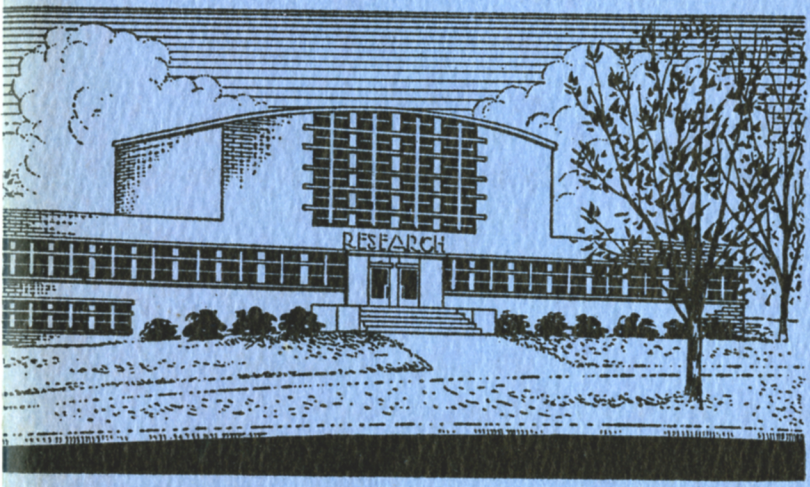
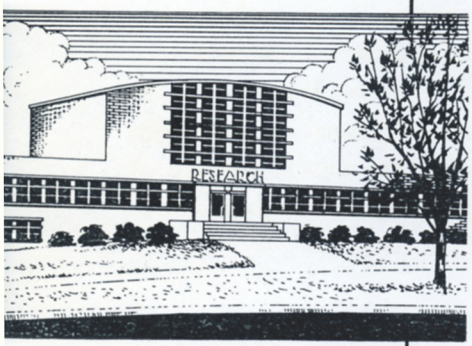
ANNUAL REPORT / 1955-1956



Engineering Experiment Station

Georgia Institute of Technology

The Engineering Experiment Station of the Georgia Institute of Technology was created by the 1919 General Assembly of the State of Georgia for, in the words of the enabling act, "the promotion of engineering and industrial research . . . the more complete development and utilization of the resources of Georgia . . . the encouragement of industries and commerce . . . and for insuring the public welfare of the people consistent with modern progress and preparedness."

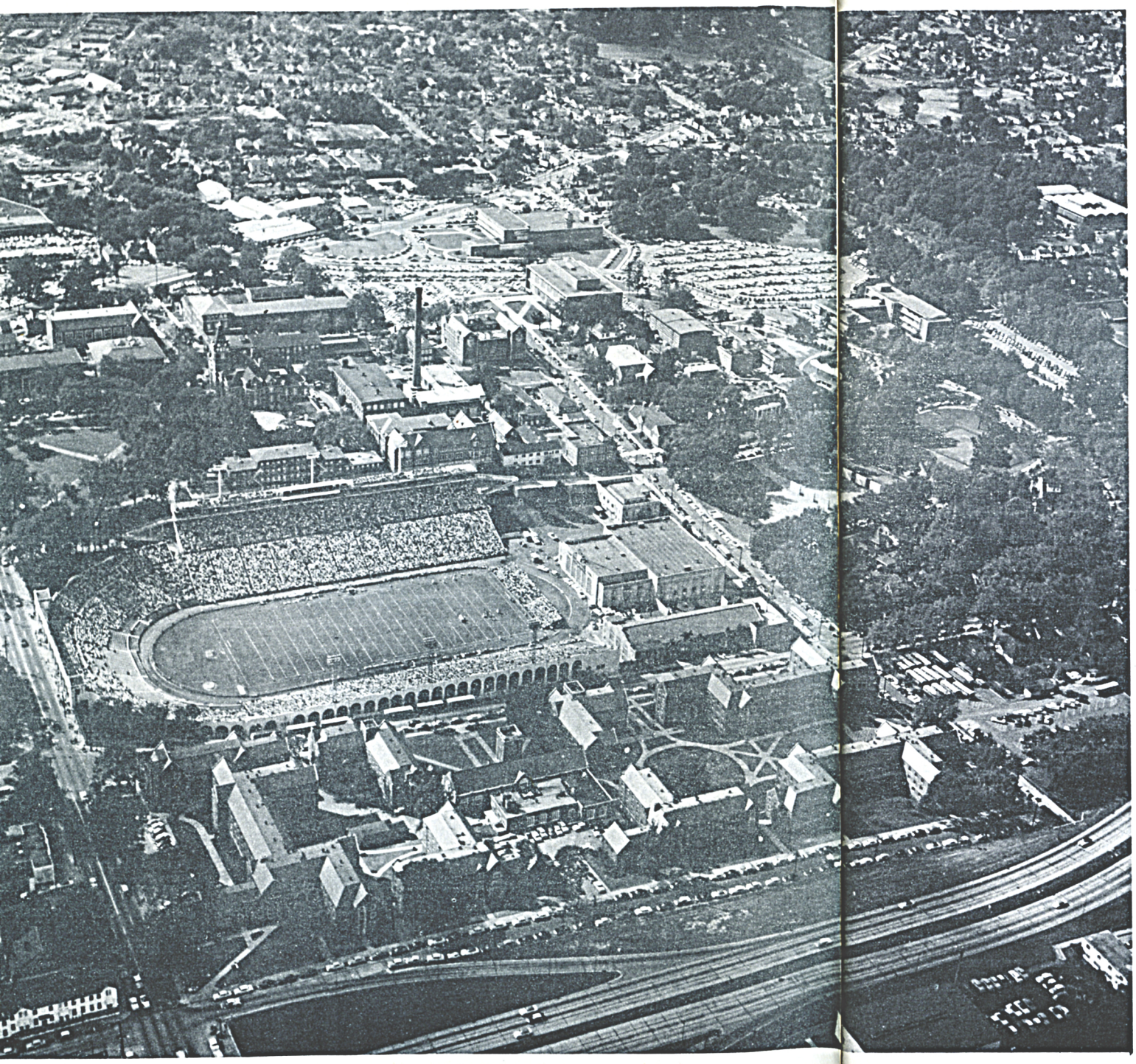


1955-1956 ANNUAL REPORT

Engineering Experiment Station

GEORGIA
INSTITUTE
OF TECHNOLOGY

Atlanta 13, Georgia



FOREWORD

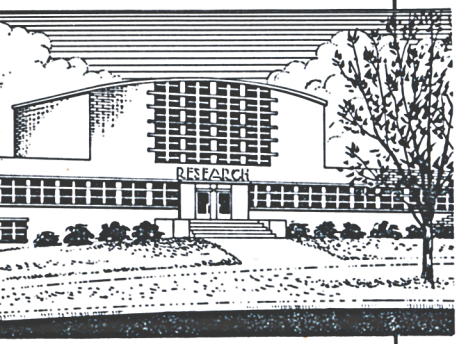
In recent years, specific research accomplishments, like atomic energy, radar, guided missiles, electronic computers and automation, have dramatized for the layman the value of scientific research. But despite all this dramatic publicity and despite industry's great support of research, many Americans still might not fully appreciate how much science has added to our high standard of living.

The National Science Foundation recently estimated that research and development carried out in the 25–year period, 1928–1953, contributed between $40 billion and $80 billion to the 1953 gross national product of $365 billion. The Foundation also estimated that expenditures for research during that 25–year period totaled about $30 billion, a median cost of $1.5 billion per year. Comparing $1.5 billion cost with $40 billion return gives us an indicated return of over 26–1, amazingly high compared to other areas of investment.

However, this annual report of the Engineering Experiment Station has been prepared for those interested in The Georgia Institute of Technology as well as in its research accomplishments. For, the Station is an integral part of Georgia Tech and, as such, is concerned as much with the education and training of young engineers and scientists as with the creation of research results.

The cooperative efforts of the Georgia Tech administration, members of the teaching staff and the student body, as well as all personnel of the Station have made possible the achievements reported to you on the following pages.

Paul Calaway



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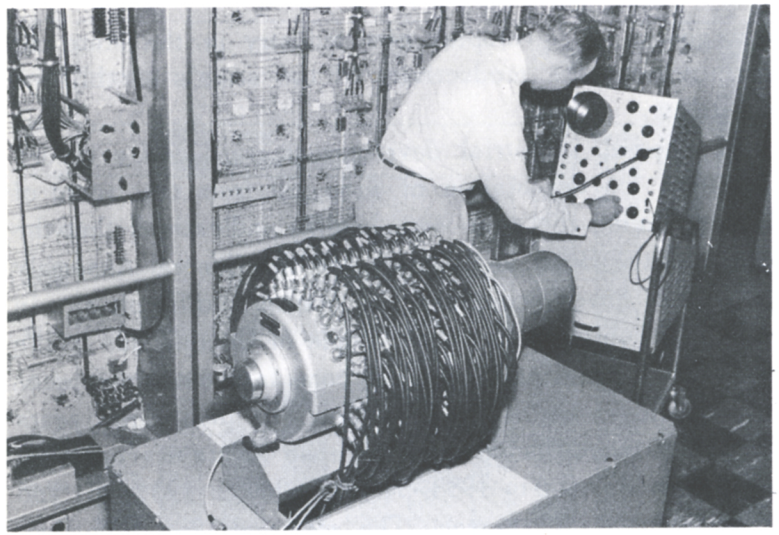


The brain of Georgia Tech's UNIVAC Scientific (1101) computer.

1/ The Year In Retrospect

AS IN the past, the major portion of Georgia Tech's research effort for the year, 1955–56, was devoted to government and industry sponsored research. But the long-range planning by administrative personnel included attention to the industrial development of the State of Georgia. As a direct result of this planning, Governor Marvin Griffin made available to Georgia Tech, through the Board of Regents, a special grant of $50,000 for support of industrial development research during the coming year.

To make the best-possible use of these funds, a new Industrial Development Branch of the Engineering Experiment Station was organized. It will begin operations in offices in the Price Gilbert Library on July 1, 1956. This branch, under the direction of Dr. Kenneth Wagner, was set up to provide the factual, scientific foundation needed to develop the state's industrial potential. The new program has two

main goals: (1) developing new industry in the state and (2) increasing the productivity of the state's established industries.

The special industrial development grant and a record allocation for the Station of $155,520 from the Board of Regents during the year were healthy indications that the Governor, the Board of Regents and the General Assembly of Georgia have recognized the Station's difficulties in meeting its obligations to the people of Georgia due to the fact that major portion of its funds come from outside sources for specific research commitments. The past three years has seen a more-than-gradual increase in state support for the Station ($89,000 in 1953–54, $119,000 in 1954–55 and $155,520 for the past year). The approved 1956–57 budget indicates even greater state support for the basic research that will benefit the people of Georgia. This continuing increase in state support of the Station was one of the most gratifying milestones of the year, 1955–56.

Other milestones of 1955–56 included the opening of the Rich Electronic Computer Center, first such installation at a Southern institution of higher learning; installation of an excellent analog computer facility in the Station's Physical Sciences Division and the development of the nuclear education and research program through the Georgia Tech Nuclear Science Committee.

Projects and Income

ALTHOUGH project totals and dollar volume are not necessarily the ultimate measures of research accomplishment, new peaks in both categories were reached during the year. The truer measures - basic research activity and facility improvement - also continued to progress satisfactorily during 1955–56.

The number of research projects active during the year rose to 194 from 185 in 1954–55. Of this total, 79 were conducted for private industry, 65 for the government, 6 for

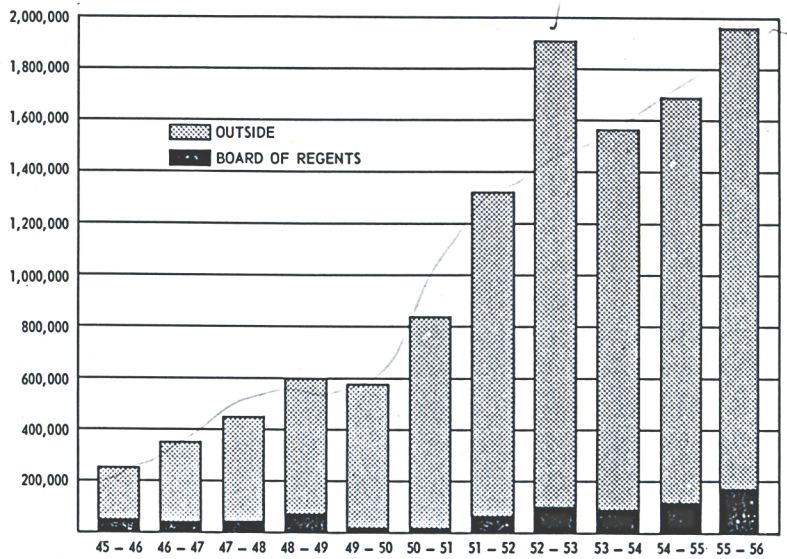


Figure 1 – the Station's income by source over the past decade.

Georgia Tech, 8 for miscellaneous sponsors, 2 in cooperation with other sponsors and 34 were sponsored by the Station itself as part of its plan for the industrial and economic development of the State of Georgia. In terms of dollars, the Station had an income for the year of over $1,960,000 an increase of over $280,000 over the total for the previous year. Of this total, $1,481,000 represented the income from government-sponsored projects. Figure 1 shows the breakdown of income by source area.

Patent Activities

THE Georgia Tech Research Institute, which serves essentially as the contractual agency for the Station, also handled all patent matters during the year. 1955–56 marked a new high in the Station's patent activities as 3 new patents were issued and staff members made discoveries that led to 9 patent applications and 41 records of invention.

Personnel

AS AN integral unit of Georgia Tech, the Engineering Experiment Station can arrange for the services of many experts to supervise and carry out research projects. The members of Tech's teaching faculty are trained in many diverse fields and are ideally suited to carry out both sponsored and basic research. During 1955–56, the Station employed 69 teaching faculty members, representing all of Tech's 13 schools, on a part-time basis to aid in the planning and execution of many of its research programs. The Station and its sponsors are not the only beneficiaries of this collaboration. For, through this program, the faculty members develop in scientific stature by increasing their knowledge of their specific fields and by acquiring better appreciation of problems which their students will soon be facing.

Because the teaching staff is not available for full-time research work, the Station has had to build up a sizable force of qualified research specialists. During the year, members of this group - many of whom have one or more advanced degrees - were made available to the other departments to teach special or advanced courses.

During the year, the Station also employed 78 graduate students and 72 undergraduate students on a part-time basis. From this employment, the students have gained valuable experience as well as needed financial aid. Graduate theses of several employees were made possible through research work performed at the Station.

Facilities and Equipment

THE completion of the computer center, representing a facility valued at over $1,000,000, was the biggest addition of the past year. Installation of an IBM 650 data processing machine and allied equipment in May, 1956 added to the value of the center.

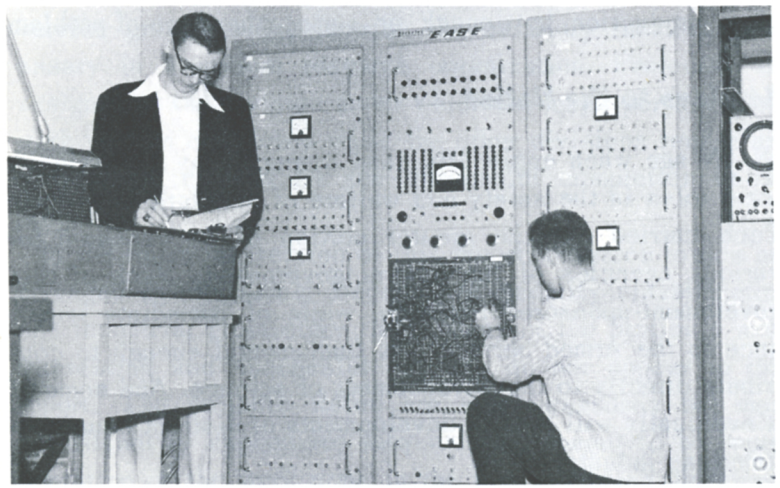
An analog computer laboratory, valued at over $35,000, was located in the Defense Branch of the Station's Physical Sciences Division. The equipment, installed in February, 1956, was used for work on five major projects.

The Hydraulics Laboratory expansion program, begun in 1953 with funds from the Georgia Tech Research Institute and the Georgia Tech Foundation, was essentially completed during the year. This laboratory, which occupies the entire basement floor of the Civil Engineering Building, now has many new facilities including increased pumping facility, a new constant-head tank, and a 14 foot by 80 foot river flume.

The Lockheed-Guggenheim 9-foot wind tunnel modernization program, an excellent example of industry-education cooperation to provide superior research facilities, was nearly completed by the end of the fiscal year. Major changes under this program, initiated in February, 1955, include revisions in the console room, a new drive system, a new balance system and data printer and a new test section.

In August, 1955, a large Diecraft research magnet, valued at $4,000, was purchased for use in solid state physics research. And during the year, a 2,000-pound electromagnet was completed for use in research on paramagnetic resonance.

Engineers operate Georgia Tech's new analog computer equipment.



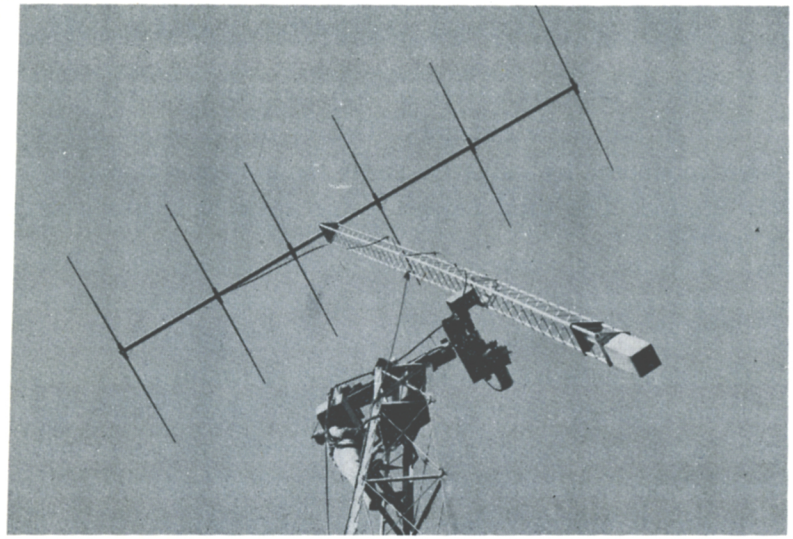
Services to the State and Region

AS IN the past, the Engineering Experiment Station offered strong support to Georgia's industries, to other non-manufacturing businesses and to the community, state and region at large. Over half the industrial projects carried out during the year were for Georgia firms. These projects, although the most tangible type of service rendered by the Station, were only one way in which it served industrial Georgia and the South. Far more frequent were the contacts in which the Station served as a clinic to which industry brought its problems for the scientific cure.

Because of the know-how possessed by the staff, industry of Georgia and the South increasingly called on the Station for advice, consultation or just plain information. Well aware of its responsibilities to the citizens and industries of Georgia and the region, the Station welcomes the inventor, businessman, or anyone seeking aid which it is qualified to give. It is estimated that the Station had over 500 such contacts during the year. All were referred, as expeditiously as possible, to the best-qualified person or persons for the answer to the specific questions. Often, the function of an important business enterprise depended on the rapid solution of a production bottleneck or some other type of problem.

Services to the Nation

IN AN age when engineering and science play such significant roles in the safety and welfare of our Nation, Georgia Tech carried out the greater portion of its research for various agencies of the federal government. Much of this government-sponsored research, while of immediate importance to the Armed Services, is fundamental enough to contribute directly to the advancement of science. And some of it eventually will lead to developments of distinct benefit to American industry.



Meteor-scatter antenna mounted on a special positioning mechanism. It is located at one of Georgia Tech's remote sites.

2 / Technical Operations

EACH member of the Station's staff is assigned to one of its four operating divisions (Chemical Sciences, Mechanical Sciences, Physical Sciences, Computer Center) or to the service groups which provide the auxiliary functions necessary in a modern research organization. Projects are assigned to the division under which the major portion of the work will be conducted while the other divisions render any assistance required for the successful completion of the project.

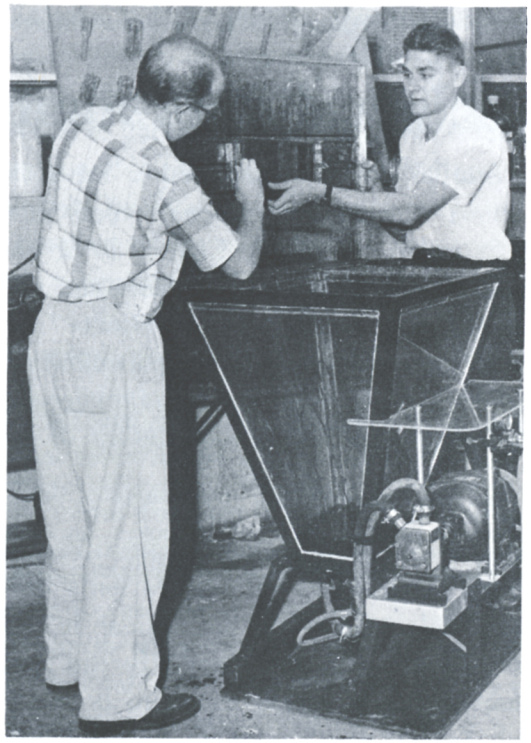
In the following section of this report, research topics are arranged by divisions. Because of security classification and industrial proprietary rights many of the Station's most interesting and successful projects do not appear in this report. The projects listed are not necessarily the most significant or expensive; they are only meant to be representative of the work done in the four operating divisions.

The Chemical Sciences Division

OF THE 65 projects active in this division during the year, 37 fell in the major category. Twelve of the major projects were sponsored by industry, 16 by the government and 9 by the Station. The total project value came to approximately $700,000.

Industrial Products Branch

THE steady growth in the number of minor industrial projects continued during the year. These small projects offer Georgia Tech a real opportunity to be of service to those industries of the state not properly equipped to solve their own technical problems. Out of this small-project work has grown the Industrial Products Branch of the division. Headed by Research Associate Professor W. H. Burrows, this branch concentrated on the development of new industrial materials and techniques under a program geared to the needs of subscribing industries. Among the studies carried out by this branch in its first year of existence were: testing of caulking compounds, analysis of gas-well residues, chemical conversion of kaolin, technical evaluation of ammonia tank failures, photoengraving processes, oil and protein extraction from oil-bearing seeds and the painting of Southern pine.



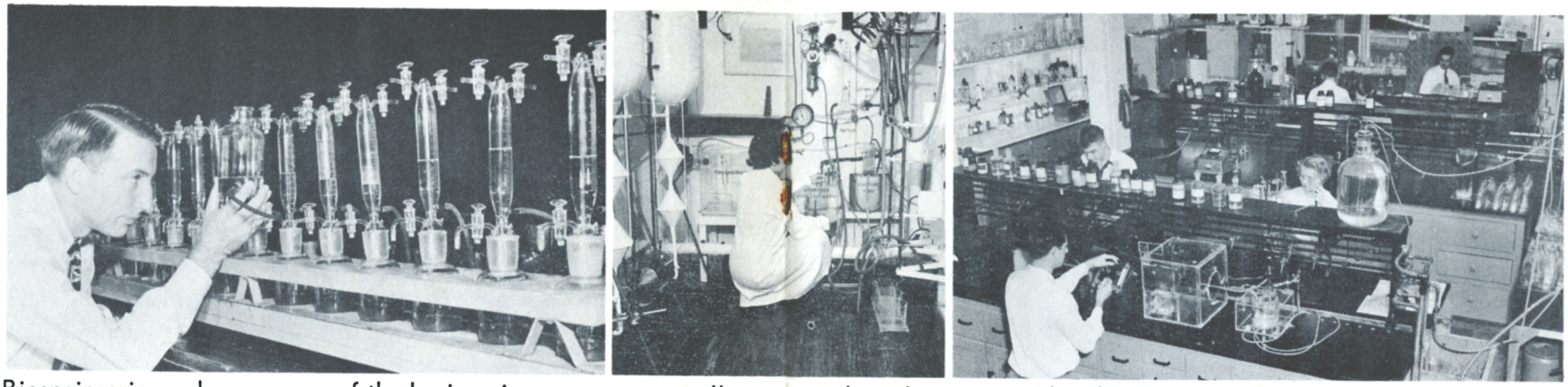
The new spray etching bath developed by Tech engineers of the Industrial Products Branch. It was used in perfecting the new powderless etching process at Georgia Tech. The new process perfected for Photoengravers Research, Inc., reduces the time of etching copper from 38 minutes to 2–3 minutes.

Micromeritics Laboratory

THE laboratory for the study of fine particles is operated cooperatively by the School of Chemical Engineering and the Station. During 1955–56, this laboratory was concerned with 3 important projects. The largest project, a fundamental study of dry dispersion, was concerned with the molecular, electrostatic, ionic, etc. forces holding materials together as well as with the shearing forces which can be brought into play to pull adhering material apart. The second project was an investigation into the "Growth of Small Aerosol Particles with Humidity Change," a fundamental study of a problem of considerable concern to cloud physics. The final project in this laboratory was concerned with the design and construction of "A Continuous Thermal Precipitator for Aerosol Sampling."

Ceramics Laboratory

GEORGIA TECH is vitally concerned with the future development of the ceramic and mineral industries in Georgia and the South. Through research, much of it carried out at Tech, the uses of Georgia's minerals have been extended to the point that almost every ceramic industry may find the greater proportion of its raw materials within the boundaries of the state. During 1955–56, the Station's ceramic research laboratory maintained this research pace.



Bioengineering embraces many of the basic sciences . . . as well as aerosol studies . . . and others carried out in well-equipped labs.

One of these projects had as its objective the development of ceramic glasses which will supply iron, manganese, copper and zinc to soils deficient in any or all of these elements. The preliminary work dealt with the development of a method of determining trace-element availability for plant life. Under this method, a chelating compound (or compounds) was employed to simulate the action of living plants in absorbing from the soil the trace elements under consideration. With such a tool, the deficiency of a given soil could be determined without the necessity of growing plants in the soil. Of even greater significance would be the evaluation of materials to be used in supplying trace elements without an extensive plant-growing program.

Another major project of this laboratory was an investigation of high-temperature resistant materials with particular emphasis on new or unexplored techniques of applying these materials as coatings.

Bioengineering Laboratory

PROVISION of a healthy environment in today's industrialized world requires the solution of many problems by a team of investigators using a relatively new approach, often called "bioengineering," and involving chemistry, biology, physics, and sanitary engineering. During the year, the Station's bioengineering team initiated or continued to conduct a number of studies concerning microorganisms in air and water. Studies of the problem of bleachery wastes in Georgia, the toxicity of chromium in sewage treatments, the chlorination of proteins and the variations in chemical character of Georgia streams were initiated during the reporting period.

But the major milestone of the bioengineering laboratory's year was the completion of a 4–year program of study on the effects of chemical vapors on airborne bacteria. During the course of these studies, techniques and procedures were developed for experimental aerobiology which can be used readily by other workers to form the basis for a standard procedure for the evaluation of aerial disinfectants. These techniques and procedures include an aerosol chamber for carrying out detailed studies on airborne bacteria and aerosol cylinders for the rapid screening of candidate compounds as aerial disinfectants.

In addition to the studies on the effects of chemical vapors on airborne bacteria, a 2–year study on the effects of low temperatures on such organisms was completed in 1956.

The Mechanical Sciences Division

OF THE 32 projects active in this division during the year, 12 were sponsored by industry, 8 by government, 3 by the Station, 5 were services to Georgia Tech, 2 were cooperative projects and 2 were sponsored by the American Society of Mechanical Engineers.

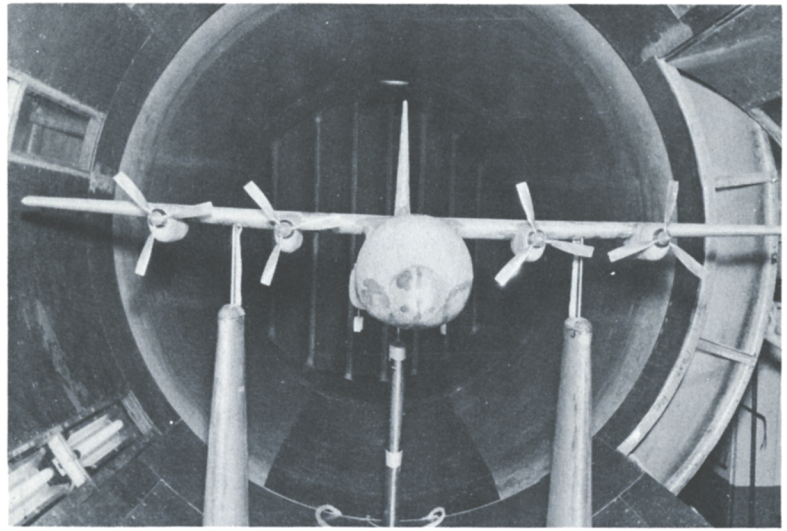
The ASME-sponsored projects were awarded to Georgia Tech in October, 1955. The first project was a study of the viscosity of steam at pressures up to 10,000 psia and temperature to 1200° F. The second project was a study of the feasibility of a method of measuring the thermal diffusivity of steam at high pressure and temperature. In connection with these projects, two Station staff members (Dr. Thomas W. Jackson and Dr. William B. Harrison, III, respectively) have written papers which were presented at the 5th. International Steam Conference in London in July, 1956.

In 1955–56, the division contributed substantially to the establishment of a research center for the School of Mechanical Engineering. In May, 1956, work was started on modernizing the old wood pattern shop into an up-to-date research building. When this work is completed, the research capability of Georgia Tech will be greatly increased.

Mechanical Design Section

THIS section is one of the primary centers within the Station providing direct services to individuals and industry. Personnel of the section develop equipment, answer questions, solve minor technical problems and guide questioners to sources of information and assistance.

Many of the projects undertaken are basically mechanical development, but others are primarily contributions to other research work of which development services or assistance are a minor part.



Lockheed Aircraft's C-130 (Hercules), first model tested in the recently modified 9–foot wind tunnel at Georgia Tech.

Aeronautical Engineering Laboratory

THE extensive modernization program of Tech's 23-year-old, 9' wind tunnel, mentioned in the facilities and equipment section of this report, was essentially completed during the year and calibration of the flow in the tunnel was begun before the end of the fiscal year. Upon completion of this calibration of the balance system, the vastly expanded tunnel facilities will be back in service with the first sponsored project. The tunnel will also be available for the use of other manufacturers and for faculty and graduate student research early in the 1956–57 fiscal year.

The structures laboratory, used basically for student instruction, was improved by the installation of a new hydraulic testing machine pumping unit. Station personnel assisted in the installation of the unit which was also used on outside testing programs.

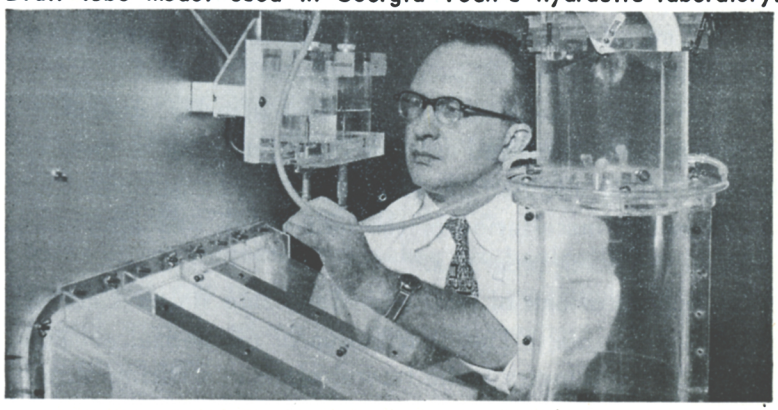
The results of one of Research Associate Walter Castles' helicopter studies, "The distribution of the normal component of induced velocity in the lateral plane of a lifting rotor,"

was approved for publication by the National Advisory Committee for Aeronautics (NACA) as a technical note. A subsequent report concerning the induced velocity distribution in the rotor plane and utilizing certain portions of the results of the first paper is projected for late summer, 1956.

Hydraulics Laboratory

SINCE 1951, the Geological Survey, United States Department of Interior, has sponsored an extensive research program at Georgia Tech. Virtually all of the USGS's research on open-channel hydraulics is now conducted in this laboratory. Professor C. E. Kindsvater is the project director and is also retained by the USGS as a consultant. The work accomplished by this research program has probably done more than any other activity to focus attention on Tech's Hydraulic Laboratory as numerous publications connected with this program have received international circulation. In addition, this program has been of great financial aid to the expansion of the facilities of the Hydraulics Laboratory mentioned in the "Facilities and Equipment Section" of this report. Others helping in this expansion include the Georgia Tech Foundation, the Georgia Tech Research Institute, the Plantation Pipe Line Company and the Southern Natural Gas Company.

Draft tube model used in Georgia Tech's hydraulic laboratory.



The Physical Sciences Division

OF THE 67 projects active in this, the largest division of the Station, 26 were activated during the year. Fourteen of the 20 industry-sponsored projects and 12 of the 32 government-sponsored projects were initiated in 1955–56. Other projects in the Division included 13 sponsored by the Station and 2 cooperative projects. The total value of all projects in this Division was approximately $900,000.

The New Branch Organization

The Physical Sciences Division was subdivided into five branches during the year. Each of the branches is headed by an outstanding young scientist with proven technical ability in his branch's field of research as well as demonstrated qualities of leadership. The Station's administration is extremely well pleased with the results of the first year's operation of the branch organization and feels that it will prove more and more valuable as Georgia Tech and the Station expand in the future.

COMMUNICATIONS BRANCH - established in July, 1955, under the leadership of Special Research Engineer William B. Wrigley, this branch was engaged in investigations covering the fields of airborne command communications systems, HF, VHF, and UHF vehicular antennas, quartz crystals plating and aging, measurement techniques of the electric parameters of quartz crystals, UHF frequency controls and the meteor-scatter program.

DEFENSE BRANCH - established in July, 1955, and headed by Senior Research Physicist Frederick Dixon, this branch was concerned with countermeasure techniques for use against certain types of torpedoes, missiles and radar weapons systems. A simulation facility which involves analog computer operations and computations research and developement was put into operation in this branch early in 1956.

RADAR THEORY AND APPLICATIONS BRANCH - headed by Special Research Physicist Walter W. Wright, this branch was established in January, 1956. During the year it conducted investigations pertaining to multiple-target resolution techniques for extracting information from radar data, optimum use of microwave aperture for measurement of angle-of-arrival, low-angle tracking and radar enviromental interference.

RADAR DEVELOPMENT BRANCH - established in January, 1956, and headed by Special Research Engineer Maurice W. Long, this branch worked on programs on reflecting properties of radar targets, microwave antennas, and feed mechanisms for millimeter wave scanners.

PHYSICS BRANCH - established in May, 1956, and headed by Senior Research Physicist J. Elmer Rhodes, this branch carried out research in the fields of general physics including solid state physics, atomic physics, radioisotopes research and microwave physics.

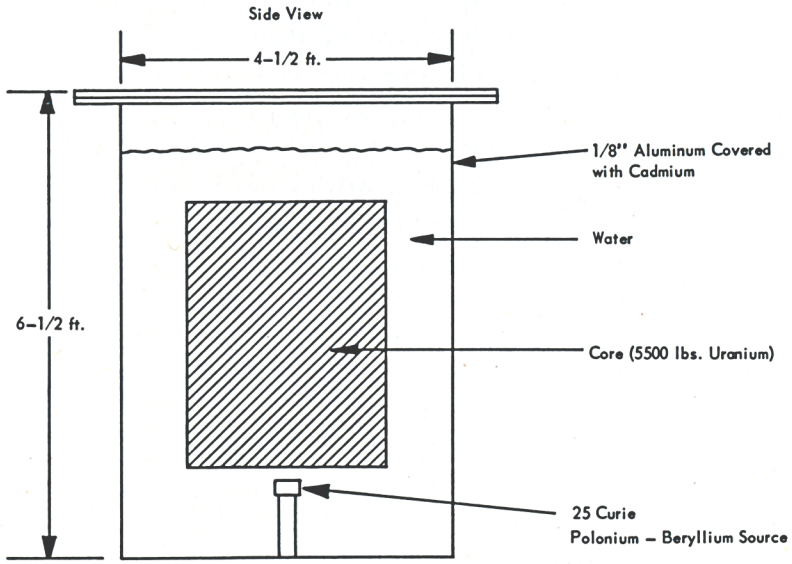
The Nuclear Science Committee

ONE of the finest examples in recent years of cooperation between several divisions of Georgia Tech was in the work of the Nuclear Science Committee. This 17–member committee, appointed in January, 1955, by the late President Blake R. Van Leer, was given the responsibility of examining the future role of nuclear energy in education and research at Georgia Tech. The committee, under the chairmanship of Dr. James E. Boyd, associate director of the Station; included representatives from every school or department directly concerned with the aspects of nuclear engineering and science.

One of the first tasks undertaken by this committee was to catalog the experience and interests of faculty and staff members in the fields of nuclear engineering and nuclear science. From this survey, the committee found that 39 staff members had backgrounds in a branch of these fields.

The committee also established by survey that Georgia Tech's most needed nuclear facility was a radioisotopes laboratory. A Radioisotopes Subcommittee was formed to make a detailed study of Tech's requirements in this area. Other subcommittees were formed to study requirements in nuclear education (the Education Subcommittee) and to consider the institution's needs for a nuclear reactor (the Reactor Subcommittee). The subcommittees also represented a cross-section of the various departments of Georgia Tech interested in nuclear science.

The initial report of the Nuclear Science Committee and its subcommittees was published in the January, 1956 issue of "The Research Engineer" and in the March, 1956 issue of "The Georgia Tech Alumnus". During the year, various



Plan drawing of Tech's subcritical assembly now in construction.

members of the committee appeared individually or in panel discussions before professional and alumni groups in Georgia and in other states.

It is too early to estimate completely the value of this committee's efforts. But the financial support provided by Governor Griffin and the Board of Regents in April, 1956, will permit launching of a graduate-level program in nuclear engineering and nuclear science in the coming fall quarter as well as finance construction of the radioisotopes laboratory. Because the activities of this committee have been directed toward the development of Georgia Tech as a whole, the future of the Institute in nuclear engineering and nuclear science looks very bright.

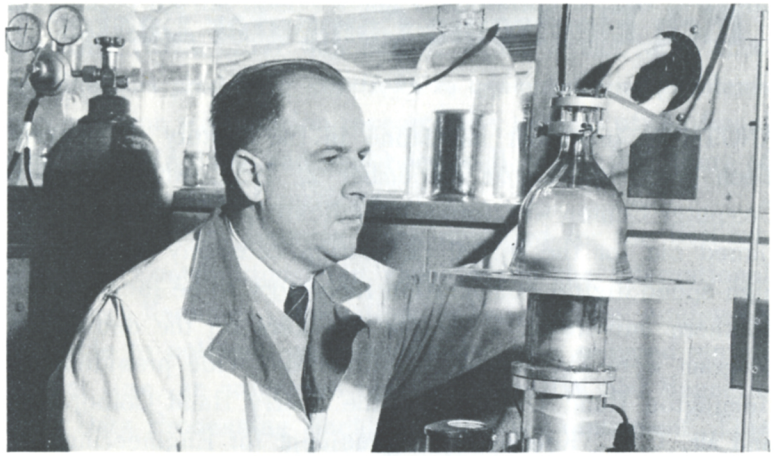
Microscopy and X-ray Laboratories

THESE laboratories perform two functions: service for more extensive projects based elsewhere at Georgia Tech or complete projects within the scope of their own capabilities. During the year, the electron microscopy laboratory, the optical microscopy laboratory and the x-ray diffraction laboratory carried out projects for several sponsors including a number of kaolin producers, a writing equipment manufacturer, mineral producers, industrial research organizations, chemical manufacturers, a veterans' hospital, an electrical bell manufacturer and others.

Because the equipment available in these laboratories is not duplicated elsewhere in the area, the staffs are called upon constantly for consultative services, advice and use of equipment and instruments. Such services constitute an important use of the Station's facilities to bolster the educational program at Georgia Tech and the industrial advancement of the region.

Analog Computer Laboratory

ANALOG computer equipment, consisting of 40 operational amplifiers, 30 precision potentiometers, 2 electronic multipliers, 2 diode function generators and the necessary power supplies and patch board components was installed in the Defense Branch area in February, 1956. Additional equipment was obtained on loan from Beckman Instruments Co. During the year, the laboratory worked at full capacity on projects including a radar protection study, an underwater sound study, a countermeasures study, a cosmic radiation study and an aircraft barometric altimeter problem.



Sputtering system used in Georgia Tech's thin metal research.

Thin Metal Films Laboratory

THE primary work of this laboratory during the year was in an aging study of quartz crystal resonators, which involved the fabrication and testing of approximately 250 quartz resonators. Comparisons were made in the stabilities of units plated with gold, platinum, rhodium, aluminum or bimetal layers of platinum or rhodium plus gold. Units plated with gold or rhodium gave superior stabilities under all reasonable test conditions.

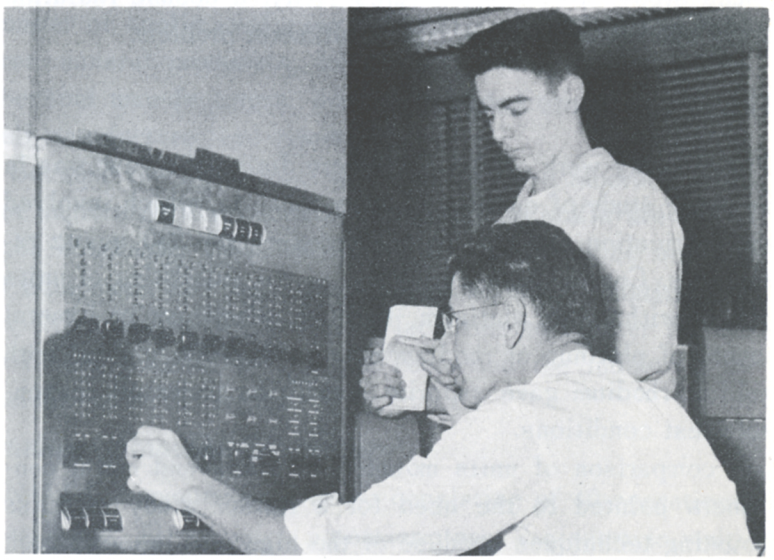
A comparison of units mounted in glass and metal containers pointed to the need for a further study of glass mounting techniques because of the high unit losses which occurred during the high temperature sealing phase.

Rich Electronic Computer Center

ANOTHER important milestone in the history of Georgia Tech was reached on December 2, 1955, when the new Computer Center was formally dedicated. A capacity crowd turned out for the formal dedication ceremony of the first high-speed digital computation laboratory to be located in a Southern university. Principal speakers on the dedication program were Dr. Howard T. Engstrom, vice president for Remington Rand Division of the Sperry Rand Corporation and Mr. C. L. Keenoy, vice president for Engineering and Product Development for the National Cash Register Company.

The Computer Center Wing of the Research Building was completed early in August, 1955. On August 4, 1955, installation of an ERA 1101 electronic digital computer, now

The console and punched-card feeder of the IBM 650 computer.



designated by the Sperry Rand Corporation as the UNIVAC Scientific (ERA 1101) was begun. Three weeks later, this machine was producing solutions to computational problems in connection with Station research. By the end of the fiscal year, the ERA 1101 had performed well over 1,000 hours of useful computational services.

In March, 1956, Georgia Tech qualified for the IBM Educational Contribution Plan under which the International Business Machine Corporation makes certain equipment available to colleges and universities at a reduced rental. At that time, an order was placed for an IBM 650 Magnetic Drum Data Processing Machine and allied equipment. This new system was installed in May 1956 and, under the plan, will be used at least 50% of the first-shift time for an educational and basic academic research program.

Work on five major projects was carried out by members of the computer center staff during the year. In addition to these projects, the UNIVAC Scientific performed computation services for nine projects of other divisions of the Station. Personnel of the center also aided in work on several other Station projects.

The personnel and machines of the center assisted in solving academic research projects for both Georgia Tech and for other colleges in the area.

The machines of the Computer Center were used for laboratory purposes by the School of Mathematics for its courses in numerical analysis and programming. Two UNIVAC Scientific (ERA 1101) programming classes were conducted for 49 Georgia Tech Staff Members.

As the newest of Georgia Tech's major facilities, the computer center has drawn a large number of visitors during the year. Since December, over 1,600 people have toured the center. The interest of the people of this region in electronic computation is evidenced by the fact that members of this division's staff were called upon to make 25 different speeches in the area during the year.

3/ Publications By The Staff

IT IS the policy of the Engineering Experiment Station to encourage the publication of scientific articles by staff members. By the use of discretion and the diligent pursuit of permission from the sponsoring agencies, a number of theses and articles were cleared and released for publication during the past year. On this and the following pages are listed some of these publications:

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Fetner, R. H., "A Study of Factors Affecting X-Ray-Induced Chromosome Aberrations in the Microspores of Tradescantia paludosa," *Radiation Research*, 4 (May, 1956). Station Reprint 106.

Gladden, J. K., Goglia, M. J., and Ward, H. C., "Physical Properties of JP-4 Fuels and Development of Equations for Predicting Fuel System Performance Under Two-Phase Flow Conditions," *WADC Technical Report 55-422, Part 2* (1955).

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Orr, Clyde, Jr. and Gordon, M. T., "The Density and Size of Airborne *Serratia Marcescens*," The Journal of Bacteriology, 71, 315 (February, 1956). Station Reprint 100.

Perlin, I. E., "Plans for the Georgia Tech Computer Center," *Proceedings of the High Speed Computer Conference at Louisiana State University*, 1955.

Perlin, I. E., *Trigonometry,* International Textbook Company (1955).

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Prince, M. D., *Linear Sine Paper for Engineering Applications,* New York: McGraw-Hill Publishing Company (1956).

Sisam, C. H. and Atchison, W. F., *Analytic Geometry,* New York: Henry Holt and Company (1955).

Tolan, J. H., "Cobalt-60 Teletherapy, Part II," *The Research Engineer, 11,* 16 (April, 1956).

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Station Reprints available upon request.

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