DUESENBERRY, J. S. CHIPMAN, J. TINBERGEN, D. G. CHAMPERNOWNE, R. SOLOW, R. DORFMAN and T. C. KOOPMANS. Mathematics in Economics:

Discussion of Mr. Novick's Article. Introduction: Mathematics in Economics — No, No or Yes, Yes, Yes. *Rev. Econ. Statistics* 36, p. 359, November, 1954.

SAMUELSON, PAUL A. The Pure Theory of Public Expenditure. *Rev. Econ. Statistics* 36, pp. 387-389, November, 1954.

SAMUELSON, PAUL A. Comment on *Professor Samuelson on Operationalism in Economic Theory*, by Donald F. Gordon. *Quarterly Journal of Economics* 69, pp. 310-314, May, 1955.

SAMUELSON, PAUL A. Recent American Monetary Policy. *London Financial Times*, May 16, 1955.

SHULTZ, GEORGE P. and GEORGE B. BALDWIN. Automation: A New Dimension to Old Problems. (In *Proceedings of Seventh Annual Meeting*, Industrial Relations Research Association, December, 1954, pp. 114-128. Detroit, Michigan: The Association, 1955.)

SIEGEL, ABRAHAM J. and CLARK KERR. Industrialization and the Labor Force: A Typological Framework. (In *Labor, Management and Economic Growth*, edited by R. L. Aronson and J. P. Windmuller. Ithaca, N.Y.: Cornell University, 1954.)

SIEGEL, ABRAHAM J. and CLARK KERR. The Interindustry Propensity to Strike — An International Comparison. (In *Industrial Conflict*, edited by A. Kornhauser, R. Dubin and A. M. Ross. New York: McGraw-Hill Book Co., 1954.)

SIEGEL, ABRAHAM J. and CLARK KERR. The Structuring of the Labor Force in Industrial Society: New Dimensions and New Questions. *Indus. and Labor Relations Rev.* 8, pp. 151-168, January, 1955.

Department of Electrical Engineering

ADAMS, CHARLES W. Small Computers in a Large World (Keynote Address). *Eastern Joint Computer Conference Proc.* 4, December, 1954.

ADAMS, CHARLES W. Automatic Data-Processing Equipment: A Survey. (In *Electronic Data-Processing in Industry*, Special Report Number 3, by T. F. Bradshaw and others. New York: Assoc., June, 1955.)

ADLER, RICHARD B. and S. J. FRICKER. Notes on the Flow of Scheduled Air Traffic. *Royal Aero. Soc. J.* 58, pp. 475-484, July, 1954.

ADLER, RICHARD B. and S. J. FRICKER. Notes on the Flow of Scheduled Air Traffic. *I.R.E. Trans.* (Aeronautical and Naval Electronics -2), June, 1955.

BAGHDADY, ELIE J. On Reciprocal Inductance. *I.R.E. Proc.* 42, p. 1807, December, 1954.

BAGHDADY, ELIE J. Frequency-Modulation Interference Rejection with Narrow-Band Limiters. *I.R.E. Proc.* 43, pp. 51-61, January, 1955.

BAKER, STUART C. An Acoustic Intensity Meter. *Acoustical Soc. Am. J.* 27, pp. 269-273, March, 1955.

BARLOW, JOHN S., G. W. FREY, JR. and J. B. NEWMAN. Very Low Frequency Noise Power from the Lightning Discharge. *Franklin Inst. J.* 258, pp. 187-203, September, 1954.

BARUCH, JORDAN J., W. J. GALLOWAY and B. G. WATTERS. An Explosive Noise Source. *Acoustical Soc. Am. J.* 27, pp. 220-223, March, 1955.

BERANEK, LEO L. Section III: Acoustic Measurements, General Review. *Acoustica* 4, pp. 92-96, 1954.

BERANEK, LEO L. Loudspeakers and Microphones. *Acoustical Soc. Am. J.* 26, pp. 618-629, September, 1954.

BERANEK, LEO L. Sound Systems for Large Auditoriums. *Acoustical Soc. Am. J.* 26, pp. 661-675, September, 1954.

BERANEK, LEO L., S. LEBATE and U. INGARD. Noise Control for NACA Supersonic Wind Tunnel. *Acoustical Soc. Am. J.* 27, pp. 85-98, January, 1955.

BERANEK, LEO L., G. W. KAMPERMAN and CLAYTON H. ALLEN. Noise of Centrifugal Fans. *Acoustical Soc. Am. J.* 27, pp. 217-219, March, 1955.

BERANEK, LEO L., B. G. WATTERS and S. LABATE. Acoustical Behavior of Some Engine Test Cell Structures. *Acoustical Soc. Am. J.* 27, pp. 449-456, May, 1955.

BOEHNE, EUGENE W. Application of Operations Research in the Power Field. *Elec. Eng.* 73, pp. 655-658, July, 1954.

BOLT, RICHARD H. and T. F. HUETER. Sonics. New York: John Wiley and Sons, 1955.

BOLT, RICHARD H. A Community's Reaction to Noise: Can It Be Forecast? *Noise Control* 1, pp. 63-71, January, 1955.

BOOTON, RICHARD C. and A. TUSTIN. The Role of Mathematics in Economic Prediction and Stabilization. *International Sci. Bull.* (UNESCO) 6, pp. 628-640, 1954.

BOOTON, RICHARD C. The Measurement and Representation of Nonlinear Systems. *I.R.E. Trans.* (Professional Group Circuit Theory-1), pp. 32-34, December, 1954.

BROWN, GORDON S. Educating Electrical Engineers to Exploit Science. *Elec. Eng.* 74, pp. 110-115, February, 1955.

BROWN, GORDON S. Training Your Workers for Automation. *Surplus Record* 32, pp. 16-18, 46-48, June, 1955.

BUCK, DUDLEY, A., D. R. BROWN and N. MENYUK. A Comparison of Metals and Ferrites for High-Speed Pulse Operation. *A.I.E.E. Trans.* 16, p. 631, January, 1955.

CAMPBELL, DONALD P. Signal Flow Diagrams for Process Evaluation. *Ind. Eng. Chem.* 47, pp. 409-413, March, 1955.

DWIGHT, HERBERT B. Electrical Elements Power Transmission Lines. New York: Macmillan Company, 1954.

EDGERTON, HAROLD E., R. BONAZOLI and J. T. LAMB. Duration and Peak Candlepower of Some Electronic Flashlamps. *Soc. Motion Picture & Television Engrs. J.* 63, pp. 15-18, July, 1954.

EDGERTON, HAROLD E. Electronic Flash Is For You. *U.S. Camera* 18, pp. 59-60, January, 1955.

EDGERTON, HAROLD E. Electronically Produced and Controlled Illumination. *I.R.E. Trans.* (Professional Group Industrial Electronics-2) , pp. 51-56, March, 1955.

EDGERTON, HAROLD E. Photographing the Sea's Dark Underworld. *Nat. Geog. Mag.* 107, pp. 523-537, April, 1955.

ELIAS, PETER. Error-Free Coding. *I.R.E. Trans.* (Professional Group Information Theory-4), pp. 29-37, September, 1954.

ELIAS, PETER. Predictive Coding. *I.R.E. Trans.* (Professional Group Information Theory-1), pp. 16-33, March, 1955.

ELIAS, PETER. Coding for Noisy Channels. *I.R.E. Convention Record* (Pt. 4 Computers, Information Theory, Automatic Control), pp. 37-46, 1955.

EPSTEIN, DAVID J. Permeability. (Chapter in *Dielectric Materials and Applications*, edited by A. R. von Hippel. Cambridge: John Wiley and Sons, Inc. and Technology Press, 1954.)

EPSTEIN, DAVID J. Ferromagnetic Materials. (Chapter in Vol. 17 of *Digest of the Literature on Dielectrics.) Nat. Acad. Sci. Nat. Research Council* 330, pp. 52-65, October, 1954.

FANO, ROBERT M. Information Theory, Past, Present and Future. *I.R.E. Convention Record* 2, pp. 2-3, March, 1954.

FANO, ROBERT M. Information Theory and Generalized Networks. *Symposium on Information Networks Proc.*, pp. 3-9, April, 1954.

FLANAGAN, JAMES LOTON. Letter to the Editor: The Difference Limen for Vowel Formant Frequency. *Acoustical Soc. Am. J.* 27, pp. 613-617, May, 1955.

GOLDSTEIN, M. H., JR. and C. W. MERRIAM, JR. Evaluation of an Automatic Landing System for Aircraft. Report of the National Telemetering Conference (Chicago, Ill.), pp. 149-155, May, 1955.

GUILLEMIN, ERNST A., H. STATZ and R. A. PUCEL. Design Considerations of Junction Transistors at Higher Frequencies. *I.R.E. Proc.* 42, pp. 1620-1628, November, 1954.

HAUS, HERMANN A. Equivalent Circuit for a Passive Nonreciprocal Network. *J. Appl. Phys.* 25, pp. 1500-1502, December, 1954.

HAUS, HERMANN A. Limitations on the Noise Figure of Microwave Amplifiers of the Beam Type. *I.R.E. Trans.* (Professional Group Electron Devices-1), pp. 238-258, December, 1954.

HAUS, HERMANN A. Noise in One-Dimensional Electron Beams. *J. Appl. Phys.* 26, pp. 560-571, May, 1955.

HUFFMAN, DAVID A. Information Conservation and Sequence Transducers. *Symposium on Information Networks Proc.*, April, 1954.

HUFFMAN, DAVID A. Philosophies of Sequential Circuit Behavior. *Symposium on Circuit Analysis Proc.*, pp. 1-24, May, 1955.

KUSKO, ALEXANDER and P. N. HELLER. Computer for Automatizing Network Analyzer Operation. *A.I.E.E. Trans.* (Communications and Electronics) 18, pp. 208-213, May, 1955.

LAMBERT ROBERT F. Acoustical Studies of the Tractrix Horn, I. *Acoustical Soc. Am. J.* 26, pp. 1024-1028, November, 1954.

LAMBERT ROBERT F. and A. O. JENSEN. Acoustical Studies of the Tractrix Horn, II. *Acoustical Soc. Am. J.* 26, pp. 1029-1033, November, 1954.

LEE, YUK-WING. On Wiener Filters and Predictors. *Symposium on Information Networks Proc.*, pp. 19-29, April, 1954.

McWHORTER, ALAN L. and R. H. KINGSTON. Channels and Excess Current in Grown Germanium P-N Junction Diodes. *I.R.E. Proc.* 42, pp. 1376-1380, September, 1954.

MASON, SAMUEL J. Power Gain in Feedback Amplifiers. *I.R.E. Trans.* (Professional Group on Circuit Theory-1), pp. 20-25, June, 1954.

MAWARDI, OSMAN K. On Acoustic Boundary Layer Heating. *Acoustical Soc. Am. J.* 26, pp. 726-731, September, 1954.

MAWARDI, OSMAN K. and J. E. YOUNG. On the Propagation of Noise in Pipes, Parts I and II. *Acoustical Soc. Am. J.* 26, p. 938(A), September, 1954.

MAWARDI, OSMAN K., G. D. GIFFORD and R. B. GOLDMAN. Apparatus for Measuring Noise of Vortical Origin. *Acoustical Soc. Am. J.* 26, p. 939(A), September, 1954.

MAWARDI, OSMAN K. On the Spectrum of Noise from Turbulence. *Acoustical Soc. Am. J.* 27, pp. 442-445, May, 1955.

MISHKIN, ELIEZER. Theory of the Induction Machine Derived Directly from Maxwell's Field Equations. *J. Mech. and Appl. Math.* (Oxford, England), 7, pp. 472-487, December, 1954.

MISHKIN, ELIEZER. Disturbances in the Induction Machine Due To Broken Squirrel-Cage Rings. *Franklin Inst. J.* 259, pp. 133-143, February, 1955.

MOON, PARRY and D. E. SPENCER. Calculation of Camera Exposure. *Franklin Inst. J.* 258, pp. 113-139, August, 1954.

MOON, PARRY and D. E. SPENCER. Reply to Discussion of Vector Laplacian. *Franklin Inst. J.* 258, pp. 215-216, September, 1954.

MOON, PARRY and D. E. SPENCER. Electromagnetism, Old and New. *Franklin Inst. J.* 258, pp. 398-400, November, 1954.

MOON, PARRY and D. E. SPENCER. Photometrics in Astronomy. *Franklin Inst. J.* 258, pp. 461-471, December, 1954.

MOON, PARRY and D. E. SPENCER. On Photographic Exposure Meters. *Soc. Motion Picture & Television Engrs. J.* 63, pp. 233-237, December, 1954.

MOON, PARRY and D. E. SPENCER. The Photometric Range of Outdoor Scenes. *Soc. Motion Picture & Television Engrs. J.* 63, pp. 237-239, December, 1954.

MOON, PARRY and D. E. SPENCER. A Postulational Approach to Electromagnetism. *Franklin Inst. J.* 259, pp. 293-305, April, 1955.

NEWTON, GEORGE C., JR. Discussion of *A Method for Evaluating Nonlinear Servomechanisms*, by M. V. Mathews. *A.I.E.E. Trans.* (Applications and Industry) 18, p. 123, May, 1955. 1955.

REZA, FAZLOLLAH M. Geometrical Properties of the "Root Locus" Curves. *International Congress of Mathematicians Proc.* 2, p. 159, August, 1954.

REZA, FAZLOLLAH M. and P. M. LEWIS, II. A Note on the Transfer Voltage Ratio of Passive RLC Networks. *I.R.E. Proc.* 42, p. 1452, September, 1954.

REZA, FAZLOLLAH M. Introductory Qualitative Synthesis of Linear Passive Networks in the Time Domain. *National Electronics Conference Proc.* 10, pp. 190-197, March, 1955.

RIAZ, MAHMOUD. Discussion: *Alteration of the Dynamic Response of Magnetic Amplifiers by Feedback*, by R. O. Decker. *A.I.E.E. Trans.* (Communications and Electronics) 16, pp. 664-665, January, 1955.

ROSENBLITH, WALTER A. Some Electrical Responses from the

Auditory Nervous System. *Symposium on Information Networks Proc.* 3, pp. 223-247, April, 1954.

ROSENBLITH, WALTER A., K. H. PRIBRAM and B. S. ROSNER. Electrical Responses to Acoustic Clicks in Monkey: Extent of Neocortex Activated. *J. Neurophysiol.* 17, pp. 336-344, July, 1954.

ROSENBLITH, WALTER A. Electrical Responses from the Auditory Nervous System. *Am. Otological Soc. Trans.* 42, pp. 135-154, 1954. *Annals of Otology, Rhinology and Laryngology* 63, pp. 839-851, September, 1954.

ROSENBLITH, WALTER A. and L. S. FRISHKOPF. Neural Responses to Clicks: An Analysis of Masked and Unmasked Intensity Functions. *Acoustical Soc. Am. J.* 26, p. 943, September, 1954.

ROSENBLITH, WALTER A. Standards for the Conservation of Hearing in Industry. *Mag. Standards* 26, p. 13, January, 1955. *Natl. Conf. on Standards Proc.* 5, pp. 30-34, November, 1954.

ROSENBLITH, WALTER A. Outline of an Inventory of Noises in the Home. *New England Professional Engr.* 8, pp. 12-14, November, 1954.

SAUNDERS, ROBERT M. and T. A. BRUNS. Analysis of Feedback Control Systems. New York: McGraw-Hill Book Co., April, 1955.

SAUNDERS, ROBERT M. and R. A. HEARTZ. Harmonics Due to Slots in Electric Machines. *A.I.E.E. Trans.* 73, pp. 946-949, August, 1954.

SAUNDERS, ROBERT M. and L. J. PRINCE, JR. A Generalized Method for Determining the Closed-Loop Frequency Response of Nonlinear Systems. *A.I.E.E. Trans.* 73, p. 224, September, 1954.

SAUNDERS, ROBERT M. Discussion: *Accurate Tachometry Methods with Electronic Counters*, by J. M. Shulman. *A.I.E.E. Trans.* 73, p. 454, November, 1954.

SAUNDERS, ROBERT M. Discussion: *Equations Predicting the Operation of the D-C Motor*, by R. W. Ahlquist. *A.I.E.E. Trans.* 73, p. 1504, December, 1954.

SAUNDERS, ROBERT M. Discussion: *Analysis of Nonlinear Coupled Circuits*, by Y. H. Ku. *A.I.E.E. Trans.* 73, p. 630, January, 1955.

SCOTT, RONALD R. A Wide-Band-Analog-Function Multiplier. *Electronics*, pp. 160-164, February, 1955.

SHANKS, DANIEL. On Analogous Theorems of Fredholm and Frame and on the Inverse of a Matrix. *Quarterly Appl. Math.* 13, pp. 95-98, April, 1955.

SHEN, DAVID W. C. and S. LISSER. An Analogue Computer for Automatic Determination of System Swing Curves. *A.I.E.E. Trans.* (Communications and Electronics) 15, pp. 475-483, November, 1954.

SILVERMAN, RICHARD A. and M. BALSER. Coding for Constant-Data-Rate Systems — Part I: A New Error-Correcting Code. *I.R.E. Proc.* 42, pp. 1428-1435, September, 1954.

SILVERMAN, RICHARD A. and M. BALSER. Statistics of Electromagnetic Radiation Scattered by a Turbulent Medium. *Phys. Rev.* 96, pp. 560-563, November, 1954.

SILVERMAN, RICHARD A. and M. BALSER. Coding for Constant-Data-Rate Systems — Part II: Multiple-Error Correcting Codes. *I.R.E. Proc.* 43, pp. 728-733, June, 1955.

SMEDAL, MAGNUS I., D. P. BOYD, H. B. KIRTLAND, G. E. KELLEY and JOHN G. TRUMP. Carcinoma of the Lung. *J. Thoracic Surg.* 28, pp. 392-408, October, 1954.

SMEDAL, MAGNUS I., H. P. GREELEY and W. MOST. Treatment of Carotid-sinus Syndrome by Irradiation. *New England J. Med.* 252, pp. 91-94, January, 1955.

SMEDAL, MAGNUS I., J. L. FROMER, JOHN G. TRUMP and KENNETH A. WRIGHT. High Energy Electrons for Generalized Superficial Dermatoses. *A.M.A. Arch. Dermat.* 71, pp. 391-395, March, 1955.

SMEDAL, MAGNUS I. and H. D. ADAMS. Treatment of Carcinoma of the Esophagus by Resection and Postoperative Supervoltage Roentgen Therapy. *Surg. Clin. N. Amer.* 35, pp. 647-652, June, 1955.

STEVENS, KENNETH N. A Survey of Background and Aircraft

Noise in Communities Near Airports. *N.A.C.A. Tech. Note* Number 3379, December, 1954.

STEVENS, KENNETH N. and A. S. HOUSE. Development of a Quantitative Description of Vowel Articulation. *Acoustical Soc. Am. J.* 27, pp. 484-493, May, 1955.

TAKAHASHI, YASUNDO Y. T. Graphical Determination of the Dynamics of Heat Reduction. *Control Eng.* 2, pp. 46-50, May, 1955.

TRUMP, JOHN G., R. C. GRANKE, KENNETH A WRIGHT, W. W. EVANS and J. E. NELSON. The Film Method of Tissue Dose Studies with 2.0 Mev. Roentgen Rays. *Am. J. Roentgenology, Radium Therapy, and Nuclear Medicine* 72, pp. 302-307, August, 1954.

TRUMP, JOHN G., KENNETH A. WRIGHT, W. W. EVANS, H. F. HARE, M.D., W. L. CONLON, E. EWERT and R. C. GRANKE. Treatment of Tumors of the Pelvic Cavity with Supervoltage Radiation. *Am. J. Roentgenology, Radium Therapy and Nuclear Medicine* 72, August, 1954.

TRUMP, JOHN G., C. H. GOLDIE, KENNETH A. WRIGHT, J. H. ANSON and R. W. CLOUD. Radiographic Properties of X-Rays in the Two- to Six-Million Volt Range. *A.S.T.M. Bull.* 201, pp. 49-54, October, 1954.

TRUMP, JOHN G., B. AARSET and R. W. CLOUD. Electron Emission from Metals Under High-Energy Hydrogen Ion Bombbardment. *J. Appl. Phys.* 25, pp. 1365-1368, November, 1954.

TRUMP, JOHN G., J. L. FROMER, M.D., M. I. SMEDAL, M.D. and KENNETH A. WRIGHT. High Energy Electrons for Generalized Superficial Dermatoses. *Am. Medical Assoc. Archives of Dermatology* 71, pp. 391-395, March, 1955.

TRUMP, JOHN G., G. HORRAX, M.D., M. I. SMEDAL, M.D., R. C. GRANKE and KENNETH A. WRIGHT. Present Day Treatment of Pituitary Adenomas. *New England J. of Medicine* 252, pp. 524-526, March, 1955.

TRUMP, JOHN G., H. C. BOURNE, JR. and R. W. CLOUD. Role of Positive Ions in High Voltage Breakdown in Vacuum. *J. Appl. Phys.* 26, p. 596, May, 1955.

VON HIPPEL, ARTHUR R., editor. Dielectric Materials and Applications. Cambridge: John Wiley and Sons and Technology Press, 1954.

VON HIPPEL, ARTHUR R. Dielectrics and Waves. Cambridge: John Wiley and Sons and Technology Press, 1954.

WHITE, DAVID C., V. B. HAAS, M. RIAZ and H. WOODSON. Study of Voltage Regulating Systems for Aircraft Alternating Current Generators. *W.A.D.C. Technical Report* 54-298 — Part I AF 33(616)2190, August, 1954.

WIDROW, BERNARD. A Radio-Frequency Nondestructive Readout for Magnetic-Core Memories. *I.R.E. Proc.* (Professional Group on Electronic Computers-3-4), pp. 12-15, December, 1954.

WIESNER, JEROME B. Source Noise and Its Effect Upon Electronic Systems. *I.R.E. Trans.* (Electronic Devices-1), pp. 3-10, December, 1954.

WOODSON, HERBERT H. and C. W. LUFCY. Design Considerations of the Half-Wave Bridge Magnetic Amplifier. *A.I.E.E. Trans.* (Communications & Electronics) 13, pp. 220-225, July, 1954.

ZIMMERMANN, HENRY J. BuOrd (NOrd 14362) *Quarterly Progress Reports:* July 15, 1954, October 15, 1954, January 15, 1955 and April 15, 1955.

ZIMMERMANN, HENRY J. MX-2013 *Quarterly Progress Reports:* July 1, 1954, October 1, 1954, January 1, 1955 and April 1, 1955.

Department of Food Technology

CHARM, S. E., SAMUEL A. GOLDBLITH and BERNARD E. PROCTOR. Theoretical Considerations in Food Processing by Gamma Radiations. I. Cylindrical Absorbers Within a Cylindrical Source. *Food Technology* 8, pp. 473-477, October, 1954.

GOLDBLITH, SAMUEL A. Cold Sterilization. (A Chapter in *A Forum Report: Business Opportunities in Atomic Energy*, edited by Oliver Townsend and Edwin Wiggin. New York: Atomic Industrial Forum, 1954.)

GOLDBLITH, SAMUEL A. Potentialities of Utilizing an Electron Bombardment Treatment for the Production of Canned Meat Products. *Symposium on Quality & Stability of Canned Meats* (Washington, D.C.: National Academy of Sciences, 1954), pp. 114-122.

GOLDBLITH, SAMUEL A. A Decade of Radiation Research. *Proceedings of 2nd Cathode Ray Symposium* (Milwaukee, Wisc.: General Electric X-Ray Dept., March, 1955).

GOLDBLITH, SAMUEL A., BERNARD E. PROCTOR, S. DAVISON, E. M. OBERLE, C. J. BATES, B. KAN, O. A. HAMMERLE and B. KUSMIEREK. How Processing Conditions Affect Microorganism Radioresistance. *Nucleonics* 13, pp. 42-45, January, 1955.

GOLDBLITH, SAMUEL A. Preservation of Foods by Ionizing Radiations. *Am. Dietetic Assoc. J.* 31, pp. 243-249, March, 1955.

GOLDBLITH, SAMUEL A. and BERNARD E. PROCTOR. Review of Status and Problems of Radiation Preservation of Foods and Pharmaceuticals. *J. Agricultural and Food Chemistry* 3, pp. 253-256, March, 1955.

GOLDBLITH, SAMUEL A. and PHILIP S. RANE. The Effect of the Addition of Free-Radical Acceptors on the Radiosensitivity of Pseudomonas Fluorescens. *Nucleonics* 13, p. 82, June, 1955.

HARRIS, ROBERT S. Vitamins. (In *Americana Annual*, p. 792. New York: Americana Corp., 1955.)

HARRIS, ROBERT S. Importancia del Analisis de los Alimentos en la Solucion de Problemas Alimenticios. *Revista Farmaceutica de Cuba*, pp. 55-60, 1954.

HARRIS, ROBERT S., JOHN W. CHAMBERLAIN and JAMES H. BENEDICT. Formation of Monoglycerides During Fat Digestion in Human Beings. *Federation Proc.* 13, p. 685, March, 1954.

HARRIS, ROBERT S., F. BRONNER, C. J. MALETSKOS and C. E. BENDA. Studies in Calcium Metabolism. Effect of Food Phytates on Calcium[45] Uptake in Children on Low Calcium Breakfasts. *J. Nutrition* 54, pp. 523-542, December, 1954.

HARRIS, ROBERT S. et al. Tabla Provisional de la Composition Nutritiva de los Alimentos Cubanos. *Boletin del Colegio Medico de la Habana* 6, pp. 145-156, May, 1955.

HARRIS, ROBERT S., J. M. NAVIA, H. LOPEZ, M. CIMADELVILLA and E. FERNANDEZ. Nutrient Composition of Cuban Foods. I. Foods of Vegetable Origin. *Food Research* 20, pp. 97-113, March-April, 1955.

HARRIS, ROBERT S. and W. H. SEBRELL. The Vitamins, Volume I, Volume II and Volume III. New York: Academic Press, Inc., 1955.

KAREL, MARCUS, Y. AIKAWA and BERNARD E. PROCTOR. Water-Vapor Permeability by Electric Hygrometer. An Evaluation of Mylar and Saran Films by Modified Apparatus as Developed at M.I.T. *Modern Packaging* 28, pp. 213-215, 322-324, April, 1955.

LOCKHART, ERNEST E. and H. V. SHUSTER. Development and Application of Objective Methods for Quality Evaluation of Spices. I. Color-Grading of Capsicums. *Food Research* 19, pp. 472-482, September-October, 1954.

MOOR, JOAN R., F. BRONNER, ROBERT S. HARRIS and C. E. BENDA. Calcium Metabolism. V. Differential Absorbability of Calcium Salts by Children. *Federation Proc.* 14, p. 428, March, 1955.

MOOR, JOAN R., F. BRONNER, ROBERT S. HARRIS, J. KREPLICH and C. E. BENDA. Calcium Metabolism. VI. Radiocalcium^{45} Metabolism in a Moribund Boy with Gargoylism. *Federation Proc.* 14, p. 429, March, 1955.

PROCTOR, BERNARD E. and R. P. JOSLIN. Pasteurization of Liquid Whole Egg by Cathode Ray Irradiation. (In *Stability of Dehydrated Eggs*, a symposium held at Univ. of Chicago, February, 1953.) *U.S. Q. Food and Container Inst. Survey of Progress on Military Substinence Problems*, Advis. Bd. on Q. Res. & Develop., Comm. on Foods, Nat. Research Council, 1954.

PROCTOR, BERNARD E. Food Irradiation. *World Refrigeration* 5, pp. 367-371, 394, 1954.

PROCTOR, BERNARD E., ERNEST E. LOCKHART, SAMUEL A. GOLD-

BLITH, A. V. GRUNDY, G. E. TRIPP, M. KAREL and R. C. BROGLE. The Use of Ionizing Radiations in the Eradication of Insects in Packaged Military Rations. *Food Technology* 8, pp. 536-540, December, 1954.

PROCTOR, BERNARD E. and M. KAREL. Effects of Cathode Ray Irradiation. *Modern Packaging* 28, pp. 137-139, 188, February, 1955.

ROBERTS, EDITH A. and BERNARD E. PROCTOR. The Comparative Effect of Ionizing Radiations and Heat Upon the Starch Containing Cells of the Potato Tuber. *Food Research* 20, pp. 254-263, May-June, 1955.

SHERMAN, HENRY. Contributions to the chapter on Vitamin B_6 in *The Vitamins*, by R. S. Harris and W. H. Sebrell, Volume III, pp. 243-253, 255, 264-276, 293-298. (New York: Academic Press, 1954.)

Department of Geology and Geophysics

BRACE, WILLIAM F. Quartzite Pebble Deformation in Central Vermont. *Am. J. Sci.* 253, pp. 129-145, March, 1955.

BUERGER, MARTIN J. and T. HAHN. The Crystal Structure of Berthierite, $FeSb_2S_4$. *Amer. Mineralogist* 40, pp. 226-238, March-April, 1955.

DENNEN, WILLIAM H. Laboratory Mapping. *J. Geol. Educ.* 2, pp. 75-76, Fall, 1954.

DENNEN, WILLIAM H. and WILLIAM C. FOWLER. Spectrographic Analysis by Use of a Mutual Standard Method. *Geol. Soc. Am. Bull.* 66, pp. 655-662, June, 1955.

FAIRBAIRN, HAROLD W. Concentration of Heavy Accessories from Large Rock Samples. *Geol. Soc. Am. Bull.* 65, p. 1250, December, 1954.

HAWKES, HERBERT E. Geochemical Prospecting Investigations in the Nyeba Lead-Zinc District, Nigeria. Bulletin 1000-B, U.S. Geological Survey, 1954.

HURLEY, PATRICK M. The Helium Age Method and the Distribution and Migration of Helium in Rocks. (Chapter in *Nuclear Geology*, edited by Henry Faul. New York: John Wiley & Sons, 1954.)

SHROCK, ROBERT R. Review of Memoir on *Silicified Middle Ordovician Trilobites*, by H. B. Whittington and W. R. Evitt, II. (N.Y. Geol. Soc. Am., 1953.) *U.S. Quarterly Book Rev.* 10, pp. 260-261, June, 1954.

SIMPSON, STEPHEN M., JR. Similarity of Output Traces as a Seismic Operator Criterion. *Geophysics* 20, pp. 254-269, April, 1955.

WHITEHEAD, WALTER L. Nuclear Geology. (A chapter in *Hydrocarbons Formed by Effect of Radioactivity and Their Role in the Origin of Petroleum.* New York: John Wiley & Sons, 1954.)

WHITEHEAD, WALTER L. and LEWIS H. KING. Vacuum Differential Analysis of Coal. *Economic Geology* 50, pp. 22-41, January, 1955.

Department of Graphics

ADAMS, DOUGLAS P. Namogram for Zero-Energy Napper. *Textile World* 104, p. 132, August, 1954.

ADAMS, DOUGLAS P. A Personality Sketch — Professor John T. Rule. *J. Eng. Drawing* 19, p. 21, May, 1955.

COONS, STEVEN A. Graphics and Differential Equations. *J. Eng. Educ.* 45, pp. 555-556, March, 1955.

TWIGG, JOHN F. Graphic Solution for Complex Quadratic Roots. *J. Eng. Drawing* 18, pp. 33-36, November, 1954.

Department of Humanities

BARTLETT, IRVING H. From Slave to Citizen: The Story of the Negro in Rhode Island. Providence: Urban League of Greater Providence, 1954.

BLUM, JOHN M. Nest of the Bull Moose. *Sat. Rev. Lit.* 37, pp. 19-20, August, 1954.

BLUM, JOHN M. Muses in the Lab. *Tech. Eng. News* 36, pp. 19-21, April, 1955.

BLUM, JOHN M. Review of *Red Scare: A Study In National Hysteria, 1919-1920*, by Robert K. Murray. (Minneapolis: Univ. of Minn. Press, 1955.) *The Mississippi Valley Historical Review* 42, pp. 144-146, June, 1955.

BOWLES, EDMUND A. *Haut* and *Bas:* The Grouping of Musical Instruments in the Middle Ages. *Musica Disciplina* 8, pp. 115-140, 1954.

CHANDLER, ALFRED D., JR. Patterns of American Railroad Finance, 1830-1850. *Business History Rev.* 28, pp. 248-263, September, 1954.

CHANDLER, ALFRED D., JR. Review of *Ford: The Times, the Man and the Company,* by Allan Nevin. (N.Y.: Scribner, 1954.) *Business History Rev.* 28, pp. 387-389, December, 1954.

CHANDLER, ALFRED D., JR. Review of *The Roosevelt Family of Sagamore Hill,* by Hermann Hagedorn. (N.Y.: MacMillan, 1954.) *Am. Historical Rev.* 60, pp. 690-691, April, 1955.

COLLINS, CARVEL. Faulkner's Reputation and the Contemporary Novel. (A Chapter in *Literature in the Modern World,* edited by John Mason Brown, Archibald MacLeish and Edward Weeks. Nashville: Peabody College, 1954.)

COLLINS, CARVEL. Henry James' *The Turn of the Screw. The Explicator* 13, June, 1955.

COLLINS, CARVEL. Review of *The Solitary Singer: A Critical Biography of Walt Whitman,* by Gay Wilson Allen. (New York: Macmillan, 1955.) *United States Quarterly Book Review* 11, pp. 167-168, June, 1955.

COLLINS, CARVEL. The Art of Fiction: Georges Simenon. *Paris Review* 9, pp. 71-90, June, 1955.

COLLINS, CARVEL. Review of *A Fable,* by William Faulkner. (New York: Random House, 1954.) *New York Times Book Review,* pp. 1 and 13, August 1, 1954.

COLLINS, CARVEL. A note on *The Sound and the Fury,* by William Faulkner. *New York Times Book Review,* p. 8, August 8, 1954.

COLLINS, CARVEL. Faulkner and Certain Earlier Southern Fiction. *College English* 16, pp. 92-97, November, 1954.

COLLINS, CARVEL. Review of *A Treasury of Railroad Folklore,* edited by B. A. Botkin and Alvin Harlow. (New York: Crown Publishers, 1953.) *J. Am. Folklore* 68, pp. 237-238, April-June, 1955.

COLLINS, CARVEL. Additional reviews in *United States Quar-*

terly Book Review and *New York Times Book Review.*

de SANTILLANA, GIORGIO D. The Crime of Galileo. Chicago: The Univ. of Chicago Press, 1955.

de SANTILLANA, GIORGIO D. Galileo Galilei. Translation of *Dialogue on the Great World Systems* (abridged text edition), by T. Salusbury. Chicago: Univ. of Chicago Press, 1955.

de SANTILLANA, GIORGIO D. Lights and Shadows in the Philosophy of Science. *Confluence* 3, pp. 187-195, June, 1954.

DEUTSCH, KARL W. A People of Plenty in a World of Want. Review of *People of Plenty: Economic Abundance and the American Character*, by David M. Potter. (Chicago: Univ. of Chicago Press, 1954.) *The Yale Review* 44, pp. 292-295, Winter, 1955.

DEUTSCH, KARL W. Review of *Mathematical Thinking in the Social Sciences*, edited by Paul F. Lazarsfeld. (Chicago: Free Press, 1954.) *Am. J. Sociology* 40, pp. 398-399, January, 1955.

GOOCH, BRISON D. Review of *The French Revolution 1788-1792*, by Gaetano Salvemini. (London: Jonathon Cope, 1954.) *Western Political Quarterly* 8, pp. 137-138, March, 1955.

GOOCH, BRISON D. Review of *Der Krimkrieg und die Entstehung der Modernen Flotten*, by Wilhelm Treue. (Göttingen: Musterschmidt, 1954.) *Journal of Modern History* 27, p. 204, June, 1955.

HARTLEY, EDWARD N. Review of *The History of Kirkstall Forge*, by Rodney Butler. (York, England: William Sessions, Ltd., The Ebor Press, 1954.) *The Business History Rev.* 29, pp. 99-100, March, 1955.

KOEHL, ROBERT L. What the Colleges Can Do To Help the Social Science Come of Age. *Harvard Educational Rev.* 24, pp. 263-272, Fall, 1954.

LURIE, EDWARD. Louis Agassiz and the Races of Man. *Isis* 45, pp. 227-242, September, 1954.

MacMASTER, ROBERT E. The Question of Heinrich Rückert's Influence on Danilevskij. *The American Slavic & East European Rev.* 14, pp. 59-66, February, 1955.

MAHONEY, THOMAS H. D. Review of *Admiral Kimmel's Story*,

by Husband E. Kimmel. (Chicago: Regnery, 1955.) *Boston Herald*, January 16, 1955.

MAHONEY, THOMAS H. D. Review of *Ideals and Self-Interest in America's Foreign Relations: The Great Transformation of the 20th Century*, by Robert Osgood. (Chicago: Univ. of Chicago Press, 1953.) *The Catholic Historical Review* 40, pp. 478-479, January, 1955.

MAHONEY, THOMAS H. D. Review of *Civilization and Foreign Policy*, by Louis J. Halle. (New York: Harper, 1955.) *America* 92, p. 679, March, 1955.

MAHONEY, THOMAS H. D. Review of *The American Legion and Foreign Policy*, by Roscoe Baker. (New York: Bookman Assoc., 1955.) *America* 92, p. 679, March, 1955.

MAHONEY, THOMAS H. D. Review of *Major Problems of U.S. Foreign Policy, 1954.* (Washington: The Brookings Institution, 1954.) *The Historical Bulletin* 33, p. 246, May, 1955.

MAHONEY, THOMAS H. D. Review of *A Foreign Economic Policy for the United States*, by Clarence Randall. (Chicago: Univ. of Chicago Press, 1955.) *America* 93, p. 160, May, 1955.

O'DEA, THOMAS F. The Sociology of Religion. *The Am. Catholic Sociological Rev.* 15, pp. 73-103, Summer, 1954.

O'DEA, THOMAS F. Mormonism and the American Experience of Time. *Western Humanities Rev.* 8, pp. 181-190, Summer, 1954.

O'DEA, THOMAS F. Mormonism and the Avoidance of Sectarian Stagnation: A Study of Church, Sect, and Incipient Nationality. *Am. J. Sociology* 60, pp. 285-293, November, 1954.

O'DEA, THOMAS F. The Effects of Geographical Position on Belief and Behavior in a Rural Mormon Village. *Rural Sociology* 19, pp. 358-364, December, 1954.

RAE, JOHN B. and THOMAS H. D. MAHONEY. *The United States in World History*, 2nd edition. New York: McGraw-Hill, 1955.

RAE, JOHN B. Review of *Economic Forces in American History*, by George H. Soule. (New York: Sloan Assoc., 1952.) *Midwest J.* 6, pp. 100-102, Summer, 1954.

RAE, JOHN B. Review of *From Mine to Market. The History*

of Coal Transportation on the Norfolk and Western Railway, by Joseph T. Lambie. (New York: N.Y. University Press, 1954.) *Business History Rev.* 28, pp. 398-399, December, 1954.

RAE, JOHN B. The Engineer as Business Man in American Industry: A Preliminary Analysis. *Explorations in Entrepreneurial History* 7, pp. 94-104, December, 1954.

RAE, JOHN B. Review of *The Memoirs of Herbert Hoover*, Vols. II and III. (New York: The MacMillan Co., 1954.) *Freedom and Union* 10, p. 22, January, 1955.

RAE, JOHN B. Engineering Education as Preparation for Management: A Study of M.I.T. Alumni. *Business History Rev.* 29, pp. 64-74, March, 1955.

RAE, JOHN B. The Railroad Land-Grant Legend. *J. Econ. History* 15, pp. 112-113, Spring, 1955.

STAHLMAN, WILLIAM D. Review of *Heraclitus: The Cosmic Fragments*, by G. S. Kirk. (New York: Cambridge University Press, 1954.) *Isis* 45, pp. 308-309, September, 1954.

STAHLMAN, WILLIAM D. Review of *Catalogue of Astrological and Mythological Illuminated Manuscripts of the Latin Middle Ages*, Vol. 3, by F. Saxl and H. Meier. (London: The Warburg Institute, 1953.) *Isis* 45, pp. 309-311, September, 1954.

STAHLMAN, WILLIAM D. Review of *Miracle and Natural Law in Graeco-Roman and Early Christian Thought*, by Robert M. Grant. (Amsterdam: North-Holland Publishing Co., 1952.) *Isis* 45, pp. 390-391, December, 1954.

School of Industrial Management

(Including the Undergraduate Course in Business and Engineering Administration)

ATWATER, THOMAS V., JR. Review of *Long-Form Report Practice*. (New York: American Institute of Accountants, 1954.) *Accounting Research* 5, pp. 364-366, October, 1954.

ATWATER, THOMAS V., JR. The Theory of Inventory Management: A Review. *Naval Research Logistics Quarterly* 1, pp. 294-300, December, 1954.

BERANEK, WILLIAM and F. J. WESTON. Programming Invest-

ment Portfolio Construction. *The Analyst J.* 11, pp. 51-55, May, 1955.

BOWMAN, EDWARD H. Using Statistical Tools to Set a Reject Allowance. *N.A.C.A. Bulletin* 36, pp. 1334-1342, June, 1955.

BROWN, CARROLL J. Incentive Wage Methods Plan Engineering Handbook (second edition). New York: McGraw-Hill Book Co., 1955.

DURAND, DAVID and LAWRENCE A. JONES. Mortgage Lending Experience in Agriculture. (A study by the National Bureau of Economic Research.) Princeton, N.J.: Princeton University Press, 1954.

DURAND, DAVID. Bank Stocks and the Analysis of Covariance. *Econometrica* 23, pp. 30-45, January, 1955.

DURAND, DAVID and J. ARTHUR GREENWOOD. The Distribution of Length and Components of the Sum of *n* Random Unit Vectors. *The Annals of Mathematical Statistics* 26, June, 1955.

GOETZ, BILLY E. Contribution of Micro-Economics to Engineering Economy. *Engg. Econ. Comm. A.S.E.E. Proc.*, pp. 15-25, June, 1954.

GREGORY, ROBERT H. Computers and Accounting Systems. *Accounting Research* 6, pp. 38-48, January, 1955.

HILL, THOMAS M. and Members of the Committee on Concepts and Standards of the American Accounting Association. Consolidated Financial Statements. *Accounting Review* 30, pp. 194-197, April, 1955.

KREBS, WILLIAM A. W., JR. The Atomic Energy Act from the Entrepreneur's Point of View. (In *The New Atomic Energy Law — What It Means to Industry.* New York: Atomic Industrial Forum, Inc., 1954.)

MOORE, LEO B. Standards Outlook — Human Relations. *The Magazine of Standards* 25, p. 343, October, 1954.

MOORE, LEO B. Standards Outlook — Organizational Position. *The Magazine of Standards* 25, p. 375, November, 1954.

MOORE, LEO B. Standards Outlook — Method of Operation. *The Magazine of Standards* 25, p. 403, December, 1954.

MOORE, LEO B. Standards Outlook — A Standards Example.

The Magazine of Standards 26, p. 31, January, 1955.

MOORE, LEO B. Standards Outlook — Standards Training. *The Magazine of Standards* 26, p. 63, February, 1955.

MOORE, LEO B. Standards Outlook — Consumer Concern. *The Magazine of Standards* 26, p. 95, March, 1955.

MOORE, LEO B. Standards Outlook — Time-Itis Revealed. *The Magazine of Standards* 26, p. 127, April, 1955.

MOORE, LEO B. Standards Outlook — Time-Itis Resolved. *The Magazine of Standards* 26, p. 159, May, 1955.

MOORE, LEO B. Standards Outlook — Professional Stature. *The Magazine of Standards* 26, p. 191, June, 1955.

RUBENSTEIN, ALBERT H., Editor. Coordination, Control, and Financing of Industrial Research. New York: Kings Crown Press, Columbia Univ., 1955.

SCHELL, ERWIN H. Spiritual and Moral Values in Business. (A paper in *Responsibilities of Business Leadership*, pp. 51-58. New York: General Electric Co., 1954.)

SCHELL, ERWIN H. A Place for Gladness. *The Technology Review* 57, pp. 27, 28 and 46, November, 1954.

SCHELL, ERWIN H. Human Dimensions of Enterprise. *Think* 21, pp. 13-15, June, 1955.

WHITIN, THOMSON M. and OSKAR MORGENSTERN. Nature and Uses of Data and Methods. (In *Input-Output Analysis: An Appraisal*, a report of the National Bureau of Economic Research. Princeton, N.J.: Princeton University Press, 1955.)

WHITIN, THOMSON M. On the Span of Central Direction. *Logistics Quarterly* 1, pp. 25-35, March, 1954.

WHITIN, THOMSON M.. Review of *Input-Output Relations: Proceedings of a Conference on Inter-Industrial Relations* (Driebergen, Holland), edited by the Netherlands Economic Institute. *Kyklos* 4, pp. 391-392, May, 1954.

WHITIN, THOMSON M. Erich Schneider's Inventory Control Analysis. *Operations Res. Soc. Am. J.* 2, pp. 329-334, August, 1954.

WHITIN, THOMSON M.. Random Variations and Returns to Scale. *Operations Res. Soc. Am. J.* 2, p. 351, August, 1954.

WHITIN, THOMSON M. Inventory Control Research: A Survey. *Management Science* 1, pp. 32-40, October, 1954.

WHITIN, THOMSON M. and M. PESTON. Random Variations, Risk, and Returns to Scale. *J. Econ.* 273, pp. 603-612, November, 1954.

WHITIN, THOMSON M. Inventory Management. *Management Science* 1, p. 194, January, 1955.

WHITIN, THOMSON M. and Members of the Educational Committee of the Operations Research Society of America and others. Report of the Education Committee. *Operations Res. Soc. Am. J.* 3, pp. 108-110, February, 1955.

WHITIN, THOMSON M. Review of *A Study on Operational Fractionation of Inventory at N.S.C. Oakland. Am. Statistical Assoc. J.* 50, p. 460, June, 1955.

ZANNETOS, ZENON S. Involuntary Liquidations of LIFO Inventories — A Comparison of Two Systems. *Accounting Research* 5, pp. 289-303, October, 1954.

Department of Mathematics

BAXTER, GLEN E. An Analogue of the Law of the Iterated Logarithm. *Am. Math. Soc. Proc.* 6, pp. 177-181, April, 1955.

BAXTER, GLEN E. On a Characterization of the Normal Law. *Nat. Acad. Sci. Proc.* 41, pp. 383-385, June, 1955.

DI PRIMA, RICHARD C. A Note on the Asymptotic Solutions of the Equation of Hydrodynamic Stability. *J. Math. and Phys.* 33, pp. 249-257, October, 1954.

DI PRIMA, RICHARD C. Application of the Galerkin Method to Problems in Hydrodynamic Stability. *Appl. Math.* 13, pp. 55-62, April, 1955.

FRANKLIN, PHILIP. Basic Mathematical Formulas. (Chapter in *Fundamental Formulas of Physics*, edited by Donald H. Menzel. New York: Prentice-Hall, 1955.)

HELGASON, SIGURDUR S. The Derived Algebra of a Banach Algebra. *Nat. Acad. Sci. Proc.* 40, pp. 994-995, October, 1954.

HELGASON, SIGURDUR S. Some Problems in the Theory of

Almost Periodic Functions. *Mathematica Scandinavica* 13, pp. 40-58, 1955.

KNOWLES, JAMES K. and ALBERT G. H. DIETZ. Viscoelasticity of Polymethyl Methacrylate — An Experimental and Analytical Study. *A.S.M.E. Trans.* 77, pp. 177-186, February, 1955.

LEVINSON, NORMAN and E. A. CODDINGTON. Theory of Ordinary Differential Equations. New York: McGraw-Hill Book Co., 1955.

LIN, CHIA-CHIAO. On Periodically Oscillating Wakes in the Oseen Approximation. (In *Studies in Mathematics and Mechanics*, presented to Richard von Mises. New York: Academic Press, Inc., 1954.)

LIN, CHIA-CHIAO. On a Perturbation Theory Based on the Method of Characteristics. *J. Math. and Phys.* 33, pp. 117-134, July, 1954.

LIN, CHIA-CHIAO. Some Physical Aspects of the Stability of Parallel Flows. *Nat. Acad. Sci. Proc.* 40, pp. 741-747, August, 1954.

LIN, CHIA-CHIAO and THEODORE VON KARMAN. Theoretical Comments on the Paper of Mr. E. N. Fales. *Franklin Inst. J.* 259, pp. 517-518, June, 1955.

NASH, JOHN. C^1 Isometric Imbeddings. *Annals of Math.* 60, pp. 383-396, November, 1954.

NASH, JOHN. A Path Space and the Stiefel-Whitney Classes. *Nat. Acad. Sci. Proc.* 41, pp. 320-321, May, 1955.

RANKIN, BAYARD. The Transitions of a Markovian Process from Set to Set. *Annals Math. Statistics* 26, p. 160, March, 1955.

REISSNER, ERIC and H. REISSNER. Torsion of a Circular Cylindrical Body by Means of Tractions Exerted upon the Cylindrical Boundary. (In *Studies in Mathematics and Mechanics*, presented to Richard von Mises. New York: Academic Press, Inc., 1954.)

REISSNER, ERIC. Small Rotationally Symmetric Deformations of Shallow Helicoidal Shells. *J. Appl. Mechanics* 22, pp. 31-34, March, 1955.

REISSNER, ERIC. On Some Aspects of the Theory of Thin Elastic Shells. *Boston Soc. Civil Engrs. J.* 42, pp. 100-133, April, 1955.

REISSNER, ERIC. Stresses in Elastic Plates over Flexible Subgrades. *Am. Soc. Civil Engrs. Proc.* 81, pp. 690-691, May, 1955.

THOMAS GEORGE B., JR., R. S. BURINGTON, J. W. CELL, R. P. DILWORTH, W. E. RESTEMEYER and S. E. WARSCHAWSKI. Report on Engineering Mathematics. *J. Eng. Educ.* 45, pp. 583-588, April, 1955.

WADSWORTH, GEORGE P. and JOSEPH G. BRYAN. Some Statistical and Mathematical Approaches to Meteorology, Final Report on Contract AF19(122)-446, GRD, Air Force Cambridge Research Center, October, 1954.

WHITEHEAD, GEORGE W. On Mappings into Group-Like Spaces. *Commentarii Mathematici Helvetici* 28, pp. 320-328, 1954.

Department of Mechanical Engineering

BUCKINGHAM, EARLE. Dimensions and Tolerances for Mass Production. New York: Industrial Press, 1954.

COLLINS, S. C. and G. J. VAN WYLEN. New Approach to Measurement of Specific Heats of Gases. *Rev. Sci. Instr.* 26, pp. 601-602, June, 1955.

CRANDALL, STEPHEN H. Numerical Treatment of a Fourth Order Parabolic Partial Differential Equation. *Assoc. Computing Machinery J.* 1, pp. 111-118, July, 1954.

CRANDALL, STEPHEN H. Implicit vs. Explicit Recurrence Formulas for the Linear Diffusion Equation. *Assoc. Computing Machinery J.* 2, pp. 42-49, January, 1955.

CRANDALL, STEPHEN H. The Symmetry Relations for Anisotropic Heat Conduction. *Physica* 21, pp. 251-252, March, 1955.

EZEKIEL, FREDDIE D. Towards Improving Student Teacher Relationships. *J. Eng. Educ.* 45, pp. 758-760, June, 1955.

HRONES, JOHN A. Conference on the Dynamics of Control Systems. *Automatic Control* (Japan) 2, pp. 3-4, January, 1955.

KAYE, JOSEPH, G. A. BROWN, J. J. DIECKMANN and E. A. SZIKLAS. Experimental Velocity Profiles for Supersonic Flow of Air in a Tube with and without Heat Transfer. *Proc. Second U.S. National Congress of Appl. Mech.* New York: A.S.M.E., 1955.

KEENAN, JOSEPH H. Concepts Employed in the Thermodynamics of Coupled Irreversible Flows. *Appl. Mech. Rev.* 8, pp. 49-53, February, 1955.

KEYES, FREDERICK G. and JOSEPH H. KEENAN. The Present Status of Steam Properties. *Mech. Eng.* 77, pp. 127-132, February, 1955.

LEE, SHIH-YING. Contribution to Hydraulic Control-6, New Value Configurations for High-Performance Hydraulic and Pneumatic Systems. *A.S.M.E. Trans.* 76, pp. 905-910, 1954.

LEE, SHIH-YING and J. LOWEN SHEARER. Development of Valves for the Control of Pneumatic Power. *National Conference on Industrial Hydraulics Proc.* 8, pp. 157-169, 1954.

LEE, SHIH-YING and J. LOWEN SHEARER. Developing and Applying Pneumatic Control Valves. *Machine Design* 27, pp. 240-248, May, 1955.

LESSELLS, JOHN M. Strength and Resistance of Metals. New York: John Wiley & Sons, 1954.

McCLINTOCK, FRANK A. and FRANCIS J. RYAN. On the Rate of Growth of Fatigue Cracks. *J. Appl. Mech.* 21, pp. 296-297, September, 1954.

MURRAY, WILLIAM M. Effects of Shock Loadings. *Product Eng.* 25, pp. 171-175, December, 1954.

PAYNTER, HENRY and H. ZIEBOLZ. Uber Anwendungen von Rechengeraten mit Verkurzter Zeitskala bei der Regelung und Nachbildung Dynamischer Sysdeme. *Regelungstechnik* 2, pp. 255-259, January, 1954.

PAYNTER, HENRY M. Have You Thought of Characterizing Valves Through Feedback? *Control Eng.* 1, pp. 47-49, October, 1954.

PAYNTER, HENRY M. How to Analyze Control Systems Graphically. *Control Eng.* 2, pp. 30-35, February, 1955.

PAYNTER, HENRY M. How to Analyze Control Systems Graphically — Part II. *Control Eng.* 2, pp. 72-78, March, 1955.

RABINOWICZ, ERNEST. The Friction of Boundary-Lubricated Surfaces. (In *Proceedings of the 2nd U.S. Congress of Applied Mechanics.* New York: A.S.M.E., 1955.)

RABINOWICZ, ERNEST. The Importance of Wear Fragments During Sliding. (In *Fundamentals of Friction and Lubrication in Engineering.* Chicago: Am. Soc. of Lubrication Engrs., 1954.)

RABINOWICZ, ERNEST. The Boundary Friction of Very Well Lubricated Surfaces. *Lubrication Engineering* 10, pp. 205-208, July, 1954.

RABINOWICZ, ERNEST, F. HEYMANN and B. G. RIGHTMIRE. Friction Apparatus for Very Low Speed Sliding Studies. *Review of Scientific Instruments* 26, pp. 56-58, January, 1955.

RABINOWICZ, ERNEST and E. P. KINGSBURY. Lubricants for Titanium. *Metal Progress* 67, pp. 112-114, May, 1955.

RESWICK, JAMES B. Determine System Dynamics — Without Upset. *Control Eng.* 2, pp. 50-57, June, 1955.

ROGOWSKI, AUGUSTUS R. The M.I.T. Engine Stand. Laboratory Equipment for Testing and Research Work on Diesel Engines. *Diesel Engine Manufacturers Assoc. Bull.* 13, April, 1955.

SHANK, MAURICE E. Brittle Failure of Steel Structures — A General Engineering Problem. *Am. Petroleum Inst. Proc.* 34, pp. 131-142, 1954.

SHANK, MAURICE E. Brittle Failure of Steel Structures — I A Brief History. *Metal Progress* 66, pp. 83-88, September, 1954.

SHANK, MAURICE E. Brittle Failure of Steel Structures — II Factors of Importance. *Metal Progress* 66, pp. 120-126, October, 1954.

SHANK, MAURICE E. Brittle Failure of Steel Structures — III Theory, Practice, Future Prospects. *Metal Progress* 67, pp. 111-121, June, 1955.

SHANK, MAURICE E. and W. R. CLOUGH. Decrease of Density

During Plastic Deformation of Nodular Iron. *Am. Inst. Mining & Met. Engrs. Trans.* 200, pp. 1093-1094, September, 1954.

SHAPIRO, ASCHER H. Review of *General Theory of High Speed Aerodynamics*, edited by W. R. Sears. (Princeton, N.J.: Princeton Univ. Press, 1954.) *J. Appl. Mech.* 22, pp. 285-286, June, 1955.

SHAPIRO, ASCHER H. The Dynamics and Thermodynamics of Compressible Fluid Flow, Vol. II. New York: The Ronald Press Co., 1954.

SHAPIRO, ASCHER H. Free Surface Water Table. (A chapter in *Physical Measurements in Gas Dynamics and Combustion*, edited by R. W. Ladenburg, B. Lewis, R. N. Pease and H. S. Taylor. Princeton, N.J.: Princeton Univ. Press, 1954.)

SHAPIRO, ASCHER H., R. SIEGEL and S. J. KLINE. Friction Factor in the Laminar Entry Region of a Smooth Tube. *Proceedings of the Second U.S. National Congress on Applied Mechanics*, pp. 733-741. New York: A.S.M.E., 1955.

SHAPIRO, ASCHER H. Review of *Modern Developments in Fluid Dynamics — High Speed Flow*, edited by L. Howarth. (New York: Oxford Univ. Press, 1953.) *J. Appl. Mech.* 21, p. 305, September, 1954.

SHAPIRO, ASCHER H. Review of *Gas Dynamics of Thin Bodies*, by F. I. Frankl and E. A. Karpovich, translated from the Russian by M. D. Friedman. (New York: Interscience Publishers, Inc., 1954.) *J. Appl. Mech.* 22, pp. 158-159, March, 1955.

SHAPIRO, ASCHER H. Review of *General Theory of High Speed Aerodynamics*, edited by W. R. Sears. (Princeton, N.J.: Princeton Univ. Press, 1954.) *J. Appl. Mech.* 22, pp. 285-286, June, 1955.

SHAPIRO, ASCHER H. Review of *Transactions of the Symposium on Fluid Mechanics and Computing, April 23-24, 1953*, edited by G. Birkhoff, K. O. Friedrichs and T. E. Sterne. (New York: Interscience Publishers, Inc., 1954.) *J. Appl. Mech.* 22, p. 286, June, 1955.

SHAW, MILTON C. Technical Applications of Principles of Solid Sliding Contact. (A chapter in *Fundamentals of Friction and Lubrication in Engineering.* Chicago: Am. Soc. of Lubrication Engrs., 1954.)

SHAW, MILTON C. Plastic Flow in the Cutting and Grinding of Materials. *Nat. Acad. Sci. Proc.* 40, pp. 394-401, June, 1954.

SHEARER, J. L. Proportional Control of Rate-Type Servomotors. *A.S.M.E. Trans.* 76, pp. 889-893, August, 1954.

SHEARER, J. L. Dynamic Characteristics of Valve-Controlled Hydraulic Servomotors. *A.S.M.E. Trans.* 76, pp. 895-901, August, 1954.

SLIBAR, ALFRED. Optimale Schwingungstilgung durch Fliehkraftpendel. *Zeitschr. für Angew. Mathematik und Mechanik* 34, pp. 328-329, August–September, 1954.

SLIBAR, ALFRED and KURT DESOYER. Bestimmung der Günstigsten Masse von Bifilaren Schwingungstilgern. *Maschinenbau & Warmewirtschaft* 9, September, 1954.

STENNING, ALAN H. Stall Propagation in Cascades of Airfoils. *J. Aero. Sci.* 21, pp. 711-713, October, 1954.

TAYLOR, C. FAYETTE. The Relation of Cylinder Size to the Design and Performance of Diesel Engine Installations for Railway and Marine Service. Paper No. B2 in preprint for the *International Combustion Engine Conference,* The Hague, May, 1955.

TAYLOR, C. FAYETTE, J. C. LIVINGOOD, T. Y. TOONG, T. P. RONA and I. A. BLACK. Surface Ignition in a Motored Engine. Preprint for the *Joint Conference on Combustion, A.S.M.E.* and *I.M.E.*, June 15, 1955.

TAYLOR, C. FAYETTE and A. R. ROGOWSKI. Scavenging the Two-Stroke Engine. *S.A.E.J.* 62, pp. 486-502, 1954.

TOONG, TAU YI and JOSEPH KAYE. Theoretical Velocity and Temperature Profiles for the Laminar Boundary Layer of the Flow of a Compressible Fluid in the Entrance Region of a Tube. *Proceedings of the Second U.S. National Congress of Applied Mechanics,* pp. 781-785. New York: A.S.M.E., 1955.

TOONG, TAU-YI. A New Examination of the Concepts of Adiabatic-Wall Temperature and Heat-Transfer Coefficient. *Proceedings of the Second U.S. National Congress of Applied Mechanics*, pp. 811-816. New York: A.S.M.E., 1955.

WADLEIGH, KENNETH R. Fundamental Laws Written for the System and the Control Volume. *Mech. Eng. Educ. Bull.* 6, pp. 7-18, July, 1954.

WILSON, WILLIAM A. Design of Power-Plant Tests to Insure Reliability of Results. *A.S.M.E. Trans.* 77, pp. 405-408, May, 1955.

Medical Department

DALRYMPLE, WILLARD. Psychotherapy and the Practitioner. *Student Medicine* 3, pp. 35-35, October, 1954.

DALRYMPLE, WILLARD. Prophylaxis Against Rheumatic Fever Recurrences in College Students. *Student Medicine* 3, pp. 64-67, April, 1955.

DALRYMPLE, WILLARD. Tropical Eosirophilia. *N.E.J. Medicine* 252, pp. 585-588, April, 1955.

HARDY, HARRIET L. and HOWARD B. SPRAGUE. An Unusual Case of Joint Pains and Fever. Berylliosis and Pulmonary Hypertension Mistaken for Rheumatic Fever. *Circulation* 10, p. 129, July, 1954.

HARDY, HARRIET L. Epidemiology, Clinical Character and Treatment of Beryllium Poisoning. *Archives of Industrial Health* (A.M.A.) 11, pp. 273-279, April, 1955.

HORWOOD, MURRAY P. Higher Education in the U.S.A. *Rangoon University Indian Students Association Annual Magazine*, pp. 11-13, December, 1954.

MEANS, JAMES HOWARD. Speculations on the Medicine of Tomorrow. *North Carolina Medical J.* 15, pp. 237-244, June, 1954.

MEANS, JAMES HOWARD. Role of Hospital Trustee Today. *Hospital Management* 78, p. 41, August, 1954.

MEANS, JAMES HOWARD. Historical Background of the Use of Radioactive Iodine in Medicine. *N.E. J. Medicine* 252, pp. 936-940, June, 1955.

Department of Metallurgy

ADAMS, CLYDE M., R. G. POWELL and HOWARD F. TAYLOR. Research on Shell Molding. *Am. Foundrymen's Soc. Trans.* 62, pp. 143-155, May, 1954.

ADAMS, CLYDE M., W. D. WALTHER and HOWARD F. TAYLOR. Techniques for Improving Strength and Ductility of Aluminum Alloy Castings. *Am. Foundrymen's Soc. Trans.* 62, pp. 219-230, May, 1954.

ADAMS, CLYDE M., U. K. BHATTACHARYA and HOWARD F. TAYLOR. Stress Required to Hot Tear Plain Carbon Cast Steel. *Am. Foundrymen's Soc. Trans.* 62, pp. 557-567, May, 1954.

ADAMS, CLYDE M., W. D. WALTHER and HOWARD F. TAYLOR. Vacuum Test. *Am. Foundryman* 27, pp. 62-64, March, 1955.

ADAMS, CLYDE M. and D. I. SINIZER. Titanium Casting Metallurgy and Production Techniques. *Am. Foundryman* 27, pp. 85-89, June, 1955.

AVERBACH, B. L., H. C. FIEDLER and MORRIS COHEN. The Effect of Deformation on the Martensitic Transformation in Austenitic Steels. *Am. Soc. Metals Trans.* 47, pp. 267-285, 1955.

AVERBACH, B. L., HUGH MUIR and MORRIS COHEN. The Elastic Limit and Yield Behavior of Hardened Steels. *Am. Soc. Metals Trans.* 47, pp. 380-399, 1955.

BEVER, MICHAEL B. and P. A. CLARKIN. The Role of Water Vapor and Ammonia in Case Hardening Atmospheres. *Am. Soc. Metals Trans.* 47, pp. 794-805, 1955.

BEVER, MICHAEL B., L. R. RUBIN and J. S. L. LEACH. A Calorimetric Investigation of the Energy Relations in Alloys of Composition Cu_3Au. *Am. Inst. Mining & Met. Engrs. Trans.* 203, pp. 421-423, 1955.

BEVER, MICHAEL B. and P. A. CLARKIN. Corrosion Resistance of Carbo-Nitrided Steel. *Metal Progress* 66, pp. 108-109, December, 1954.

BEVER, MICHAEL B., J. S. L. LEACH and E. G. LOEWEN. Energy Relations in Cold Working an Alloy at 78°K and at Room Temperature. *J. Appl. Phys.* 26, pp. 728-731, June, 1955.

CHAUDHURI, A. R., H. C. CHANG and NICHOLAS J. GRANT. Creep Deformation of Magnesium at Elevated Temperatures by Non-Basal Slip. *J. Metals* 7, p. 682, May, 1955.

CHIPMAN, JOHN and H. R. LARSON. Activities of Fe, FeO, Fe_2O_3 in Simple Slags. *Am. Inst. Mining & Met. Engrs. Trans.* 200, pp. 759-762, June, 1954.

CHIPMAN, JOHN and J. C. FULTON. Slag-Metal-Graphite Reactions and the Activity of Silica in Lime-Alumina-Silica Slags. *Am. Inst. Mining & Met. Engrs. Trans.* 200, pp. 1136-1146, October, 1954.

CHIPMAN, JOHN and G. R. ST. PIERRE. Thermal Dissociation of Sulfur Dioxide and the Dissociation Energy of SO and SO_2. *Am. Chem. Soc. J.* 76, pp. 4787-4791, October, 1954.

CHIPMAN, JOHN. Blast Furnace Slag-Metal Reactions. *Am. Inst. Mining & Met. Engrs. Blast Furnace, Coke Oven & Raw Materials Committee Proc.* 13, p. 193, 1954.

CHIPMAN, JOHN and H. A. WRIEDT. Solubility of Oxygen in Liquid Nickel and Iron-Nickel Alloys. *Am. Inst. Mining & Met. Engrs. Trans.* 203, pp. 477-479, 1955.

COBLE, R. L. and WILLIAM D. KINGERY. Effect of Porosity on Thermal Stress Fracture. *Am. Ceramic Soc. J.* 38, pp. 33-37, January, 1955.

COHEN, J. B., J. S. L. LEACH and MICHAEL B. BEVER. A Calorimetric Investigation of Heats of Formation and Precipitation in Some Cu-Sn Alloys. *Am. Inst. Mining & Met. Engrs. Trans.* 200, pp. 1257-1258, 1954.

COHEN, MORRIS, and F. S. BUFFINGTON. On Self-Diffusion in Cubic Metals. *Acta Metallurgica* 2, pp. 660-666, September, 1954.

deBRUYN, PHILIP L. The Chemical Theory of Flotation. *Chemical Engineering Symposium Series* 50, pp. 5-15, 1954.

deBRUYN, PHILIP L. Flotation of Quartz by Cationic Collectors. *Mining Eng.* 7, pp. 291-296, March, 1955.

FUERSTENAU, DOUGLAS W. and ANTOINE M. GAUDIN. Streaming Potential Studies — Quartz Flotation with Anionic Collectors. *Mining Eng.* 7, pp. 66-72, January, 1955.

GAUDIN, ANTOINE M. and DWIGHT L. HARRIS. Adsorption of a Mercaptan on Zinc Minerals. *Mining Eng.* 6, pp. 925-928, September, 1954.

GAUDIN, ANTOINE M. and JOHN G. MORROW. Adsorption of Dodecylammonium Acetate on Hematite and Its Flotation Effect. *Mining Eng.* 6, pp. 1196-1202, December, 1954.

GAUDIN, ANTOINE M. and DOUGLAS W. FUERSTENAU. Quartz Flotation with Anionic Collectors. *Mining Eng.* 7, pp. 66-72, January, 1955.

GAUDIN, ANTOINE M. and HORACIO E. BERGNA. The High Frequency Induction Furnace in the Determination of Radiocarbon. *Anal. Chem.* 27, pp. 467-468, March, 1955.

GAUDIN, ANTOINE M. Comminution as a Chemical Reaction. *Mining Eng.* 7, pp. 561-562, June, 1955.

GRANT, NICHOLAS J. Creep and Fracture at Elevated Temperatures. (A chapter in *Utilization of Heat Resistant Alloys.* Symposium presented at University of Mich., March 11 & 12, 1954. Cleveland, Ohio: Am. Soc. for Metals, 1954.)

GRANT, NICHOLAS J., E. C. ROBERTS and MORRIS COHEN. Creep-Tempering Relationships in Hardened 4.5 Per Cent Chromium Steels. *Am. Soc. Metals Trans.* 47, p. 650, 1955.

GRANT, NICHOLAS J. The Influence of Metal Structure on Properties of Investment Castings. *Precision Metal Molding* 12, p. 122, September, 1954.

GRANT, NICHOLAS J and A. W. MULLENDORE. Creep Rupture Characteristics of Aluminum-Magnesium Solid Solution Alloys. *J. Metals* 6, p. 973, September, 1954.

GRANT, NICHOLAS J. and C. STEIN. The Chromium Rich Portion of the Chromium-Nickel Phase Diagram. *J. Metals* 7, p. 127, January, 1955.

GRANT, NICHOLAS J. Outline of Recommended Melting Practices for Small Melts. *Investment Casting Inst. Proc.* 3, May, 1955.

GRANT, NICHOLAS J. and J. L. LUNSFORD. How Important Is Hydrogen Embrittlement? *Iron Age* 175, p. 92, June, 1955.

HILLIARD, J. E., BENJAMIN L. AVERBACH and MORRIS COHEN.

Thermodynamic Properties of Solid Aluminum-Zinc Alloys. *Acta Metallurgica* 2, pp. 621-631, July, 1954.

HOUSKA, CHARLES R. and B. E. WARREN. X-ray Study of the Graphitization of Carbon Black. *J. Appl. Phys.* 25, pp. 1503-1509, December, 1954.

KING, THOMAS B., H. EPSTEIN and J. H. WALSH. Hydrogen in Steelmaking. (In *Am. Iron & Steel Inst. Regional Technical Meetings*, pp. 25-67. New York: American Iron & Steel Institute, 1954.)

KING, THOMAS B., H. BISHOP and NICHOLAS J. GRANT. The Role of Slag Composition in Open Hearth Desulphurization and Oxidation. *Am. Iron & Steel Inst. Yearbook*, pp. 1-18, 1955.

KINGERY, WILLIAM D. and T. VASILOS. Note on Properties of Aqueous Suspensions of TiC and TiN. *J. Phys. Chem.* 58, pp. 486-488, June, 1954.

KINGERY, WILLIAM D. and T. VASILOS. Thermal Conductivity: XI, Conductivity of Some Refractory Carbides and Nitrides. *Am. Ceramic Soc. J.* 37, pp. 409-414, September, 1954.

KINGERY, WILLIAM D. and J. FRANCL. Fundamental Study of Clay: XIII, Drying Behavior and Plastic Properties. *Am. Ceramic Soc. J.* 37, pp. 596-602, December, 1954.

KINGERY, WILLIAM D. Recommended Letter Symbols for Thermal Stress Analysis. *Am. Ceramic Soc. J.* 38, pp. 1-2, January, 1955.

KINGERY, WILLIAM D. Factors Affecting Thermal Stress Resistance of Ceramic Materials. *Am. Ceramic Soc. J.* 38, pp. 3-15, January, 1955.

KINGERY, WILLIAM D., F. A. HALDEN and C. R. KURKJIAN. Base Exchange Capacity of Talc. *J. Phys. Chem.* 59, pp. 378-380, April, 1955.

KINGERY, WILLIAM D. and F. A. HALDEN. Metal-Ceramic Interactions: V, Note on Reactions of Metals with Titanium Carbide and Titanium Nitride. *Am. Ceramic Soc. Bull.* 34, pp. 117-119, April, 1955.

RAMACHANDRAN, SUNDARESAN, THOMAS B. KING and NICHOLAS J.

GRANT. The Rate of Sulphur Transfer Between Blast Furnace Type Metal and Slag. *Am. Inst. Mining & Met. Engrs. Blast Furnace Conference Proc.* 14, 1955.

RUDMAN, P. S. and BENJAMIN L. AVERBACH. X-Ray Measurements of Local Atomic Arrangements in Al-Zn and Al-Ag Solid Solutions. *Acta Metallurgica* 2, pp. 576-582, July, 1954.

SHIH, C. H., BENJAMIN L. AVERBACH and MORRIS COHEN. Some Characteristics of the Isothermal Martensitic Transformation. *J. Metals* 7, pp. 183-187, January, 1955.

SPACIL, HENRY S., T. PERRY and JOHN WULFF. Effect of Oxygen on Welding and Brazing Molybdenum. *Welding Journal — Research Supplement* 33, pp. 442-s-448-s, September, 1954.

STARK, PHILIP and B. S. LEMENT. Effect on Tempering on the Hardness of Retained Austenite. *J. Metals* 6, pp. 1074-1075, September, 1954.

TAYLOR, HOWARD F. and C. C. REYNOLDS. Alloying and Heat Treating Spherulitic Graphite Cast Iron. *Am. Foundrymen's Soc. Trans.* 62, pp. 181-194, May, 1954.

UDIN, HARRY, E. R. FUNK and JOHN WULFF. Welding for Engineers. New York: John Wiley & Sons, 1954.

UDIN, HARRY, J. H. JOHNSTON and JOHN WULFF. Joining of Molybdenum. *Welding Journal — Research Supplement* 33, pp. 449-s-458-s, September, 1954.

UHLIG, HERBERT H. Passivity and Adsorption. *N.Y. Acad. Sci. Annals* 58, pp. 843-854, September, 1954.

UHLIG, HERBERT H. and I-MING FENG. Fretting Corrosion of Mild Steel in Air and in Nitrogen. *J. Appl. Mech.* 21, pp. 395-400, December, 1954.

UHLIG, HERBERT H. Mechanism of Fretting Corrosion. *J. Appl. Mech.* 21, pp. 401-407, December, 1954.

UHLIG, HERBERT H. Contribution of Metallurgy to the Origin of Meteorites. Part I — Structure of Metallic Meteorites, Their Composition and the Effect of Pressure. *Geochim. Cosmochim. Acta* 6, pp. 282-301, December, 1954.

UHLIG, HERBERT H. and A. E. BRENNER. Effect of Electric Field on Oxidation of Copper. *Acta Metallurgica* 3, pp. 108-109, January, 1955.

UHLIG, HERBERT H., D. N. TRIADIS and M. STERN. Effect of Oxygen, Chlorides and Calcium Ion on Corrosion Inhibition of Iron by Polyphosphates. *Electrochem. Soc. J.* 102, pp. 59-66, February, 1955.

UHLIG, HERBERT H. Contribution of Metallurgy to the Origin of Meteorites. Part II — The Significance of Neumann Bands in Meteorites. *Geochim. Cosmochim. Acta* 7, pp. 34-42, February, 1955.

UHLIG, HERBERT H., J. S. MacNAIRN and D. A. VAUGHN. Formation of the Intermetallic Compound PtZn at Room Temperature. *Acta Metallurgica* 3, pp. 302-304, May, 1955.

WAGNER, CARL W., R. E. CARTER and F. D. RICHARDSON. Oxidation of Cobalt Metal. *J. Metals* 7, pp. 336-343, February, 1955.

WULFF, JOHN and W. E. LITTMANN. The Influence of the Grinding Process on the Structure of Hardened Steel. *Am. Soc. Metals Trans.* 47, pp. 692-714, 1955.

Department of Meteorology

BEMIS, ALAN C. The Role of Melting Snow in the Atmosphere. *J. Meteorology* 12, pp. 186-188, April, 1955.

STARR, VICTOR P. and ROBERT M. WHITE. Two years of Momentum Flux Data for 13°N. *Tellus* 6, pp. 180-181, April, 1954.

STARR, VICTOR P. Commentaries Concerning Research on the General Circulation. *Tellus* 6, pp. 268-272, August, 1954.

STARR, VICTOR P. and ROBERT M. WHITE. Balance Requirements of the General Circulation. Air Force Cambridge Research Center Technical Report 54-205 (Geophysical Research Papers No. 35), pp. 1-57, December, 1954.

WURTELE, MORTON G. The Development of a Lee Wave. *J. Marine Research* 14, pp. 1-13, June, 1955.

Department of Modern Languages

HALLE, MORRIS. The Strategy of Phonemics. *Word* 10, pp. 197-209, August-December, 1954.

HALLE, MORRIS. Why and How We Study the Sounds of Speech. *Georgetown Univ. Monograph Series on Languages and Linguistics* 7, pp. 73-83, September, 1954.

HALLE, MORRIS. Review of *Physiologie der Stimmel und Sprache*, by H. Lullies. (Berlin: Springer-Verlag, 1953.) *Acoustical Soc. Am. J.* 27, pp. 391-392, March, 1955.

HALLE, MORRIS. Review of *Miscellanea Phonetica II.* (London: International Phonetic Assoc., Univ. College, 1954.) *Acoustical Soc. Am. J.* 27, p. 621, May, 1955.

LOCKE, WILLIAM N. and A. DONALD BOOTH. Machine Translation of Languages. New York: Technology Press of M.I.T. in association with John Wiley & Sons, 1955.

LOCKE, WILLIAM N. Return to Providence — A Rejoinder. *The French Review* 28, pp. 179-184, December, 1954.

LOCKE, WILLIAM N. Speech Typewriters and Translating Machines. *P.M.L.A. (Publications of the Modern Language Association of America)* 70, pp. 23-32, April, 1955.

ROSEN, CHARLES W. M.I.T. Teaches History of Ideas in French. *French Review* 28, pp. 345-350, February, 1955.

YNGVE, VICTOR H. Syntax and the Problem of Multiple Meaning. (A chapter in *Machine Translation of Languages*, by W. N. Locke and A. D. Booth. New York: Technology Press of M.I.T. in association with John Wiley & Sons, 1955.)

YNGVE, VICTOR H. The Machine and the Man. *Mechanical Translation* 1, pp. 20-23, August, 1954.

YNGVE, VICTOR H. Machines for the Translation of Languages. *J. Communication* 5, pp. 35-40, Summer, 1955.

YNGVE, VICTOR H. Mechanical Translations (translated by Saburo Muroga into Japanese). *Science* (Japanese) 25, pp. 23-26, January, 1955.

Department of Naval Architecture and Marine Engineering

ABKOWITZ, MARTIN A. and D. L. PASTER. Design and Drag of Torpedo Water Scoops. NAVORD Report No. 549, U.S. Bureau of Naval Ordnance, March, 1955.

ABKOWITZ, MARTIN A. and D. L. PASTER. Hydrodynamic Stability Derivatives and Their Use — The Dynamic Center

of Mass and Its Applications. Technical Memorandum No. 17, U.S. Naval Underwater Ordnance Station (Newport, Rhode Island), April, 1955.

MANNING, GEORGE C. Fundamentals of Ship Design. Cambridge: Technology Press of M.I.T., 1955.

TROOST, LAURENS and A. ZAKAY. A New Evaluation of the Lucy Ashton Ship Model and Full Scale Tests. *International Shipbuilding Progress* 1, pp. 5-9, October, 1954.

TROOST, LAURENS. On Skin Friction Formulation. (In *Transactions of the 7th International Conference on Ship Hydrodynamics*, p. 125. Göteborg, Sweden: Gumperts Förlag, 1955.)

TROOST, LAURENS. New Management Course for Careers in the Maritime Industries. *Shipbuilding and Shipping Record* 85, p. 46, January, 1955.

Department of Physics

ALLEN, LELAND C. Interpolation Scheme for Energy Bands in Solids. *Phys. Rev.* 98, pp. 993-996, May 15, 1955.

BECK, FRIEDRICH. Stability of a Phase Boundary Inside a Superconductor. *Phys. Rev.* 98, pp. 852-854, May 15, 1955.

BITTER, FRANCIS. Currents, Fields, and Particles. Cambridge: Technology Press of M.I.T., 1954.

BITTER, FRANCIS and JOHN WAYMOUTH. Experiments on Electroluminescence. *Phys. Rev.* 95, pp. 941-944, August 15, 1954.

BITTER, FRANCIS, S. P. DAVIS, B. RICHTER and J. E. R. YOUNG. Optical Studies of Radioactive Mercury. *Phys. Rev.* 96, pp. 1531-1539, December 15, 1954.

BOCKELMAN, CHARLES K. and J. J. JUNG. Energy Levels of Be^{10}. *Phys. Rev.* 96, pp. 1353-1355, December, 1, 1954.

BOCKELMAN, CHARLES K., CORNELIUS M. BRAAMS, WILLIAM W. BUECHNER and D. B. GUTHE. Angular Distribution of Proton Groups from $Ca^{42}(d,p)Ca^{43}$ Reaction. *Am. Phys. Soc. Bull.* 30, p. 55, April, 1955.

BRAAMS, CORNELIUS M. (d,p) Reactions of Ca^{42} and Ca^{44}. *Phys. Rev.* 95, p. 650, July 15, 1954.

BROWN, SANBORN C. and F. H. REDER. Energy Distribution Function of Electrons in Pure Helium. *Phys. Rev.* 95, pp. 885-889, August 15, 1954.

BROWN, SANBORN C. and L. GOULD. Microwave Determination of the Probability of Collision of Electrons in Helium. *Phys. Rev.* 95, pp. 897-903, August 15, 1954.

BROWN, SANBORN C. Elementary Laboratory Instruction in England. *Am. J. Phys.* 23, pp. 27-30, January, 1955.

BROWN, SANBORN C. and D. V. ROSE. High-Frequency Gas Discharge Plasma in Hydrogen. *Phys. Rev.* 98, pp. 310-316, April 15, 1955.

BROWN, SANBORN C. Count Rumford on Photosynthesis. *Am. Acad. Arts & Sci. Proc.* 86, pp. 43-46, May, 1955.

BROWNE, CORNELIUS P. Energy Levels in Al^{26}. *Phys. Rev.* 95, pp. 860-861, August 1, 1954.

BROWNE, CORNELIUS P., S. F. ZIMMERMAN and WILLIAM W. BUECHNER. Energy Levels of Al^{27}. *Phys. Rev.* 96, pp. 725-729, November 1, 1954.

BROWNE, CORNELIUS P. and W. C. COBB. Some Energy Levels of Na^{22}. *Am. Phys. Soc. Bull.* 30, p. 44, April, 1955.

BROWNELL, GORDON L., J. B. STANBURY et al. Endemic Goiter: The Adaptation of Man to Iodine Deficiency. Harvard Univ. Monographs in Medicine and Public Health, No. 12. Cambridge: Harvard Univ. Press, 1954.

BROWNELL, GORDON L. and J. B. STANBURY. Multi-Compartmented Biologic Models. *J. Clin. Endocrin. and Metab.* 14, pp. 1079-1085, September, 1954.

BROWNELL, GORDON L. and F. C. HICKEY. Dynamic Analysis of Iodine Metabolism in Four Normal Subjects. *J. Clin. Endocrin. and Metab.* 14, pp. 1423-1436, November, 1954.

BROWNELL, GORDON L. and W. H. SWEET. Localization of Intra-Cranial Lesions by Scanning with Positron-Emitting Arsenic. *Am. Med. Assoc. J.* 157, pp. 1183-1188, April, 1955.

BUECHNER, WILLIAM W., CORNELIUS P. BROWNE, H. ENGE, M. MAZARI and C. D. BUNTSCHUH. Magnetic Spectrograph for Nuclear Disintegration Studies. *Phys. Rev.* 95, p. 609, July 15, 1954.

BUECHNER, WILLIAM W., A. SPERDUTO and M. MAZARI. Magnetic Analysis of Protons from $Al^{27}(d,p)Al^{28}$. *Am. Phys. Soc. Bull.* 30, p. 44, April, 1955.

CALDWELL, DAVID O. and J. R. RICHARDSON. Elastic Scattering of 20.6-Mev Protons by Deuterons. *Phys. Rev.* 98, pp. 28-39, April 1, 1955.

FESHBACH, HERMAN, C. E. PORTER and VICTOR F. WEISSKOPF. Model for Nuclear Reactions with Neutrons. *Phys. Rev.* 96, pp. 448-464, October 15, 1954.

FRANK, NATHANIEL H. and WILLIAM TOBOCMAN. Electromagnetic Theory. (A chapter in *Fundamental Formulas of Physics*, edited by D. H. Menzel. New York: Prentice-Hall, Inc., 1955.

FRANK, NATHANIEL H. Responsibility of the Physics Teacher in Engineering Education. *Am. J. Phys.* 22, pp. 463-464, October, 1954.

FRANK, NATHANIEL H. The Responsibility of the Physics Teacher in Engineering Education. *J. Eng. Educ.* 45, pp. 242-243, November, 1954.

FRANK, NATHANIEL H. The Role of Physics in Engineering Education. *J. Eng. Educ.* 45, pp. 404-407, January, 1955.

FRANK, NATHANIEL H. Critique of Teaching Objectives in Colleges. *Physics Today* 8, pp. 19-20, June, 1955.

GREENBERG, JACK S. and MARTIN DEUTSCH. Internal Pair Creation Accompanying Negatron Decay. *Am. Phys. Soc. Bull.* 30, p. 65, April, 1955.

HERLIN, MELVIN A. and CHARLES E. CHASE. Ultrasonic Measurements in Magnetically Cooled Helium. *Phys. Rev.* 95, pp. 565-566, July 15, 1954.

HUETER, THEODOR F and RICHARD H. BOLT. Sonics, Techniques for the Use of Sound and Ultrasound in Engineering and Science. New York: John Wiley & Sons, 1955.

HUETER, THEODOR F., D. P. NEUHAUS and J. KOLB. An Experimental Study of Polarization Effects in Barium Titanate Ceramics. *Acoustical Soc. Am. J.* 26, pp. 696-703, September, 1954.

HUETER, THEODOR F. and D. P. NEUHAUS. Elektromechanische Aktivitat von $BaTiO_3$-Keramik bei Gegenpolarisation. *Die Naturwissenschaften* 41, p. 424, September, 1954.

HUETER, THEODOR F. and D. P. NEUHAUS. Ultrasonic Attenuation Studies in Biased $BaTiO_3$ Ceramics. *Acoustical Soc. Am. J.* 27, pp. 292-296, March, 1955.

KING, JOHN G. and V. JACCARINO. Hyperfine Structure and Nuclear Moments of the Stable Bromine Isotopes. *Phys. Rev.* 94, pp. 1610-1616, June 15, 1954.

LANZA, GIOVANNI and N. DALLAPORTA. Discussion of Stars Produced by Negative K-Mesons. *Il Nuovo Cimento* 12, pp. 260-269, December, 1954.

LINSLEY, JOHN. Measurement of Multiply Charged Cosmic Rays by a New Technique. *Phys. Rev.* 97, pp. 1292-1302, March 1, 1955.

MORSE, PHILIP M., H. N. GARBER and M. ERNST. A Family of Queuing Problems. *Operations Research Soc. Am. J.* 2, p. 444, September, 1954.

MORSE, PHILIP M. Operations Research. *Communications on Pure and Applied Math.* 8, p. 1, February, 1955.

MORSE, PHILIP M. Acoustics and Basic Physics. *Acoustical Soc. Am. J.* 27, p. 213, March, 1955.

MUELLER, HANS and DAVID C. PEASLEE. Elements of Atomic Physics. New York: Prentice-Hall, Inc., 1955.

PAULISSEN, GEORGE T. and MARK HANS. Electric Excitation of Palladium, Cadmium and Molybdenum by Protons. *Am. Phys. Soc. Bull.* 30, p. 17, April, 1955.

RANKIN, W. D., L. S. OSBORNE, P. C. STEIN, A. WATTENBERG and A. WINSTON. Search for Electromagnetic Interactions Between μ Mesons and Electrons. *Phys. Rev.* 97, pp. 809-810, February, 1955.

SHARP, RICHARD D., A. SPERDUTO and WILLIAM W. BUECHNER. Angular Distribution of Proton Groups from the $N^{14}(d,p)N^{15}$ Reaction. *Am. Phys. Soc. Bull.* 30, p. 32, April, 1955.

SLATER, JOHN C. Modern Physics. New York: McGraw-Hill Book Co., 1955.

SLATER, JOHN C. One-Electron Energies of Atoms, Molecules and Solids. *Phys. Rev.* 98, pp. 1039-1045, May 15, 1955.

STRANDBERG, MALCOM W. P. and M. TINKHAM. Theory of the Fine Structure of the Molecular Oxygen Ground State. *Phys. Rev.* 97, pp. 937-951, February 15, 1955.

STRANDBERG, MALCOM W. P. and M. TINKHAM. Interaction of Molecular Oxygen with a Magnetic Field. *Phys. Rev.* 97, pp. 951-966, February 15, 1955.

STRANDBERG, MALCOM W. P. and M. TINKHAM. Excitation of Circular Polarization in Microwave Cavities. *I.R.E. Proc.* 43, pp. 734-738, June, 1955.

TISZA, LASZLO and IRWIN MANNING. Variational Principles in Irreversible Thermodynamics. *Phys. Rev.* 98, p. 1165, May 15, 1955.

WEINSTEIN, ROY, MARTIN DEUTSCH and SANBORN C. BROWN. Fine Structure of Positronium. *Am. Phys. Soc. Bull.* 29, p. 8, November, 1954.

WILLIAMS, ROBERT W. Cosmic Rays and High-Energy Phenomena. (A chapter in *Fundamental Formulas of Physics*, edited by D. H. Menzel. New York: Prentice-Hall, Inc., 1955.

WILLIAMS, ROBERT W. and J. H. VILAIN. μ-Meson Decay Spectrum. *Phys. Rev.* 94, pp. 1011-1017, May 15, 1954.

WILLIAMS, ROBERT W. High-Energy Cross Sections I. The Size of the Nucleus. *Phys. Rev.* 98, pp. 1387-1393, June 1, 1955.

WILLIAMS, ROBERT W. High-Energy Cross Sections II. Nucleon-Nucleon Cross Section at Cosmic-Ray Energies. *Phys. Rev.* 98, pp. 1393-1398, June 1, 1955.

ZAGIEL, ITZHAK. The Camera Lucida. *Modern Textiles* 35, pp. 31, 64, 66-67, May, 1954.

Library

BARTLETT, ELEANOR L. The Writings of Karl Taylor Compton. *The Technology Review* 57, pp. 89-92 ff., December, 1954.

TATE, VERNON D., Editor. Proceedings of Third Annual Meet-

ing, National Microfilm Association. Hingham, Mass.: Nat'l. Microfilm Assoc., 1954.

TATE, VERNON D. Theses — A Solution. *Library Journal* 79, pp. 1277-1279, July, 1954.

TATE, VERNON D. Annual Meeting, National Microfilm Association. *Am. Documentation* 5, pp. 173-174, September, 1954.

TATE, VERNON D. Review of *Manual on Document Reproduction and Selection*, compiled by F. Donker Duyvis and others. (FID Publication No. 264. The Hague: International Federation for Documentation, 1953.) *The American Archivist* 18, pp. 75-76, January, 1955.

TATE, VERNON D. Death is a Cup. *Sat. Rev.* 36, p. 16, February 5, 1955.

TATE, VERNON D. Microreproduction and the Acquisitions Program. *Library Trends* 3, pp. 432-447, April, 1955.

Administration

BURCHARD, JOHN E. Contributor to: *Architecture and the University* (Proceedings of Conference, December, 1953). Princeton, N.J.: School of Architecture, Princeton University, 1954.

BURCHARD, JOHN E. Contributor to: *The Metropolis in Modern Life*, edited by Robert Moore Fisher (pp. 376-380). Garden City, N.Y.. Doubleday & Co., Inc., 1955.

BURCHARD, JOHN E. Architecture in the Atomic Age. *Architectural Record* 116, pp. 119-130, December, 1954.

BURCHARD, JOHN E. A Thousand Lost Golf Balls. *Phi Kappa Phi J.* 35, pp. 3-13, March, 1955.

BURCHARD, JOHN E. The Dilemma of Architecture. *Architectural Record* 117, pp. 193-198, May, 1955.

BURCHARD, JOHN E. Ariadne's Thread. *Colorado Quarterly* 3, pp. 381-398, Spring, 1955.

DUDLEY, BEVERLY. Karl Taylor Compton. *The Technology Review* 56, pp. 453-455, July, 1954.

DUDLEY, BEVERLY. A Report on Commencement and Alumni Day. *The Technology Review* 56, pp. 471-476, July, 1954.

DUDLEY, BEVERLY. A Brief History of Electrical Engineering. *I.R.E. Student Quarterly* 1, pp. 24-31, February, 1955.

DUDLEY, BEVERLY. Frequency Marker with 50 Kilocycle Intervals. *Q.S.T.* 39, p. 14, March, 1955.

DUDLEY, BEVERLY. Structures — Spherical and Cylindrical. *The Technology Review* 57, pp. 391-400, June, 1955.

HARRISON, GEORGE R. Karl Taylor Compton 1887-1954. *Physics Today* 7, pp. 4-6, September, 1954.

HARRISON, GEORGE R. Karl Taylor Compton: Scientist, Public Servant. *The Technology Review* 57, pp. 83-94, December, 1954.

HARRISON, GEORGE R. Big Power for U.S. — In the Sun. *U.S. News & World Report* 38, pp. 82-85, January 7, 1955.

HARRISON, GEORGE R. and G. W. STROKE. Interferometric Control of Grating Ruling with Continuous Carriage Advance. *Optical Soc. Am. J.* 45, pp. 112-121, February, 1955.

HARRISON, GEORGE R. Spectroscopy with the Echelle. (Chapter in *Vistas in Astronomy*, by Cambridge (Eng.) University Observatory. Vol. 1, March, 1955.)

HARRISON, GEORGE R. Einstein: Appraisal of an Intellect. *Atlantic Monthly* 195, pp. 23-26, June, 1955.

HAZEN, HAROLD L. The E.C.P.D. Accreditation Program. *J. Eng. Educ.* 45, pp. 101-112, October, 1954.

HAZEN, HAROLD L. Relations with Regional Crediting Associations. *J. Eng. Educ.* 45, pp. 209-218, November, 1954.

KILLIAN, JAMES R., JR. Preface to *When M.I.T. Was Boston Tech*, by S. C. Prescott. Cambridge, Mass.: Technology Press of M.I.T., 1954.

KILLIAN, JAMES R., JR. and other members of the Committee on Institutional Research Policy. Sponsored Research Policy of Colleges and Universities. American Council on Education, 1954.

KILLIAN, JAMES R., JR. Science in the Public Arena. A Review of three books: *Government and Science*, by Don K. Price, New York: New York University Press, 1954; *Ideas and Weapons*, by I. B. Holley, Jr., New Haven: Yale Univer-

sity Press, 1953, and *Ships, Machinery, and Mossbacks*, by Harold G. Bowen, Princeton, N.J.: Princeton University Press, 1954. *The Yale Review* 44, pp. 127-133, Autumn, 1954.

KILLIAN, JAMES R., JR. Science for the Good of Mankind. *The Technology Review* 57, pp. 29, 30, 47, 48, 50, November, 1954.

KILLIAN, JAMES R., JR. Human Resources and Technological Advance. *Instrument Soc. Am. J.* 1, pp. 8-9, December, 1954.

KILLIAN, JAMES R., JR. Karl Taylor Comptom: The Man. *The Technology Review* 57, pp. 87, 88, 116, 118, December, 1954.

KILLIAN, JAMES R., JR. A Four-Point Program for Technological Vigor. *Am. Engineer* 25, pp. 9-14, April, 1955.

KILLIAN, JAMES R., JR. A New Maturity. *Student Government Bull.* 3, U.S. Natl. Student Assoc., pp. 5-11, May, 1955.

MATTILL, JOHN I. Highlights of the 62nd Annual Meeting of A.S.E.E. *J. Eng. Educ.* 45, pp. 14-23, September, 1954.

MATTILL, JOHN I. Publications for Public Relations. *College Public Relations Quarterly* 6, pp. 35-36, April, 1955.

MERRITT, ROY B. Punting the Mills Way. *Scholastic Coach* 24, pp. 22-23, 80-81, September, 1954.

MERRITT, ROY B. Judging the Dives. *The Athletic J.* 35, pp. 18-19, 57-58, January, 1955.

PITRE, THOMAS P. Administration of Financial Aid. (A chapter in *College Admissions*, Vol. 2, Proceedings of the Second Colloquium on College Admissions, Harriman, New York, October 22-26, 1954.) New York, N.Y.: College Entrance Examination Board, 1955.

THRESHER, B. ALDEN., Editor. Freshman Admission Forms and Letters. New York, N.Y.: College Entrance Examination Board, 1954.

THRESHER, B. ALDEN. The College Intervenes. (A chapter in *College Admissions*, Vol. 2, Proceedings of the Second Colloquium on College Admissions, Harriman, New York, October 22-26, 1954.) New York, N.Y.: College Entrance Examination Board, 1955.

Center for International Studies

BAUER, RAYMOND A. Bolshevik Attitude Toward Science. (A chapter in *Totalitarianism*, edited by Carl J. Friedrich. Cambridge, Mass.: Harvard University Press, 1954.)

BAUER, RAYMOND A. and E. WASIOLEK. Nine Soviet Portraits. The Technology Press of M.I.T. in association with John Wiley and Sons, Inc., 1955.

BAUER, RAYMOND A. The Psycho-Cultural Approach to Soviet Studies. *World Politics* 7, pp. 119-132, October, 1954.

BAUER, RAYMOND A., S. KELLER and I. POOL. The Shift in Business Opinion on the Tariff. *Fortune* 51, p. 107, April, 1955.

CHAO, KUO-CHUN. Mass Organizations in Mainland China. *The Am. Political Science Rev.* 48, pp. 752-765, September, 1954.

HSIEH, CHIAO-MIN and ALICE TAYLOR. Formosa. *Focus* 5, pp. 1-6, April, 1955.

LAMB, HELEN B. India: A Colonial Setting. (Chapter in *Economic Development, Principles and Patterns*, edited by H. F. Williamson and J. A. Buttrick. New York: Prentice-Hall, Inc., 1954.)

LAMB, HELEN B. The Indian Business Communities and the Evolution of an Industrialist Class. *Pacific Affairs J.* 28, pp. 101-116, June, 1955.

LERNER, DANIEL and DAVID RIESMAN. Self and Society: Reflections on Some Terms in Transition. *Explorations* 5, pp. 67-80, June, 1955.

MALENBAUM, WILFRED. India's Economic Progress under the Plan. *The Economic Weekly* 6, pp. 1016-1018, September 11, 1954.

MALENBAUM, WILFRED. India's Domestic Product, 1951/52-1953/54. *Indian Economic J.* 2, pp. 247-253, January, 1955.

MALENBAUM, WILFRED. International Public Financing. *International Conciliation* 502, pp. 315-339, March, 1955.

ROSTOW, WALT W., RICHARD W. HATCH, A. ECKSTEIN and F. A. KIEMAN, JR. Prospects for Communist China. The Technology Press of M.I.T. in association with John Wiley and Sons, 1954.

ROSTOW, WALT W. An American Policy in Asia. The Technology Press of M.I.T. in association with John Wiley and Sons, 1955.

ROSTOW, WALT W. Trends in the Allocation of Resources in Secular Growth. Institut de Recherches Economiques et Sociales de L'Universite de Louvain, Spring, 1954.

ROSTOW, WALT W. Factors in a British Trade Cycle. (A review of *Economic Fluctuations in Great Britain 1833-42*, by R. C. O. Matthews. New York: Cambridge Univ. Press, 1954.) *J. Econ. History* 14, pp. 266-270, Summer, 1954.

ROSTOW, WALT W. Marx Was a City Boy; or Why Communism May Fail. *Harper's Magazine* 210, pp. 25-30, February, 1955.

ROSTOW, WALT W. The Challenge Facing the United States. *The Technology Review* 57, pp. 181-185 ff., February, 1955.

ROSTOW, WALT W. A History of Peterborough New Hampshire (review). *The New England Quarterly* 28, pp. 127-133, March, 1955.

Division of Industrial Cooperation

ABRAHAMS, SIDNEY C. and J. KALNAJS. The Crystal Structure of Barium Peroxide. *Acta Crystallographica* 7, pp. 838-842, December, 1954.

BACKOFEN, ELIZABETH W. and R. H. HERBER. Half-Lives of Mn^{52} and Mn^{54}. *Phys. Rev.* 97, p. 743, February 1, 1955.

BLANTON, H. ELMORE. Dynamic System Studies: Performance Requirements for Flight Tables. W.A.D.C. Technical Report No. 54-250, Part 10. Wright-Patterson Air Force Base, Ohio: Wright Air Development Center, September, 1954.

BRIDGE, HERBERT S., H. COURANT, B. DAYTON, HERBERT C. De STAEBLER, JR., BRUNO ROSSI, R. SAFFORD and D. WILLARD. Recent Results on S. Particles. *Il Nuovo Cimento* 12, pp. 81-89, July 1, 1954.

BRIDGE, HERBERT S., H. COURANT, HERBERT C. De STAEBLER, JR. and BRUNO ROSSI. Possible Example of the Annihilation of a Heavy Particle. *Phys. Rev.* 95, pp. 1101-1103, August 15, 1954.

BRIDGE, HERBERT S., HERBERT De STAEBLER, JR., BRUNO ROSSI and B. V. SREEKANTAN. Evidence for Heavy Mesons with the Decay Processes $K_{\tau_2} \rightarrow \pi + \pi^0$ and $K_{\mu_2} \rightarrow \mu + \gamma$ from Observations with a Multiplate Cloud Chamber. *Il Nuovo Cimento 1*, pp. 874–887, March 1, 1955.

COVERT, EUGENE. A Particular Solution of a Non-Linear Equation which Occurs in the Dynamics of Conservative Systems and Its Application to Undamped Airplane Motion. *J. Aero. Sci.* 22, pp. 134-135, February, 1955.

CRAMER, HARRISON E. and F. A. RECORD. Power Spectra of the Eddy-Velocity Components. *J. Meteorology* 12, pp. 146-151, April, 1955.

De STAEBLER, HERBERT, JR. Nuclear Absorption of Negative K-Particles. *Phys. Rev.* 95, pp. 1110-1111, August 15, 1954.

FELD, BERNARD T., R. D. GODBOLE, A. ODIAN, F. SCHERB, P. C. STEIN and A. WATTENBERG. High-Energy Photoproton Production by 325-Mev Bremsstrahlung Radiation. *Phys. Rev.* 94, pp. 1000-1010, May 15, 1954.

FRAZER, JOHN F., J. A. HOFMANN, M. STANLEY LIVINGSTON and A. M. VASH. Measurement of Magnetic Field Gradients. *Rev. Sci. Instr.* 26, pp. 475-476, May, 1955.

HERMANN, WALTER, VAUGHN L. BEALS, JR. and EMMETT A. WITMER. Shock Tests Made Safer with Electrically Controlled Circuit. *Applied Hydraulics* 7, pp. 72-74, November, 1954.

HILL, JACQUES A. F., R. H. SHOULBERG and M. A. RIVAS, JR. An Experimental Determination of Flat Plate Recovery Factors for Mach Numbers between 1.90 and 3.14. *J. Aero. Sci.* 21, pp. 763-771, November, 1954.

HURTIG, CARL R. Constant-Resistance AGC Attenuator for Transistor Amplifiers. *I.R.E. Trans.* (Professional Group Circuit Theory-2), pp. 191-196, June, 1955.

KUO, HSIAO-LAN. Symmetrical Disturbances in a Thin Layer of Fluid Subject to a Horizontal Temperature Gradient and Rotation. *J. Meteorology* 11, pp. 399-411, October, 1954.

KUO, HSIAO-LAN. On Convective Instability of a Rotating

Fluid with a Horizontal Temperature Contrast. *J. Marine Research* 14, pp. 17-32, March, 1955.

LAIDLAW, WILLIAM R. and PAO-TAN HSU. A Semiempirical Method for Determining Delta-Wing Pressure Distributions in an Incompressible Flow. *J. Aero. Sci.* 21, pp. 854-856, December, 1954.

LANE, ANTHONY M. and J. P. ELLIOTT. Evidence for Two-Body Spin-Orbit Forces in Nuclei. *Phys. Rev.* 96, pp. 1160-1162, November 15, 1954.

LANE, ANTHONY M. and D. H. WILLIMSON. The Use of Fractional Parentage in the Understanding of Nuclear Reaction Phenomena. *Phys. Rev.* 97, pp. 1199-1204, March 1, 1955.

LANE, ANTHONY M., E. P. WIGNER and R. G. THOMAS. A Giant Resonance Interpretation of the Nucleon Nucleus Interaction. *Phys. Rev.* 98, pp. 693-707, May 1, 1955.

LANE, ANTHONY M. and C. F. WANDEL. Evaluation of the Imaginary Part of the Nuclear Complex Potential. *Phys. Rev.* 98, pp. 1524-1525, June 1, 1955.

LANING, J. HALCOMBE, JR. and R. H. BATTIN. An Application of Analog Computers to the Statistical Analysis of Time-Variable Networks. *I.R.E. Trans.* (Professional Group Circuit Theory-2), pp. 44-49, March, 1955.

LEMENT, BERNARD S. Cold Treatment of Metals. (A chapter in *Air Conditioning and Refrigerating Data Book.* New York, N.Y.: Am. Soc. of Refrig. Eng., 1954-1955.)

LEMENT, BERNARD S., BENJAMIN L. AVERBACH and MORRIS COHEN. Further Study of Microstructural Changes on Tempering Iron-Carbon Alloys. *Am. Soc. Metals Trans.* 47, pp. 291-320, 1955.

LIVENGOOD, JAMES C., THOMAS P. RONA and JORDAN J. BARUCH. Ultrasonic Temperature Measurement in Internal Combustion Engine Chamber. *Soc. Am. J.* 26, pp. 824-830, September, 1954.

LIVENGOOD, JAMES C. and PHILIP C. K. WU. Correlation of Autoignition Phenomena in Internal Combustion Engines and Rapid Compression Machines. (In Proceedings of the 5th International Symposium on Combustion. New York: Reinhold, 1955.)

LOGAN, B. F., G. R. WELTI and G. C. SPONSLER. Analogue Study of Electron Trajectories. *Assoc. Computing Machinery J.* 2, pp. 28-41, January, 1955.

MALETSKOS, CONSTANTINE J., C. E. BENDA, J. C. HUTCHINSON and E. B. THOMAS. Studies of Thyroid Function in Myotonia Dystrophica. *Am. J. Med.* 228, pp. 668-672, December, 1954.

MARK, HANS M., C. L. McCLELLAND and CLARK GOODMAN. Electric Excitation of Heavy Nuclei by Protons. *Phys. Rev.* 97, pp. 1191-1199, March 1, 1955.

MARTIN, R. TORRENCE. Ethylene Glycol Retention by Clays. *Soil Science Soc. Am. Proc.* 19, pp. 160-164, 1955.

MATHEWS, M. V. A Method for Evaluation of Nonlinear Servomechanisms. *A.I.E.E. Trans.* (Applications and Industry-18), pp. 114-123, May, 1955.

ODIAN, A., H. MYERS, P. C. STEIN and A. WATTENBERG. Neutrons in Coincidence with High Energy Photoprotons. *Phys. Rev.* 95, pp. 576-577, July 15, 1954.

OSBORNE, L. S., W. D. RANKIN, P. C. STEIN, A. WATTENBERG and A. WINSTON. Search for Electromagnetic Interactions between μ Mesons and Electrons. *Phys. Rev.* 97, pp. 809-810, February 1, 1955.

PRIDMORE-BROWN, DAVID C. and K. U. INGARD. Sound Propagation into the Shadow Zone in a Temperature-Stratified Atmosphere above a Plane Boundary. *Acoustical Soc. Am. J.* 27, pp. 36-42, January, 1955.

RUETENIK, J. RAY and S. CORRSIN. Equilibrium Turbulent Flow in a Slightly Divergent Channel. *Phys. Rev.* 98, p. 1142, May 15, 1955.

SCARF, FREDERICK L. Spectrum of a Bethe Salpeter Equation. *Am. Phys. Soc. Bull.* 30, p. 75, April 30, 1955.

SCHMIT, LUCIEN A. and F. L. WILLIAMS. The Effects of Thermal Radiation on Aircraft Structures. Part II: The Response of a Simple Structure to Radiant Heating. W.A.D.C. Technical Report No. 54-384, Part II (Preliminary). Wright-Patterson Air Force Base, Ohio: Wright Air Development Center, 1954.

SCHWARTZ, CHARLES L. Theory of Hyperfine Structure. *Phys. Rev.* 97, pp. 380-395, January 15, 1955.

SMAKULA, ALEXANDER. Coloration and Color Centers in Calcium Fluoride Crystals. *Zeitschrift Physik* 138, p. 276, July 22, 1954.

SMAKULA, ALEXANDER, J. KALNAJS and V. SILS. Imperfections in Germanium Single Crystals. *Phys. Rev.* 97, p. 253, January 1, 1955.

SMULLIN, LOUIS D. and CHARLES FRIED. Microwave Noise Measurements on Electron Beams. *I.R.E. Trans.* (Professional Group Electron Devices-1), pp. 168-183, December, 1954.

SPERDUTO, ANTHONY, WILLIAM W. BUECHNER, C. K. BOCKELMAN and C. P. BROWNE. (d,p) Reactions from Carbon, Nitrogen, and Oxygen. *Phys. Rev.* 96, pp. 1316-1322, December 1, 1954.

STALLARD, DAVID V. A Series Method of Calculating Control-System Transient Response from the Frequency Response. *A.I.E.E. Trans.* (Applications and Industry) 17, pp. 61-64, March, 1955.

SWENSON, CLAYTON A. and R. H. STAHL. An Efficient Cryostat for Producing Temperatures between 4° and 80° K: The Production of Liquid Hydrogen Targets Using Liquid Helium. *Rev. Sci. Instr.* 25, pp. 608-611, June, 1954.

SWENSON, CLAYTON A. and R. BERMAN. Absolute Temperature Scale between 4.2° and 5.2° K. *Phys. Rev.* 95, pp. 311-314, July 15, 1954.

SWENSON, CLAYTON A. Mechanical Properties of Teflon at Low Temperatures. *The Rev. Sci. Instr.* 24, pp. 834-835, August, 1954.

WITCHER, CLIFFORD M. and L. WASHINGTON, JR. Echo-Location for the Blind. *Electronics* 27, pp. 136-137, December, 1954.

WITCHER, CLIFFORD M. Physics without Sight. *Physics Today* 7, pp. 8-10, December, 1954.

WITCHER, CLIFFORD M. Industry Asks: Are Blind Machinists Safer? *Am. Machinist* 99, pp. 152-153, March 14, 1955.

WITCHER, CLIFFORD M. The Teaching of Mathematics to the

Blind. *The Mathematics Teacher* 48, pp. 314-321, May, 1955.

WITMER, EMMETT A., WALTER HERRMANN and VAUGHN L. BEALS, JR. Transient Aerodynamics of Two-Dimensional Airfoils. Part I: Interferometric Measurements of Airflow Development about a Symmetrical Double-Wedge Airfoil in Shock-Initiated Flow. W.A.D.C. Technical Report No. 54-368 (Preliminary). Wright-Patterson Air Force Base, Ohio: Wright Air Development Center, August, 1954.

YOUNG, JAMES E. Transmission of Sound through Thin Elastic Plates. *Acoustical Soc. Am. J.* 26, pp. 485-492, July, 1954.

YOUNG, JAMES E. Correlation Functions for Noise Fields. *Acoustical Soc. Am. J.* 26, pp. 788-789, September, 1954.

YOUNG, JAMES E. Propagation of Sound over Single Absorptive Strips in Ducts. *Acoustical Soc. Am. J.* 26, pp. 804-818, September, 1954.

ZARTARIAN, GARABED, J. WALSH and H. M. VOSS. Generalized Aerodynamic Forces on the Delta Wing with Supersonic Leading Edges. *J. Aero. Sci.* 21, pp. 739-748, November, 1954.

Division of Defense Laboratories

BENEDEK, GEORGE B. and E. M. PURCELL. Nuclear Magnetic Resonance in Liquids under High Pressure. *J. Chem. Phys.* 22, p. 2003, December, 1954.

BENEDEK, GEORGE B., W. PAUL and H. BROOKS. Pressure Dependence of Resistivity, Hall Effect and Magnetoresistance in Germanium. *Am. Phys. Soc. Bull.* 30, p. 54, January 27, 1955.

BROWN, DAVID R., D. A. BUCK and N. MENYUK. A Comparison of Metals and Ferrites for High-Speed Pulse Operation. *A.I.E.E. Trans.* (Communications and Electronics) 16, pp. 631-634, January, 1955.

BROWN, DAVID R. Review of Electronic Computer Progress During 1954. *I.R.E. Trans.* (Professional Group on Electronic Computers-4), pp. 33-38, March, 1955.

CARROLL, THOMAS J. Overcoming the Line-of-Sight Shibbo-

leth with the Air and High Power. *Instr. Radio Engrs. (Australia) Proc.* 16, pp. 107-112, April, 1955.

CHASE, CHARLES E. and MELVIN A. HERLIN. Ultrasonic Propagation in Magnetically Cooled Helium. *Phys. Rev.* 97, pp. 1447-1452, March 15, 1955.

COILE, RUSSELL C. Ages of Creativeness of Electronic Engineers. *I.R.E. Proc.* 42, pp. 1322-1323, August, 1954.

DANSKIN, JOHN M. Fictitious Play for Continuous Games. *Naval Research Logistics Quarterly* 1, pp. 313-320, December, 1954.

DANSKIN, JOHN M. A Stockpiling Problem: Mathematical Treatment. *Naval Research Logistics Quarterly* 2, March-June, 1955.

DEXTER, RICHARD N., H. J. ZEIGER and BENJAMIN LAX. Anisotropy of Cyclotron Resonance of Holes in Germanium. *Phys. Rev.* 95, pp. 557-558, July 15, 1954.

DEXTER, RICHARD N. and BENJAMIN LAX. Effective Masses of Holes in Silicon. *Phys. Rev.* 96, pp. 223-224, October 1, 1954.

DEXTER, RICHARD N., BENJAMIN LAX, A. KIP and G. DRESSELHAUS. Effective Masses of Electrons in Silicon. *Phys. Rev.* 96, p. 222, October 1, 1954.

DEXTER, RICHARD N. and BENJAMIN LAX. Microwave Magnetoconductivity Effects in InSb. *Am. Phys. Soc. Bull.* 30, p. 35, April 28, 1955.

DEXTER, RICHARD N. Third Harmonic Cyclotron Resonance of Holes in Germanium. *Phys. Rev.* 98, p. 1560, June 1, 1955.

FARLEY, B. G. and W. A. CLARK. Simulation of Self-Organizing Systems by Digital Computer. *I.R.E. Trans.* (Professional Group Information Theory-4), pp. 76-84, September 15, 1954.

FEINSTEIN, AMIEL. A New Basic Theorem of Information Theory. *I.R.E. Trans.* (Professional Group Information Theory-4), pp. 2-22, September, 1954.

FREEMAN, JAMES R. Pulse Responses of Ferrite Memory Cores. *Western Joint Computer Conference Proceedings*, pp. 50-61, August, 1954.

GOLD, LOUIS. Relativistic Dynamics of a Charged Particle in Crossed Magnetic and Electric Fields with Application to the Planar Magnetron. *J. Appl. Phys.* 25, pp. 683-690, June, 1954.

GOLD, LOUIS. On the Nature of the Transcendental Curves Associated with the Relativistic Trajectories of Charged Particles. *J. Appl. Phys.* 25, pp. 691-697, June, 1954.

GOLD, LOUIS. Direct Cellular Evaluation of the Density of States in Phase Space and the Accurate Calculation of Fermi Levels. *J. Appl. Phys.* 25, pp. 1278-1280, October, 1954.

GOLD, LOUIS. Macroscopic Aspects of Neutron Interaction in Magnetics. *Phys. Rev.* 97, pp. 79-80, January 1, 1955.

GOLD, LOUIS. On the Diffusion of Decaying Particles. *J. Appl. Phys.* 26, pp. 233-235, February, 1955.

GOODENOUGH, JOHN B. A Theory of Domain Creation and Coercive Force in Polycrystalline Ferromagnetics. *Phys. Rev.* 95, pp. 917-932, August 15, 1954.

GOODENOUGH, JOHN B. and ARTHUR L. LOEB. Theory of Ionic Ordering, Crystal Distortion, and Magnetic Exchange Due to Covalent Forces in Spinels. *Phys. Rev.* 98, pp. 391-408, April 15, 1955.

GREEN, BERT F., JR. Attitude Measurement. (Chapter in *Handbook of Social Psychology*, Vol. 1, edited by G. Lidzey. Cambridge: Addison-Wesley Press, 1954.)

GREEN, MINO and J. A. KAFALAS. The Purification of Germanium: The Germanium Tetrachloride-Arsenic Trichloride System. *Chemical Soc. J.* (London), pp. 1604-1607, May, 1955.

HANLEY, L. DAVID and C. G. THORNTON. A New High Temperature Silicon Diode. *I.R.E. Proc.* 43, pp. 186-188, February, 1955.

HARRINGTON, JOHN V., P. ROSEN and D. SPAETH. Transmission of Pulses over Telephone Lines. *Symposium on Information Network Proc.*, Polytechnic Inst. Brooklyn, Paper 110, January, 1955.

HARRINGTON, JOHN V. Detection of Repeated Signals in Noise by Binary Integration. *I.R.E. Trans.* (Professional Group Information Theory-1), pp. 1-10, March, 1955.

HARRIS, JOHN N. and F. L. McNAMARA. Digital Computer Plug — In Units and Associated Equipment. *Elec. Eng.* 74, pp. 326-329, April, 1955.

HARTZLER, ALFRED J. and R. T. SIEGEL. 400-Mev Neutron-Proton Scattering. *Phys. Rev.* 95, pp. 185-192, July 1, 1954.

JONES, NOLAN T., R. H. KINGSTON and S. F. NEUSTADTER. Anomalous Forward Switching Transient in p-n Junction Diodes. *J. Appl. Phys.* 26, pp. 210-213, February, 1955.

KATZENSTEIN, HENRY S. and S. S. FRIEDLAND. New Time-of-Flight Mass Spectrometer. *Rev. Sci. Instr.* 26, pp. 324-327, April, 1955.

KEILSON, JULIAN. On Diffusion in an External Field and the Adjoint Source Problem. *Quarterly Appl. Math.* 12, pp. 435-438, January, 1955.

KINGSTON, ROBERT H. and A. L. McWHORTER. Channels and Excess Reverse Current in Grown Germanium p-n Junction Diodes. *I.R.E. Proc.* 42, pp. 1376-1380, September, 1954.

KLEINER, WALTER H. Magnetic Scattering of Slow Neutrons from O_2 Gas. *Phys. Rev.* 97, pp. 411-418, January 15, 1955.

KLEINER, WALTER H. Excited Donor Levels in Silicon. *Phys. Rev.* 97, pp. 1722-1723, March 15, 1955.

KOLM, HENRY H. and MELVIN A. HERLIN. A New Method for Measuring the Absolute Viscosity of Liquid Helium II. *Am. Phys. Soc. Bull.* 30, p. 69, April 28, 1955.

KOLM, HENRY H. and G. W. PRATT. Field-Induced Surface Effects. *Am. Phys. Soc. Bull.* 30, p. 18, June 22, 1955.

KOSTER, GEORGE F. and JOHN C. SLATER. Wave Functions for Impurity Levels. *Phys. Rev.* 95, pp. 1167-1176, September 1, 1954.

KOSTER, GEORGE F. Theory of Scattering in Solids. *Phys. Rev.* 95, pp. 1436-1443, September 15, 1954.

KOSTER, GEORGE F. and JOHN C. SLATER. Simplified Impurity Calculation. *Phys. Rev.* 96, pp. 1208-1223, December 1, 1954.

KOSTER, GEORGE F. Extension of Hund's Rule. *Phys. Rev.* 98, pp. 514-515, April 15, 1955.

KOSTER, GEORGE F. Density of States Curve for Nickel. *Phys. Rev.* 98, pp. 901-902, May 15, 1955.

LAX, BENJAMIN, HERBERT J. ZEIGER and RICHARD N. DEXTER. Anisotropy of Cyclotron Resonance in Germanium. *Physica* 20, pp. 818-828, 1954.

LAX, BENJAMIN, K. J. BUTTON and L. M. ROTH. Ferrite Phase Shifters in Rectangular Waveguide. *J. Appl. Phys.* 25, pp. 1413-1421, November, 1954.

LAX, BENJAMIN and LAURA M. ROTH. Propagation and Plasma Oscillation in Semiconductors. *Phys. Rev.* 98, pp. 548-549, April 15, 1955.

LOEB, ARTHUR L. Automatische Rekenmachines: Whirlwind I. *Netherlandsch Tijdschrift voor Natuurkunde* 21, pp. 97-117, April, 1955.

McNAMARA, FRANK L., R. E. BARRETT and R. E. BEYER. Ultrasonic Absorption in Acetate Solutions. *Acoustical Soc. Am. J.* 26, pp. 966-969, November, 1954.

MAXWELL, EMANUEL and O. S. LUTES. Threshold Field Properties of Some Superconductors. *Phys. Rev.* 95, pp. 333-338, July 15, 1954.

MAXWELL, EMANUEL and O. S. LUTES. Superconducting Transitions in Tin Whishers. *Phys. Rev.* 97, pp. 1718-1720, March 15, 1955.

MENYUK, NORMAN and JOHN B. GOODENOUGH. Magnetic Materials for Digital Computer Components. I. A Theory of Flux Reversal in Polycrystalline Ferromagnetics. *J. Appl. Phys.* 26, pp. 8-18, January, 1955.

MENYUK, NORMAN. Magnetic Materials for Digital Computer Components. II. Magnetic Characteristics of Ultra-Thin Molybdenum-Permalloy Cores. *J. Appl. Phys.* 26, pp. 692-697, June, 1955.

NEUSTADTER, SIEGFRIED F. and BENJAMIN LAX. Transient Response of a p-n Junction. *J. Appl. Phys.* 25, pp. 1148-1154, September, 1954.

NEUSTADTER, SIEGFRIED F. and ROBERT H. KINGSTON. Calculation of the Space Charge, Electric Field, and Free Carrier Concentration at the Surface of a Semiconductor. *J. Appl. Phys.* 26, pp. 718-720, June, 1955.

PAPIAN, WILLIAM N. Memory Devices. (Chapter A, section III, in *Dielectric Materials and Applications*, edited by Arthur R. von Hippel. New York: The Technology Press of M.I.T. and John Wiley & Sons, 1954.)

PAPIAN, WILLIAM N. New Ferrite-Core Memory Uses Pulse Transformers. *Electronics* 28, pp. 194-197, March, 1955.

PIKE, EUGENE W. The Process of Learning by Experiment. *Am. Statistical Assoc. J.* 50, p. 592, June, 1955.

PRATT, GEORGE W., JR. Antiferromagnetism. *Phys. Rev.* 97, pp. 926-932, February 15, 1955.

PRATT, GEORGE W., JR. Localized States at the Boundary of Two Crystals. *Am. Phys. Soc. Bull.* 30, p. 20, March, 1955.

PRICE, ROBERT. The Detection of Signals Perturbed by Scatter and Noise. *I.R.E. Trans.* (Professional Group Information Theory-4), p. 163, September, 1954.

REDIKER, ROBERT H. Ionization Chamber Measurements at 10,600 Feet of the Absorption of the N-Component in Carbon and Hydrocarbon. *Phys. Rev.* 95, pp. 526-531, July 15, 1954.

SAATY, THOMAS L. and S. GASS. Parametric Objective Function (pt.1). *Operations Res. Soc. Am. J.* 2, pp. 316-319, August, 1954.

SAATY, THOMAS L. A Number of Vertices of Polyhendron. *Am. Math. Monthly* 62, pp. 326-331, May, 1955.

SANTA, MARTIN M., G. M. KIRKPATRICK and R. S. GRISETTI. Effect of Internal Fluctuations and Scanning on Clutter Attenuation in MTI Radar. *I.R.E. Trans.* (Aeronautical and Naval Electronics-2), pp. 37-41, March, 1955.

SOKAL, NATHAN O. and G. B. TIFFANY. A Transistorized Light-Beam Audio Transmitter. *Radio and Television News* 53, pp. 35-37, June, 1955.

SPONSLER, GEORGE C. and F. L. SHADER. PPI Light Spot Bright-

ness Probability Distributions. *J. Appl. Pnys.* 25, pp. 1271-1277, October, 1954.

SPONSLER, GEORGE C. Two Formulae Involving Generalized Legendre Functions of Integral and Non-Integral Index. *J. Math. and Phys.* 34, pp. 50-53, April, 1955.

SPONSLER, GEORGE C. Trajectory-Tracer Study of Helix and Band-Type Postdeflection Acceleration. *J. Appl. Phys.* 26, pp. 676-682, June, 1955.

STEVENSON, DONALD T. and ROBERT J. KEYES. Measurement of the Recombination Velocity at Germanium Surfaces. *Physica* 20, pp. 1041-1045, November, 1954.

STEVENSON, DONALD T. and ROBERT J. KEYES. Measurement of Carrier Lifetimes in Germanium and Silicon. *J. Appl. Phys.* 26, pp. 190-195, February, 1955.

STONE, JAMES B. Engineer or Writer? *Technical Writing Rev.* 2, p. 1, March, 1955.

TOWLE, DAVID M. and R. B. LINDSAY. Absorption and Velocity of Finite Amplitude Ultrasonic Waves in Liquids. *Acoustical Soc. Am. J.* 27, pp. 530-533, May, 1955.

VAN VOORHIS, STANLEY N. Review of *Noise*, by Aldert Van der Ziel. (New York: Prentice-Hall, Inc., 1954.) *Nucleonics* 12, pp. 58-60, December, 1954.

WARSCHAUER, DOUGLAS M., W. PAUL and H. BROOKS. Effect of Pressure on the Optical Absorption Edge in Silicon and Germanium. *Am. Phys. Soc. Bull.* 30, p. 54, January, 1955.

PUBLICATIONS OF THE DEPARTMENTS AND LABORATORIES *

Department of Aeronautical Engineering

AEROELASTIC AND STRUCTURES RESEARCH LABORATORY.

EFFECT OF SHOCK AND IMPACT LOADS ON ELASTIC AND RIGID-PLASTIC BEAMS, by G. S. Ram. Report Number 25.15, September, 1954.

THE RESPONSE OF A RIGID-PLASTIC CANTILEVER BEAM TO A UNIFORMLY DISTRIBUTED LOAD WITH RECTANGULAR TIME PULSE, by G. S. Ram. Report Number 25.16, September, 1954.

THEORETICAL AND EXPERIMENTAL PRESSURE DISTRIBUTION ON LOW ASPECT RATIO WINGS OSCILLATING IN AN INCOMPRESSIBLE FLOW, by W. R. Laidlaw. Report Number 51.2, September, 1954.

COMPARATIVE FLUTTER CALCULATIONS ON LOW ASPECT RATIO WINGS IN INCOMPRESSIBLE AND SUPERSONIC FLOWS, by P. T. Hsu, G. Zartarian and H. M. Voss. Report Number 52.2, October, 1954.

APPLICATION OF NUMERICAL INTEGRATION TECHNIQUES TO THE LOW ASPECT RATIO FLUTTER PROBLEMS IN SUBSONIC AND SUPERSONIC FLOWS, by G. Zartarian, P. T. Hsu and H. M. Voss. Report Number 52.3, October, 1954.

A VARIABLE MACH NUMBER SUPERSONIC TEST SECTION FOR FLUTTER RESEARCH, by R. L. Halfman, J. McCarthy, Jr., J. S. Prigge, Jr. and G. A. Wood, Jr. Report Number 44.1, December, 1954.

A THEORETICAL AND EXPERIMENTAL INVESTIGATION OF THE VALIDITY AND APPLICABILITY OF GENERALIZED HARMONIC ANALYSIS IN THE PREDICTION OF GUST LOADS, by A. S. Richardson, Jr. and R. J. Hakkinen. Report Number 53.1, January, 1955.

*Copies of all reports listed have been deposited with the Special Collections Librarian in the M.I.T. Library, 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, including the name of the sponsoring laboratory.

APPLICATION OF THE VARIATIONAL METHOD OF TRANSIENT HEAT CONDUCTION PROBLEMS, by K. Washizu. Report Number 25.17, March, 1955.

ON THE VARIATIONAL PRINCIPLES OF ELASTICITY AND PLASTICITY, by K. Washizu. Report Number 25.18, March, 1955.

SYNTHESIS OF BEAM-NETWORK STRUCTURES FOR LOW-ASPECT-RATIO FLUTTER MODELS, by M. M. Chen and S. I. Gravitz. Report Number 54.1, March, 1955.

CONSTRUCTION AND TESTING OF A DOUBLY-FLEXIBLE MODEL OF A DELTA WING, by M. M. Chen. Report Number 54.2, June, 1955.

AEROPHYSICS RESEARCH GROUP.

WALL CORRECTIONS FOR TRANSONIC WIND TUNNELS, PART II: SOME ASPECTS OF WALL INTERFERENCE EFFECTS OF A SUPERSONIC SLOTTED-THROAT WIND TUNNEL, by K. Mikami. Transonic Aircraft Control Project Report Number 9, September, 1954.

APPROXIMATE METHODS FOR ESTIMATING TRANSONIC PRESSURE DISTRIBUTIONS AND AERODYNAMIC COEFFICIENTS, by L. Trilling and R. E. Quigley. Transonic Aircraft Control Project Report Number 11, December, 1954.

APPARATUS FOR MEASUREMENT OF DAMPING-IN-PITCH DERIVATIVES IN A TRANSONIC WIND TUNNEL, by H. S. Radt, Jr. and J. Bicknell. Transonic Aircraft Control Project Report Number 13, December, 1954.

DESCRIPTION OF A VARIABLE MACH NUMBER, VARIABLE REYNOLDS NUMBER SUPERSONIC TEST SECTION, by R. E. Quigley, S. D. Lewis and K. Mikami. Transonic Aircraft Control Project Report Number 16, March, 1955.

FLUID DYNAMICS RESEARCH GROUP.

AN APPROXIMATE AERODYNAMIC THEORY FOR GUST ENTRY OF SWEPT WINGS, by Holt Ashley. Report Number 1 (Also published as O.S.R. Technical Note Number 55-32), December, 1954.

MEASUREMENTS OF THREE-DIMENSIONAL BOUNDARY LAYERS ON WINGS, by Peter Winter. Report Number 2 (Also pub-

lished as O.S.R. Technical Note Number 55-133), March, 1955.

ON THERMALLY INDUCED SOUND FIELDS, by Leon Trilling. Report Number 3 (Also published as O.S.R. Technical Note Number 55-47), December, 1954.

PARAMETRIC STUDIES OF VISCOUS AND NONVISCOUS UNSTEADY FLOWS, by Marten Landahl, E. L. Mollo-Christensen and Holt Ashley. Report Number 4 (Also published as O.S.R. Technical Report Number 55-13), April, 1955.

UNSTEADY FLOW AROUND THIN WINGS AT HIGH MACH NUMBERS, by Marten T. Landahl Report Number 5 (Also published as O.S.R. Technical Note Number 55-245), June, 1955.

VISCOUS FLOWS NEAR SIDE EDGES AND LEADING EDGES, by Leon Trilling. Report Number 6 (Also published as O.S.R. Technical Note Number 55-220), June, 1955.

FUNDAMENTAL RESEARCH ON UNSTEADY FLOW OVER WINGS, by Holt Ashley, E. L. Mollo-Christensen, Morton Finston and Robert L. Halfman. Report Number 7.

NAVAL SUPERSONIC LABORATORY.

SURVEY OF THE PRESENT STATUS OF SUPERSONIC HEAT TRANSFER, by Morton Finston. Technical Report Number 62, December, 1954.

AN EXPERIMENTAL INVESTIGATION OF HEAT TRANSFER AT THE BOUNDARIES OF SUPERSONIC NOZZLES, by Judson R. Baron and Frank H. Durgin. Technical Report Number 65, December, 1954.

ANALYTIC DESIGN OF A FAMILY OF SUPERSONIC NOZZLES BY THE FRIEDRICHS METHOD (Including Computation Tables and a Summary of Calibration Data), by Judson R. Baron. Technical Report Number 66 (Also published as W.A.D.C. Technical Report Number 54-279), June, 1954.

Department of Architecture

PLASTICS IN HOUSING, the report of a study sponsored by the Monsanto Chemical Company, edited by Richard W. Hamilton for the project staff. June, 1955.

Department of Biology

LABORATORY FOR APPLIED BIOPHYSICS.

ELEMENTS OF INSTRUMENTATION, II: THERMAL TRANSDUCERS, by K. S. Lion and W. L. Harries. Technical Report Number 3, June, 1955.

Department of Chemical Engineering

HYDROGEN PEROXIDE RESEARCH.

HYDROGEN PEROXIDE, by W. C. Schumb, C. N. Satterfield and R. L. Wentworth. Part III, Report Number 44, December 31, 1954.

IGNITION LIMITS OF HYDROGEN PEROXIDE VAPOR, by C. N. Satterfield, P. J. Ceccotti and A. H. R. Feldbrugge. Report Number 47, November 1, 1954.

INTERFERENCES IN THE TITANIUM SULFATE METHOD FOR HYDROGEN PEROXIDE, by C. N. Satterfield and A. H. Bonnell. Report Number 48, December 1, 1954.

PROJECT SEPARATION.

PROCESSING SPENT POWER-REACTOR FUELS. U.S. Atomic Energy Commission, Report Number MIT-5005, December, 1954.

Department of Civil and Sanitary Engineering

BUILDING ENGINEERING AND CONSTRUCTION.

STRESS RELAXATION BEHAVIOR OF REPRESENTATIVE POLYMERS; MECHANICAL BEHAVIOR OF PLASTICS MATERIALS UNDER VERY HIGH RATES OF LOADING; MECHANICAL BEHAVIOR AND ENERGY ABSORBING CHARACTERISTICS OF THIN, FLEXIBLE PLASTIC FILMS; REINFORCED PLASTICS AND INSTRUMENTATION, by Albert G. H. Dietz and Frederick J. McGarry. Bi-monthly Progress Reports, July to November, 1954. Summary Report, June, 1955.

HIGH SPEED COMPRESSION TESTING OF PLASTICS MATERIALS, by Albert G. H. Dietz, Frederick J. McGarry and James Dorsey. Monthly Progress Reports, June, 1954 to May, 1955.

VOLUME CHANGES OF LIMESTONES DURING BURNING (Progress

Report Number 1 dated December 10, 1954, and Progress Report Number 2 dated April 30, 1955), by James A. Murray and Paul V. Pelaez.

HYDRODYNAMICS LABORATORY.

WATER TABLE EXPERIMENTS ON TRANSIENT SHOCK WAVE DIFFRACTION, PART II: EXPERIMENTAL RESULTS AND EVALUATION, by D. R. F. Harleman, O. A. Boedtker and S. Wolf. Technical Report Number 13, 1954.

OXYGEN ABSORPTION AND TURBULENCE CHARACTERISTICS IN BUBBLE AERATION, by A. T. Ippen and C. E. Carver, Jr. Technical Report Number 14, 1955.

SHOALING AND BREAKING OF THE SOLITARY WAVE, by A. T. Ippen and G. Kulin. Technical Report Number 15, 1955.

DAMPING CHARACTERISTICS OF THE SOLITARY WAVE, by A. T. Ippen and G. Kulin. Technical Report Number 16, 1955.

HYDRAULIC MODEL PERFORMANCE OF SPILLWAY AND OUTLET WORKS OF PELIGRE DAM, by D. R. F. Harleman, R. S. Gooch and A. A. Vulgaropulos. Technical Report Number 17, 1955.

A STUDY OF SEDIMENT SORTING BY WAVES SHOALING ON A PLAIN BEACH, by A. T. Ippen and P. S. Eagleson. Technical Report Number 18, 1955.

EXPERIMENTAL AND ANALYTICAL STUDIES OF WAVE FORCES ON BASIC COMPONENTS OF OFFSHORE STRUCTURES, PART I: RESULTS FOR VERTICAL CYLINDERS, by D. R. F. Harleman and W. C. Shapiro, Technical Report Number 19, 1955.

JOINT HIGHWAY RESEARCH PROJECT.

AN EXPERIMENT IN THE USE OF EXPANDED METAL REINFORCING TO CONTROL REFLECTION CRACKING IN BITUMINOUS SURFACES OVER CONCRETE, by L. W. Crump and A. J. Bone. June, 1955.

OIL MECHANICS LABORATORY.

THE BEHAVIOR OF SOILS UNDER DYNAMIC LOADING: FINAL REPORT ON LABORATORY STUDIES, by R. V. Whitman, J. F. Cheatham, W. S. Wang, J. A. Jacobson, T. D. Landale and M. C. Soteriades. Report Series AFSWP-118, Report Number 3, August, 1954.

Department of Economics and Social Science

INDUSTRIAL RELATIONS SECTION.

SEVENTEENTH ANNUAL REPORT, October, 1954.

Department of Electrical Engineering

LABORATORY FOR INSULATION RESEARCH.

THE LATTICE CONSTANTS OF THE ALKALI BOROHYDRIDES AND THE LOW-TEMPERATURE PHASE OF SODIUM BOROHYDRIDE, by S. C. Abrahams and J. Kalnajs. Technical Report Number 80, July, 1954.

THE CRYSTAL STRUCTURE OF BARIUM PEROXIDE, by S. C. Abrahams and J. Kalnajs. Technical Report Number 81, July, 1954.

A MAGNETO-X-RAY STUDY OF MAGNETITE AT 78°K, by S. C. Abrahams and B. A. Calhoun. Technical Report Number 82, July, 1954.

THE CRYSTAL AND MOLECULAR STRUCTURE OF ORTHORHOMBIC SULFUR, by S. C. Abrahams. Technical Report Number 83, September, 1954.

THE CRYSTAL STRUCTURE OF α-POTASSIUM SUPEROXIDE, by S. C. Abrahams and J. Kalnajs. Technical Report Number 84, September, 1954.

CRYSTALLOGRAPHY OF THE TELLURIUM-IODINE SYSTEM, by W. R. Blackmore, S. C. Abrahams and J. Kalnajs. Technical Report Number 85, September, 1954.

COLOR CENTERS IN CALCIUM FLUORIDE CRYSTALS, by A. Smakula. Technical Report Number 86, September, 1954.

THE DYNAMIC BEHAVIOR OF DOMAIN WALLS IN BARIUM TITANATE, by E. A. Little. Technical Report Number 87, October, 1954.

LINE BROADENING AND RELAXATION IN COMPRESSED GASES, by C. S. E. Phillips. Technical Report Number 88, October, 1954.

THE SYNTHESIS OF FERRITES AND PREPARATION OF COBALT FERRITE SINGLE CRYSTALS, by D. G. Wickham. Technical Report Number 89, October, 1954.

THE ORIENTATION OF ELECTRIC-BREAKDOWN PATHS IN ALKALI HALIDE SINGLE CRYSTALS, by M. E. Caspari. Technical Report Number 90, November, 1954.

PREBREAKDOWN CURRENT AND NOISE IN INSULATORS, by D. A. Powers and T. Suita. Technical Report Number 91, January, 1955.

PRECISION DETERMINATION OF LATTICE CONSTANTS WITH A GEIGER-COUNTER X-RAY DIFFRACTOMETER, by A. Smakula and J. Kalnajs. Technical Report Number 92, February, 1955.

CONDUCTION AND BREAKDOWN IN HEXANE, by W. B. Green. Technical Report Number 93, March, 1955.

INFRARED SPECTRA OF FERRITES, by R. D. Waldron. Technical Report Number 94, March, 1955.

PRECISION DENSITY DETERMINATION OF LARGE SINGLE CRYSTALS BY HYDROSTATIC WEIGHING, by A. Smakula and V. Sils. Technical Report Number 95, May, 1955.

DENSITIES AND IMPERFECTIONS OF SINGLE CRYSTALS, by A. Smakula, J. Kalnajs and V. Sils. Technical Report Number 96, May, 1955.

SERVOMECHANISMS LABORATORY.

A CLOSED EXPANSION OF THE CONVOLUTION INTEGRAL (A GENERALIZATION OF SERVOMECHANISM ERROR COEFFICIENTS), by Edward Arthurs and Louis H. Martin. Technical Memo Number 6897-TM-17, July, 1954.

THEORETICAL EVALUATION OF THE ACCURACY OF A SHAFT-TO-PHASE-MODULATED VOLTAGE CONVERTER, by J. Herbert Brown. Engineering Report Number 6873-ER-11, September, 1954.

STUDY OF VOLTAGE REGULATING SYSTEMS FOR AIRCRAFT ALTERNATING CURRENT GENERATORS, by K. Chen. Part II of W.A.D.C. Technical Report Number 54-298, August, 1954.

DESIGN FACTORS FOR MAGNETIC AMPLIFIERS, by Kenneth W. Gardiner. Technical Report Number 7002-9 August, 1954.

ANALYSIS OF MAGNETIC AMPLIFIERS BY THE USE OF DIFFER-

ENTIAL EQUATIONS, by Paul R. Johannessen. Technical Report Number 7002-7, August, 1954.

A PUSH-PULL SELF-SATURATING MAGNETIC AMPLIFIER, by Paul R. Johannessen and Richard E. Fitts. Technical Memo Number 7002-TM-15, September, 1954.

CATALOG OF SPECIAL PURPOSE AND IMPROVED ELECTRON TUBES, by Wheeler X. Johnson. Technical Memo Number 7002-TM-17, October, 1954.

PHASE-PLANE ANALYSIS OF AUTOMATIC CONTROL SYSTEMS CONTAINING NON-LINEAR GAIN ELEMENTS, by Rudolf E. Kalman. Technical Memo Number 6897-TM-15, July, 1954.

A LOW-DRIFT INTEGRATING AMPLIFIER, by William R. Porter. Technical Memo Number 6897-TM-18, September, 1954.

STABILIZATION OF A CONTROL SYSTEM HAVING COULOMB FRICTION, by John Steranka, Jr. Engineering Report Number 6873-ER-10, August, 1954.

STUDY OF VOLTAGE REGULATING SYSTEMS FOR AIRCRAFT ALTERNATING CURRENT GENERATORS, by the project staff. Part I of W.A.D.C. Technical Report Number 54-298, August, 1954.

RELATING THE SATURATED STEP RESPONSE OF A SERVO TO ITS BANDWIDTH, by George A. Biernson. Technical Memo Number 7138-TM-2, June, 1955.

SUGGESTIONS FOR DEVELOPMENT OF EQUIPMENT TO FACILITATE STATISTICAL ANALYSIS BY CORRELATION AND FOURIER TRANSFORMATION, by J. W. Brean. Technical Memo Number 7138-TM-1, January, 1955.

A MAGNETIC-AMPLIFIER SIMULATOR, by Richard E. Fitts. Technical Report Number 7002-11, May, 1955.

APPLICATION OF A MAGNETIC AMPLIFIER TO A HIGH PERFORMANCE INSTRUMENT SERVO, by Paul R. Johannessen. Technical Report Number 7002-10, May, 1955.

PRELIMINARY DESIGN OF A SERVO PROGRAMMER, by S. S. Kolodkin. Technical Memo Number 6897-TM-20, May, 1955.

ANGULAR MOTION INSTRUMENTATION FOR MODEL SEAWORTHINESS TESTING, by W. R. Porter. Technical Memo Number 6897-TM-19, May, 1955.

SERVOMECHANISMS LABORATORY (ELECTRONIC NUCLEAR INSTRUMENTATION GROUP).

STACKED-DISK NEUTRON THERMOPILE, by F. S. Replogle. Technical Report Number 5, March 15, 1955.

PULSE-AMPLITUDE ANALYSIS IN NUCLEAR RESEARCH, by A. B. Van Rennes. Technical Report Number 3, January 15, 1955.

A-C IONIZATION DETECTOR, by D. R. Whitehouse. Technical Report Number 4, January 31, 1955.

ANNUAL PROGRESS REPORT, March 1, 1955.

Department of Food Technology

STUDY OF GLASS DOSIMETERS, by B. E. Proctor and S. A. Goldblith. Quarterly Progress Report to the Atomic Energy Commission, Serial Number 236, September, 1954.

Department of Geology and Geophysics

GEOPHYSICAL ANALYSIS GROUP.

LINEAR OPERATORS AND SEISMIC NOISE, by the staff of the Geophysical Analysis Group, S. M. Simpson, Jr., Director. Report Number 9, March 15, 1955.

Department of Mechanical Engineering

CRYOGENIC ENGINEERING LABORATORY.

THE APPLICATION OF HIGH HYDROSTATIC PRESSURES AT LIQUID HELIUM TERMPERATURES, by C. A. Swenson. Office of Naval Research Technical Memorandum 55-1, January, 1955.

DYNAMIC ANALYSIS AND CONTROL LABORATORY.

A STUDY OF THE TRANSFER OF CREDIT IN RELATION TO THE BANKING SYSTEM, by R. H. Gregory and H. Jacobs, Jr. Report Number 87, July 1, 1954.

GAS TURBINE LABORATORY.

A SURVEY OF RESEARCH ACTIVITIES DURING 1953-1954 AND PROPOSALS FOR RESEARCH DURING 1955, by Edward S. Taylor and Robert C. Dean, Jr. Report 27-1, December, 1954.

THEORETICAL CONSIDERATION OF SECONDARY FLOW, by George L. Mellor, Jr. Report 27-2, December, 1954.

AXISYMMETRIC SOLUTIONS OF FLOW THROUGH A SINGLE-STAGE AXIAL COMPRESSOR, by Raymond W. Moore, Jr. and David L. Richardson. Report 27-5, December, 1954.

MEASUREMENTS OF FLOW THROUGH A SINGLE-STAGE AXIAL COMPRESSOR, by Raymond W. Moore, Jr. and Kurt H. Schneider. Report 27-6, December, 1954.

EXPERIMENTAL TECHNIQUES FOR THREE-DIMENSIONAL FLOW RESEARCH, by Raymond W. Moore, Jr., Warren G. Nelson, Arun Prasad, David L. Richardson and James R. Turner.

HEAT TRANSFER LABORATORY.

THE EFFECT OF THE ENTRANCE FLOW ON THE PERFORMANCE OF A THERMODYNAMIC TEMPERATURE SERVING INSTRUMENT, by J. A. Lehtinen, J. A. Clark and W. M. Rohsenow. Report Number 101, October, 1954.

INTERNAL COMBUSTION ENGINE LABORATORY.

HEAT TRANSFER IN INTERNAL COMBUSTION ENGINES, by T. Y. Toong, C. F. Taylor, J. F. Batter, Jr., A. Cansever, J. L. Lundholm and J. Steingrimsson. Report of research under the grant of the Shell Oil Company, November, 1954.

Department of Physics

SOLID-STATE AND MOLECULAR THEORY GROUP.

ELECTRONIC STRUCTURE OF MOLECULES: SOME RECENT DEVELOPMENTS, by Roy McWeeny. Technical Report Number 7, May 1, 1955.

Center for International Studies

THE ITALIAN POLITICAL SITUATION IN THE SPRING OF 1954, by Vincent M. Barnett, Jr. July, 1954.

WHAT FOREIGN TRADE POLICY DOES AMERICAN BUSINESS WANT?, by Raymond A. Bauer, Susanne Keller and Ithiel de Sola Pool. February, 1955.

INPUT-OUTPUT RELATIONSHIPS AMONG SELECTED INDIAN INDUSTRIES, by Ajit K. Biswas. July, 1954.

FINANCIAL IMPLEMENTATION OF THE FIVE YEAR PLAN, by Panchanan Chakrabartty. November, 1954.

CONDITIONS AND PROSPECTS FOR ECONOMIC GROWTH IN COM-

MUNIST CHINA, by Alexander Eckstein. October, 1954.

A CASE STUDY IN INDUSTRIAL DEVELOPMENT — THE GROWTH OF THE PULP AND PAPER INDUSTRY IN INDIA, by John C. Eddison. February, 1955.

RELIGIOUS BELIEF AND ECONOMIC BEHAVIOR IN A CENTRAL JAVANESE TOWN: SOME PRELIMINARY CONSIDERATIONS, by Clifford J. Geertz. February, 1955.

ENCOURAGEMENT OF FOREIGN INVESTMENT IN INDONESIA AND SOME SUPPLEMENTARY REMARKS, by Benjamin H. Higgins. September, 1954.

ENCOURAGEMENT OF FOREIGN INVESTMENT IN INDONESIA, SUPPLEMENT II: THE REPORT OF THE CANADIAN ADVISORY COMMITTEE ON OVERSEAS INVESTMENT, by Benjamin H. Higgins. October, 1954.

FOREIGN INVESTMENT IN INDONESIA, SUPPLEMENT III: FACTORS LIMITING AMERICAN FOREIGN INVESTMENT, by Benjamin H. Higgins. October, 1954.

INDIAN VIEWS OF CHINA BEFORE THE COMMUNIST REVOLUTION, by Hindi-Cheeni with D. Amba Bai. May, 1955.

THE ROLE OF LABOR-INTENSIVE INVESTMENT IN CHINA'S CAPITAL FORMATION, by Ronald H. Hsia. September, 1954.

SUMMARY OF MOSCOW AND THE COMMUNIST PARTY OF INDIA, A STUDY IN THE POSTWAR EVOLUTION OF COMMUNIST STRATEGY, by John J. Kautsky. October, 1954.

USE OF TOP-LEVEL PERSONNEL BY THE CHINESE COMMUNIST GOVERNMENT, 1949-1953, by Donald B. Keesing. December, 1954.

FORCED LABOR IN THE SOVIET UNION: A SELECTIVE BIBLIOGRAPHY, by Alexander G. Korol. March, 1955.

STATUTE ON THE CORRECTIVE LABOR CAMPS, U.S.S.R., Comments and Translation by Alexander G. Korol. April, 1955.

PSYCHOLINGUISTICS IN INTERNATIONAL COMMUNICATION, by Eric H. Lenneberg. July, 1954.

SUMMARY OF THE DEVELOPMENT OF THE INDONESIAN COMMUNIST PARTY AND ITS RELATIONS WITH THE SOVIET UNION AND THE CHINESE PEOPLES REPUBLIC, by Ruth Thomas McVey. October, 1954.

SUMMARY OF LABOR RELATIONS IN THE PETROLEUM INDUSTRY IN INDONESIA, by Edgar C. McVoy. January, 1955.

A BIBLIOGRAPHY OF SOVIET PRICE LISTS, by Max F. Millikan. April, 1955.

FINANCIAL INTERMEDIARIES, SECTIONS I AND II, by Max G. Mueller. November, 1954.

COMMUNIST ETHICS AND CHINESE TRADITION, by David S. Nivison. November, 1954.

MOSLEMS OF SOVIET CENTRAL ASIA: TRENDS AND PROSPECTS, by Richard E. Pipes. October, 1954.

PROGRESS REPORT: RESEARCH PROGRAM IN INTERNATIONAL COMMUNICATION, by Ithiel de Sola Pool. October, 1954.

ASIAN LEADERSHIP AND THE FREE WORLD ALLIANCE, by Walt W. Rostow and others. August, 1954.

RUSSIAN-ENGLISH GLOSSARY OF METALLURGICAL AND METALWORKING TERMS. June, 1955.

THE POSTWAR EVOLUTION OF COMMUNIST STRATEGY IN JAPAN, by Toshio G. Tsukahira. September, 1954.

Albert Farwell Bemis Foundation

HOUSING AND ECONOMIC DEVELOPMENT, the proceedings of a conference at the Massachusetts Institute of Technology on April 30, May 1, and May 2, 1953, edited by Burnham Kelly. January, 1955.

Laboratory for Nuclear Science

FAST NEUTRON INELASTIC SCATTERING, by R. M. Kiehn. Technical Report Number 64, December 1, 1954.

TABLES OF RADIAL SOLUTIONS OF THE DIRAC EQUATION FOR THE SCATTERING OF HIGH ENERGY ELECTRONS BY A POINT CHARGE, by A. E. Glassgold and Evelyn W. Mack. Technical Report Number 65, August 31, 1954.

EXCITATION OF HEAVY NUCLEI BY THE ELECTRIC FIELD OF LOW ENERGY PROTONS, by C. L. McClelland, H. Mark and C. Goodman. Technical Report Number 66, October 15, 1954.

Lincoln Laboratory

MAGNETOSTRICTION FILTERS, by H. M. Elliott. Technical Report Number 54, August 4, 1954.

BANDWIDTH OF MICROWAVE FERRITE DEVICES, by R. H. Fox. Technical Report Number 55, August 11, 1954.

EXTENSION OF NONRECIPROCAL FERRITE DEVICES TO THE 500- TO 3000-MCPS FREQUENCY RANGE, by R. H. Fox and B. Lax. Technical Report Number 65, September 3, 1954.

A COMMON CO-ORDINATE SYSTEM FOR THE UTILIZATION OF DATA FROM SEVERAL RADARS, by D. Goldenberg and E. W. Wolf. Technical Report Number 67, September 13, 1954.

A NONRECIPROCAL FOUR-POLE RING CIRCUIT, by R. H. Fox. Technical Report Number 68, September 17, 1954.

FERRITE DEVICES AND APPLICATIONS AT MICROWAVE FREQUENCIES, by R. H. Fox. Technical Report Number 69, September 27, 1954.

MICROWAVE SUSCEPTIBILITY MEASUREMENTS IN FERRITES, by J. O. Artman and P. E. Tannenwald. Technical Report Number 70, October 27, 1954.

FERROMAGNETIC RESONANCE IN MANGANESE FERRITE SINGLE CRYSTAL, by P. E. Tannenwald. Technical Report Number 71, September 30, 1954.

SOME QUEUE PROCESSES ASSOCIATED WITH BUFFER-STORAGE SYSTEMS, by I. S. Reed. Technical Report Number 73, December 2, 1954.

A PUNCH-CARD ABSTRACT FILE ON SOLID STATE AND TRANSISTOR LITERATURE, by L. D. Patterson. Technical Report Number 74, January 12, 1955.

SOME RESULTS IN THE STUDY OF NARROW-BAND GAUSSIAN NOISE, by R. Price. Technical Report Number 75, January 26, 1955.

L/F NOISE AND RELATED SURFACE EFFECTS IN GERMANIUM, by A. L. McWhorter. Technical Report Number 80 (Also Research Laboratory of Electronics Report Number 295), May 20, 1955.

DIVISION 6 (FORMERLY DIGITAL COMPUTER LABORATORY).

INFORMATION SORTING IN THE APPLICATIONS OF ELECTRONICS DIGITAL COMPUTERS TO BUSINESS, by H. Seward. Report Number R-232, May 24, 1954.

SWITCH FOR REGISTER SELECTION IN A MAGNETIC CORE MEMORY, by J. Raffel. Report Number R-234, May 24, 1954.

THE PROGRAMMED SYNTHESIS OF DIGITAL COMPUTERS WITHIN DIGITAL COMPUTERS, by F. Heart. Report Number 6M-2913, July 20, 1954.

MAGNETIC DRUM CHECKING, by K. McVicar. Report Number 6M-2914, July 20, 1954.

X-RAY EQUIPMENT FOR MAGNETIC RESEARCH, by D. Tumoi and F. Vinal. Report Number 6M-2943, July 29, 1954.

LOGICAL NETWORKS III, A LOGICAL NETWORK ALGEBRA, by R. Jeffrey. Report Number 6M-2948, July 30, 1954.

HIGH-SPEED GATE EMPLOYING A MAGNETIC CORE AND TRANSISTORS, by S. Oken. Report Number 6M-2961, August 3, 1954.

USE OF PUNCHED CARDS FOR COMPUTER RECORDS, by R. Cesari. Report Number 6M-3025, September 9, 1954.

TRANSISTOR FLIP-FLOPS FOR HIGH-SPEED DIGITAL COMPUTER APPLICATIONS, by E. Cohler. Report Number 6M-3029, September 9, 1954.

THE MULTI-SEQUENCE PROGRAM CONCEPT, by W. Clark. Report Number 6M-3144, November 5, 1954.

ALGEBRAIC SYNTHESIS OF LOGICAL FEEDBACK NETS, by R. Jeffrey. Report Number 6M-3083, October 6, 1954.

PULSE RESPONSES OF FERRITE MEMORY CORES, by J. Freeman. Report Number 6M-2568-1, September 20, 1954.

THOUGHTS ON INCREMENTAL PERMEABILITY, by J. Goodenough. Report Number 6M-3059, November 18, 1954.

TRANSISTOR CIRCUITS FOR DRIVING COINCIDENT CURRENT MEMORIES, by K. Olsen. Report Number 6M-3316, January 21, 1955.

PARAMAGNETIC BEHAVIOR OF FERRITES CONTAINING TWO KINDS OF MAGNETIC IONS, by N. Menyuk. Report Number 6M-3252.

A TRANSISTORIZED AMPLIFIER DISCRIMINATOR FOR CORE MEMORY OUTPUT SENSING, by F. Sarles. Report Number 6M-3417, March 7, 1955.

LOGICAL NETWORKS IV: ARITHMETICAL ANALYSIS OF LOGICAL NETS, by R. Jeffrey. Report Number 6M-3723, July 1, 1955.

A TRANSISTOR SELECTION SYSTEM FOR A MAGNETIC CORE MEMORY, by G. Davidson. Report Number 6M-3717, June 27, 1955.

SURFACE-BARRIER TRANSISTOR PULSE GENERATOR, by M. Peterson. Report Number 6M-3710, June 18, 1955.

Office of Statistical Services

APPLICATIONS OF ORTHOGONAL POLYNOMIALS TO CURVE FITTING ON A CARD PROGRAMMED CALCULATOR, by Frank M. Verzuh. Report Number S-15, September 10, 1954.

SOLUTION OF THE BOMBER FIRE CONTROL PROBLEM ON A CARD PROGRAMMED CALCULATOR, by Frank M. Verzuh. Report Number S-17, November 29, 1954.

STUDY OF ELECTROMAGNETIC PROPAGATION IN THE IONOSPHERE, by Frank M. Verzuh. Report Number S-18, December 31, 1954.

CHARACTERISTICS OF IBM ELECTRONIC DATA PROCESSING MACHINES, by Frank M. Verzuh. Report Number S-19. January 13, 1955.

CHARACTERISTICS OF SMALL MAGNETIC DRUM CALCULATORS, by Frank M. Verzuh. Report Number S-20, February 15, 1955.

OPERATION OF DECENTRALIZED COMPUTERS, by Frank M. Verzuh. Report Number S-21, May 5, 1955.

CHARACTERISTICS OF LARGE-SCALE ELECTRONIC DATA PROCESSING SYSTEMS, by Frank M. Verzuh. Report Number S-22, May 23, 1955.

Research Laboratory of Electronics

PHYSICAL LIMITATIONS ON ANTENNAS, by J. Ruze. Technical Report Number 248, October 30, 1952.

CRITERIA FOR DOCILE BEHAVIOR OF FEEDBACK AMPLIFIERS,

by S. J. Mason. Technical Report Number 258, June 10, 1954.

VELOCITY ANALYSIS OF THERMIONIC EMISSION FROM SINGLE-CRYSTAL TUNGSTEN, by A. R. Hutson. Technical Report Number 260, January 13, 1955.

NETWORK SYNTHESIS BY IMPULSE RESPONSE FOR SPECIFIED INPUT AND OUTPUT IN THE TIME DOMAIN, by F. BaHli. Technical Report Number 261, January 31, 1955.

INFORMATION FLOW IN TASK-ORIENTED GROUPS, by R. Duncan Luce, Josiah Macy, Jr., Lee S. Christie and D. Harvie Hay. Technical Report Number 264, August 31, 1953.

PERSONALITY FACTORS AND THEIR INFLUENCE ON GROUP BEHAVIOR: A QUESTIONNAIRE STUDY, by Genevieve O. Rogge. Technical Report Number 265, August 31, 1953.

THERMOELECTRIC EFFECTS IN SILVER HALIDES, by W. Grattidge. Technical Report Number 272, May 5, 1954.

TRANSATLANTIC FREQUENCY-MODULATION EXPERIMENTS, by L. B. Arguimbau, John Granlund, E. E. Manna and C. A. Stutt. Technical Report Number 278, September 20, 1954.

THEORY OF THE FINE STRUCTURE OF THE MOLECULAR OXYGEN GROUND STATE AND THE MEASUREMENT OF ITS PARAMAGNETIC SPECTRUM, by M. Tinkham and M. W. P. Strandberg. Technical Report Number 281, February 1, 1955.

A NEW BASIC THEOREM OF INFORMATION THEORY, by A. Feinstein. Technical Report Number 282, June 1, 1954.

ERROR-FREE CODING, by P. Elias. Technical Report Number 285, September 22, 1954.

AN APPROXIMATION METHOD WITH RATIONAL FUNCTIONS, by N. DeClaris. Technical Report Number 287, December 30, 1954.

PRINTED MICROWAVE SYSTEMS, by M. Schetzen. Technical Report Number 289, September 30, 1954.

HELICAL COUPLING SYSTEM, by A. J. Lichtenberg. Technical Report Number 290, October 6, 1954.

THE OPTICAL PROPERTIES OF ATOMIC VAPORS NEAR RESONANCE, by F. Bitter. Technical Report Number 292, March 16, 1955.

L/F NOISE AND RELATED SURFACE EFFECTS IN GERMANIUM, by A. L. McWhorter. Technical Report Number 295, May 20, 1955. (Also Lincoln Laboratory Technical Report Number 80.)

Spectroscopy Laboratory

PRECISION MEASUREMENT OF WAVELENGTHS WITH ECHELLE SPECTROGRAPHS. Progress Reports Numbers 11, 12, 13, and 14, dated August 15 and November 15, 1954, and February 15 and May 15, 1955, respectively.

IMPROVEMENT IN PRECISION OF MECHANICAL MEASUREMENTS BY INTERFEROMETRY AND COMPLETION OF A LARGE RULING ENGINE TO PRODUCE DIFFRACTION GRATINGS AND PRECISE SCALES. Progress Reports Numbers 8, 9, 10, 11, and 12, dated June 24, September 15, and December 15, 1954, and March 15 and June 15, 1955, respectively.

SPECTROSCOPIC INSTRUMENTATION FOR THE VACUUM ULTRAVIOLET. Progress Reports Numbers 7, 8, 9, and 10, dated June 30, September 30, and December 31, 1954, and March 31, 1955, respectively.