# 1972 Annual Report

Engineering Experiment Station

Georgia Institute of Technology Atlanta, Georgia



A Design of the second contracts

# 1972 Annual Report

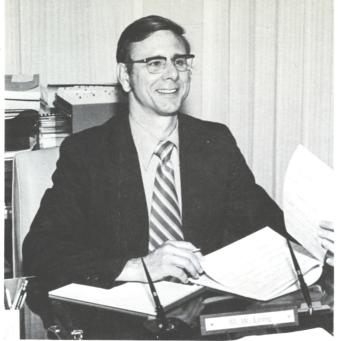
# The Engineering Experiment Station

The Engineering Experiment Station is an applied research center, supported primarily from Federal and industrial contracts. The balance of funding comes from a state appropriation to encourage the development of Georgia. EES operates under a legislative charter that includes research and service for the benefit of Georgia's people, its industry and its economic development. It provides assistance to national programs of science, technology, and preparedness. Its activities lead to the formation of new industry, new products, improved processes and the expansion of existing industry. It also solves problems such as pollution caused by waste products of industry that hamper industrial growth.

The Station serves the Nation, the State, and the Georgia Institute of Technology through advanced technological research and development programs. It serves the State by bringing in dollars to Georgia directly through contracts, through attracting industry, through developing new industries, and by creating new jobs in existing industries.

Willing

1



M. W. Long Director Engineering Experiment Station

#### The Year in Review

The amount of contract research income that EES obtained during the year was strong because of an aggressive promotion effort, even though the national picture for research funding continued to be sluggish. A large sponsored research program at EES is of major importance to the State, because the existence of the full-time staff that it supports permits response to state-oriented problems at a minimum cost and with a short reaction time. Significant reductions in research and service for the State have resulted from cuts in State funds during the last two years.

The total number of persons employed with EES declined from 567 to 494 during the year. There were 282 full-time employees, of which 167 were professional staff members, as well as 212 part-time employees. The number of part-time persons included 112 graduate and undergraduate students.

Experiences with uncertainties in State funding caused by budget cuts during the past two years have made it clear that EES must reshape its operations so as to function entirely as a contract research firm. With this philosophy, the Station has begun to consider the State appropriation as a major contract with appropriate and significant emphasis given to our largest and best sponsor, the people of Georgia. Organizational and administrative changes were announced in March as a step toward becoming one of the strongest client-oriented research centers in the United States.

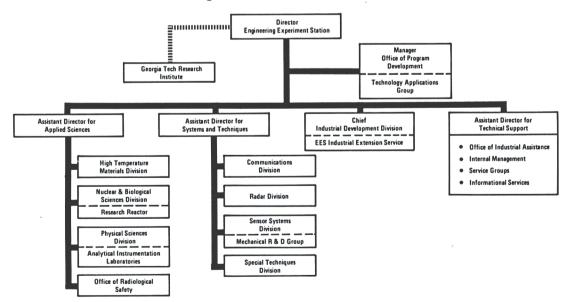
#### **Organizational Changes**

A number of organizational changes were made during the year in response to reduced state support and a continued sluggish Federal contract environment. A major restructuring of the Station that included the establishment of three departments was approved by the Board of Regents in March. The Chemical Sciences and Materials Division was phased out. A Technology Applications Group was established to include certain elements of the Chemical Sciences and Materials Division and the Waste Utilization Laboratory. The Programs Office was renamed the Office of Program Development.

The new Department of Applied Sciences is made up of the High Temperature Materials Division, the Nuclear and Biological Sciences Division, the Physical Sciences Division, and the Office of Radiological Safety. Water chemistry activities of the Chemical Sciences and Materials Division were transferred to this department. The new Department of Systems and Techniques includes the Communications Division, the Radar Division, the Sensor Systems Division, and the Special Techniques Division. Mechanical and geophysical activities of the Chemical Sciences and Materials Division were transferred to this department.

The new Department of Technical Support includes the Office of Industrial Assistance, the Machine Shop, the Photographic Laboratory, the internal management functions, and the informational and administrative services functions.

The organizational changes provide for stronger leadership, for growth in sponsored activities, better interaction between research personnel by reducing administrative barriers, and improved effectiveness of administrative personnel. The changes permit stronger budgetary control with improved flexibility.



#### **Income for Research**

Total expenditures included in the EES budget amounted to \$6,778,763. The funds are obtained from contracts handled by the Georgia Tech Research Institute, from the State appropriation received through the Board of Regents, and from several smaller sources. The income exclusive of that from the Board of Regents equaled \$5,162,570. The comparable figure was \$4,758,618 for the previous year; therefore, total income from sponsored operations was up from the preceding year.

During the fiscal year 1970-71, funds available from the State appropriation were reduced by \$153,000 as part of the University System response to expenditure cuts ordered by Governor Carter. During fiscal year 1971-72, the total State allocation was reduced to \$1,616,194 from about \$2,250,-000. During fiscal year 1970-71, \$192,000 was received directly from the Chancellor's Office to support the State Technical Services Program. Fiscal year 1971-72 was the first time in five years that separate funds were not available to support this program. Therefore, approximately \$800,000 had to be cut from State expenditures during fiscal year 1971-72. The reduced budget resulted in significant personnel losses at a time when pressing technological and economic development needs exist in Georgia.

# Contributions to the State

Each year thousands of jobs are created or preserved in Georgia by the research and service activities of the Engineering Experiment Station. Using standard economic measures it is estimated that the impact upon Georgia in terms of economic activity is \$100 million each year. This activity is generated by the research and development programs of the Engineering Experiment Station and it includes benefits caused by the technological spin-off companies that are known to have stemmed from EES activity. Last year the State gained in excess of \$4 million in taxes from this economic activity.

#### **Waste Utilization**

One of the most promising areas of research and service continues to be waste utilization. The Waste Utilization Laboratory, established as an out-growth of earlier work on the carbonization of peanut hulls, put into service a pilot plant-scale converter for experimentation with bark and various other forms of cellulosic waste. The licensee of the process, Tech-Air Corporation, successfully installed and demonstrated a commercial prototype at a Dawson, Georgia, shelling plant. Subsequently, Tech-Air formed a joint venture company with a subsidiary of Husky Oil Company which will be known as Husky Tech, Incorporated. This move is expected to rapidly accelerate the commercialization of the process among Georgia's peanut shellers.

### **Making Jobs**

The activities of EES lead directly to the creation of thousands of new jobs each year throughout the State. Among the several projects centered in the Industrial Development Division working to further the industrial progress of Georgia is the management and technical assistance program. Funded primarily by the Economic Development Administration and supported also by the State allocation, this program assists Georgia business and industry by stimulating the expansion and diversification of existing business, by supporting the formation of new enterprises, and by assisting troubled companies in solving the problems that threaten their existence.

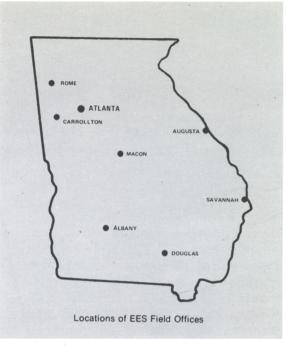
Another area of particular interest to Georgia that experienced considerable success was a project for the generation of employment in rural areas. Under this project, carried out with the sponsorship of the Heart of Georgia Community Action Council, approximately 4,000 unemployed in the 12-county area were registered. Matching up the availability of people with existing needs in local industries resulted in the employment of 848 persons now earning an estimated annual payroll of \$2,519,-000. A similar project is also underway in the Lower Chattahoochee Community Action Area, where 200 jobs have already been identified. The success of this program has generated a substantial amount of interest throughout Georgia and the Southeast and is expected to result in Federal support for research within the Industrial Development Division.

#### **Cancer Diagnosis**

A significant step in the application of the unique capability of the research reactor took place in August 1971 when an essential medical radioisotope, Flourine-18, was produced and delivered for use in cancer diagnosis at Emory University Hospital. Other examples of contributions to public needs include water quality control, industrial noise control, removal of poisonous afflatoxin from peanut presscake and technology for law enforcement.

### Industrial Research and Extension

Response to the technological needs of Georgia industry continued to be one of the primary goals of EES. Interaction with industry occurs mainly in two ways. One is assistance in short-term problem-solving, which is carried out through the Industrial Development Division Central Office,



through field offices distributed throughout Georgia, through the Office of Industrial Assistance, and through the other units of EES. EES also interacts with industry through performance of research and development contracts.

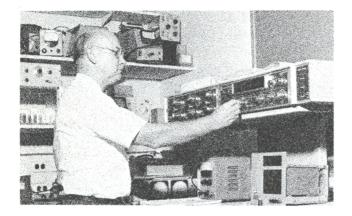
Significant contributions to the economy of rural Georgia continue to be made through the field offices on the program that was originally supported by the State Technical Services Program. This was the first year that funding for the program was not received from the Chancellor's Office. Because of its importance to Georgia, the program was supported from internal funds even though the total allocation from the Board of Regents was also reduced.

There were approximately 1,000 industrial contracts of all types and sponsored industrial research amounted to approximately \$450,000. Of note was the increase during the year of requests for assistance to industry in matters relating to governmental standards for occupational health and safety. EES acoustics specialists, in particular, were called upon with increasing frequency to assist companies with in-plant noise problems.

## Opportunities and Needs of the Engineering Experiment Station

Throughout Georgia there are pressing and growing needs for the type of contribution that EES can make to economic improvement through technological development. In order to more effectively contribute to these needs, the Station must expand its capabilities to keep pace with the changing technological environment and improve our management so as to be truly competitive with the world's best clientoriented contract organizations. To accomplish the task of appreciable growth will require acquisition of a number of senior research people, sophisticated and expensive research equipment, and, finally, significant increases in laboratory space. Some of the costs for these items will continue to be underwritten through Federal and industrial contracts, but a significant increase in State funding is required if the demands of the State are to be met.

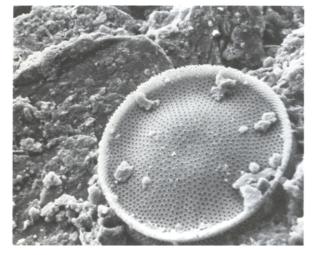
Priority will be given to expansion of EES assistance to Georgia industry through technology assessment as well as to the application of technology to help industry meet its more current problems. Plans will be developed to define affirmative actions for generation of the technical ingredients needed to help maintain or achieve long-term industrial viability and growth in the significant industries already established in Georgia, and to help develop those that logically should be part of the industrial complex.

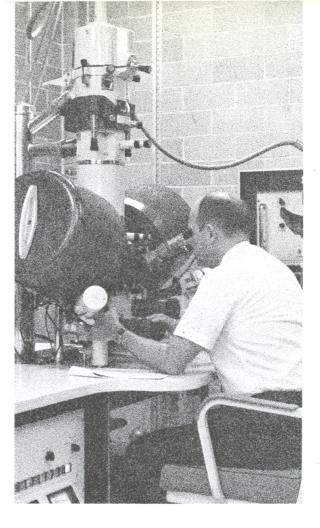






Rudolph L. Yobs Assistant Director for Technical Support







# **Applied Sciences**



Gordon R. Harrison Assistant Director for Applied Sciences



The Applied Sciences Department is a new operational unit within the Engineering Experiment Station resulting from organizational changes implemented March 1, 1972. Dr. Gordon R. Harrison was appointed Assistant Director for Applied Sciences to head this new departmental unit. The Divisions which were included with ASD are: High Temperature Materials Division, Nuclear and Biological Sciences Division, Physical Sciences Division, and the Office of Radiological Safety. These Divisions have some commonality in the pursuit of materials, environmental, biomedical, and societal research needs. In addition to some commonality and complementary research activities, the creation of a departmental organization was made as a step toward renewed growth through improvements in research and management operation, better cost effectiveness by combining administrative functions and by better utilization of technical specialists through minimization of interdivisional barriers.

## **Growth Opportunities**

The past year has produced the continued observation of available sponsored research programs shifting from a basic nature in the direction of applied research. There is strong evidence that the available dollars and opportunities for sponsored research is on a definite up-swing and to be responsive to these opportunities interests and efforts were accordingly shifting into the more "applied" research arena. The future looks very promising for enhanced growth in research activities.

Increased emphasis is also being placed on planning in order that growth can proceed in an organized, controlled, and stable fashion.

This year has produced an even greater awareness and responsiveness to the needs of society and of participation in servicing these needs through technology.

### **Research Activities**

High Temperature Materials Division continues to be active in areas of interdisciplinary research. Research conducted included:

The measurement of dielectric properties of electromagnetic materials at high temperature for utilization as electromagnetic windows for the space shuttle program.

The development of new manufacturing processes for the production of microwave magnetic materials such as ferrites and garnets.

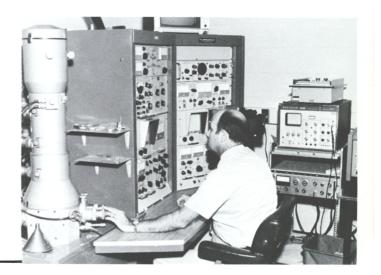
Radar window materials. This activity is concerned with the high temperature performance, structurally and electrically, of windows to be used as radomes for radar systems. Slip-cast fused silica radomes for utilization in many applications.

Research on techniques for solid waste disposal through high temperature incineration procedures. In this area the solid waste disposal problems of Georgia industry, such as the poultry, carpet, wood, and tire industries are being considered.

Work is continuing on the fabrication of sintered silicon nitride materials to explore the possibilities of this compound being a better material than fused silica in applications where appropriate.

Contract support has been obtained for conducting experiments using the large solar furnace available in Odeillo, France. This program is leading into the further consideration of utilizing solar energy as a means of generating "clean" energy for many applications.

Many research programs have been undertaken to provide technical assistance to Georgia industries. One, in particular, is the area of poke-through fittings for fire endurance in concrete slab floors for the building industry.







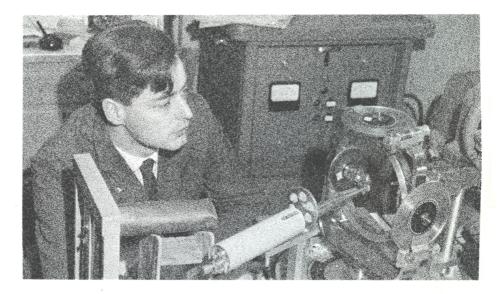
The Physical Sciences Division is experiencing the adjustments necessary to orient itself from the pursuit of and performance on very basic research tasks to that of applied research programs. In addition, some adjustment is also being untertaken to compensate for past funding situations where large research programs were available, to the environment of being responsive and productive on smaller research tasks of the applied nature.

The Analytical Instrumentation Laboratory has continued to be in large demand through contracts with government and industry throughout the year. The laboratory has serviced 54 different contracts of which 19 were from the State of Georgia.

The Bioengineering Center and the Biomedical Instrumentation activities have continued to foster closer relationship between the medical community and the engineering community as available at the Station. Emphasis has been placed on clinical problems and medical instrumentation through the application of electronics, materials, devices, and systems.

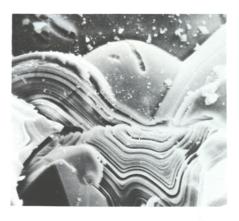
The Crystal Physics Branch is conducting investigations primarily on basic research programs dealing with appatites, biological hard tissues such as tooth enamel, and the atomic scale structural aspects of the properties of many compounds and materials.

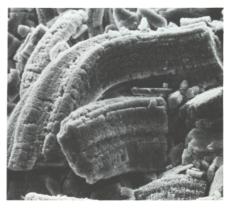
The Biomedical Engineering Group has addressed the problem of instrumentation to be introduced into clinical practice at the level of sophistication and usefulness suitable for practicing physicians. Efforts are also devoted to the area of early diagnosis of disease and the area of developing and utilizing miniaturized pressure transducers and mass spectrometry for intercardiac and pulmonary studies.



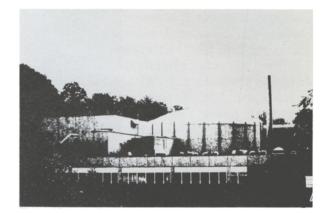
In the area of noise pollution, the Division is conducting noise studies related to the changing needs and configurations of the Hartsfield International Airport as well as the noise associated with modern highway systems. Both experimental and computer simulated studies of highway noise will be most valuable in future studies for MARTA on both rail and road travel.

The Physical Sciences Division is also working closely with law enforcement agencies through the application of physical instrumentation, especially advanced techniques such as the utilization of scanning electron microscopy and electron microproble analyses on minute amounts of physical evidence and material. Plans for our deeper involvement in this societal need are presently being discussed with city, State, and regional agencies.

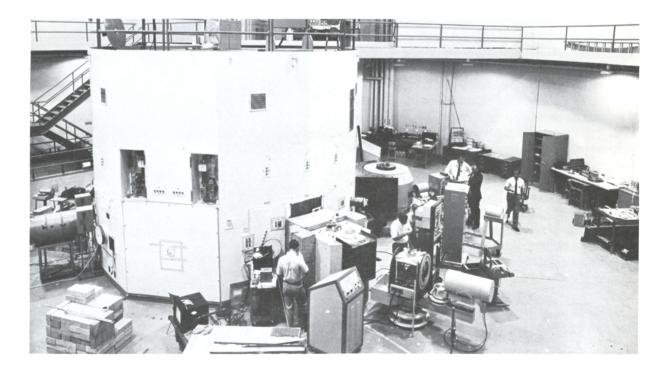








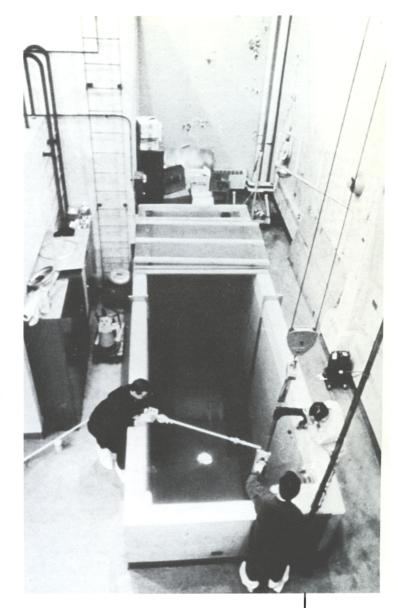
Applied Sciences High Temperature Materials Nuclear and Biological Sciences Research Reactor Physical Sciences Analytical Instrumentation

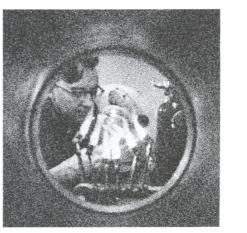


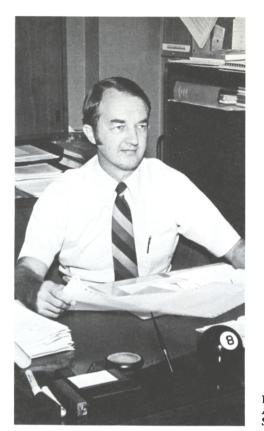
Nuclear and Biological Sciences Division activities have emphasized capabilities and capacities to perform research in biology, chemistry, physics, biotechnology for environmental quality and medical science needs, and nuclear science and technology. One of its principal functions involves the operation of the Nuclear Reactor for both research demands and educational assistance to students and faculty of Georgia Tech. In addition, the reactor facility has continued to train nuclear power plant operators in support of Georgia industry.

The Georgia Tech Research Reactor operated 237 days of the total of 261 calendar days available for operations during this period. Operation was primarily on a twoshift per day schedule and a total of 2,587 Mw hours of operation were accumulated. This provided at least 14,077 experiment hours of use of the reactor.

New activities undertaken during this period include projects in elementary particle physics, the relationship of trace elements to breast cancer, trace elements in air masses, radioisotopic x-ray fluorescence measurements of micronutrient materials for agronomy research, and low cost, low level gamma radiation detection and measurement systems.







Richard C. Johnson Assistant Director for Systems and Techniques

In March 1972, the Electronics Division was redesignated as the Systems and Techniques Department of the Engineering Experiment Station, and Dr. R. C. Johnson was named as Assistant Director for Systems and Techniques. The four branches of the Electronics Division were renamed: Special Techniques Division; Radar Divison; Sensor Systems Division; and the Communications Division.

# **Systems and Techniques**

### **Research Activities**

Despite the current difficulties in obtaining funds from Federal agencies and other sources, the individual divisions and the department as a whole have maintained strong and growing research programs. Most of our support comes from the Federal Government (primarily DoD and NASA), but we obtain some support from many other sources. The Department has again expanded its contract-development activities and support for high-quality research programs has been obtained despite Federal funding shortages.

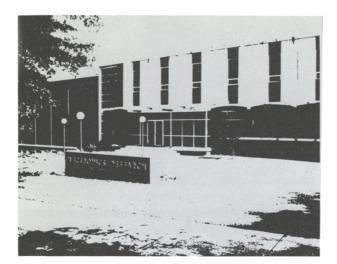
The fundamental strength of the Systems and Techniques Department is in performance of high-quality client-oriented research by a competent and dedicated fulltime technical and administrative staff. In some technical areas, the Department is *the* national leader, while in several others, it is *a* national leader. Areas of sponsored activities include radar antennas and systems, electromagnetic compatibility, radar reflectivity measurements and analysis, electromagnetic properties of materials, communications/ telemetry, radiolocations/direction-finding, coherent optics, guidance/control/power distribution, biomedical electronics.

Effective March 1, a new team known as the Mechanical Research and Development Group was established within EES. The group operates administratively within the Sensor Systems Division, and has the purpose of (1) developing sponsored programs in mechanically-oriented research and development, and (2) increasing the capacity for support in mechanical technology to all EES activities. Although emphasis is being placed on technology development for the State of Georgia, it is anticipated that a base of financial support will be obtained from Federal sources. For the past two years, the Sensor Systems Division has been engaged in a major program to analyze, design, and fabricate the elements of a sophisticated radar antenna complex. The four antennas of this complex are integrated mechanically and electrically on one pedestal to form a radar tracking system. The program is nearing successful completion with delivery of the devices to two separate sponsors.

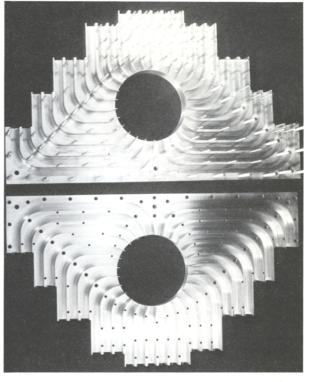
An Image Forming Light Modulator (IFLM) has been developed by the Special Techniques Division as a potential key component in an optical data-processing system for the spaceborne Earth Resources Program. The initial experimental device has been delivered and advanced versions of the IFLM and its applications are being studied under a follow-on program.

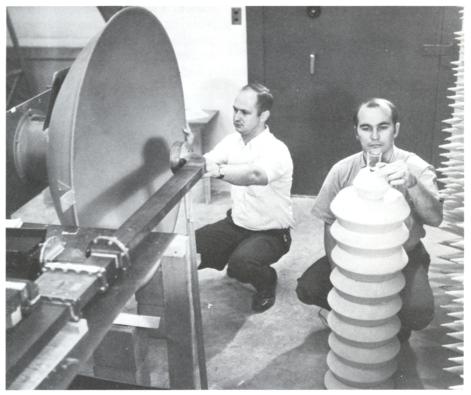
Within the Radar Division, studies of polarization as a parameter in radar and ECM applications are of particular importance. Two separate sponsored programs involving polarization agility are producing results which point the way for increased understanding and utility of polarization effects.





Communications Radar Sensor Systems Special Techniques Mechanical Research and Development



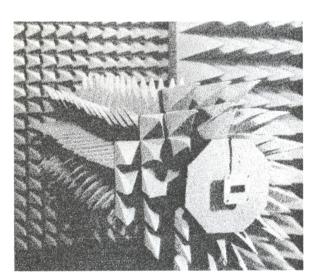


Characteristics of frequency and high-power effects related to electromagnetic compatibility and biomedical hazards are of major interest in the Communications Division. Several individual but interrelated sponsored projects are underway in this technical area, and new and important results are being obtained.

As in previous years, the Department continues to provide a campus-wide service through its Instrumentation Calibration and Repair Laboratory. We also have cooperated in several proposals for work involving academic schools, especially Electrical Engineering. In other education-related activity, the following short course was offered through the Department of Continuing Education:

"Principles of Modern Radar" October 25-29, 1971.

Also, a Microwave Dosimetry Workshop, sponsored by the Walter Reed Army Institute of Research, was held on campus June 1-2, 1972.



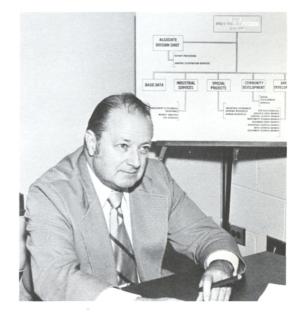


# **Industrial Development**

Sponsored research activities of the Industrial Development Division were severely curtailed during fiscal 1971-72, following the termination at the end of 1970-71 of the Georgia State Technical Services Program after five years of high-level activity. This program—the Division's largest single source of outside funds —provided almost 40 percent of IDD's total sponsored Personal Service income during fiscal 1970-71. This loss, coupled with an overall scarcity of Federal research funds, was only partially overcome by a vigorous in-state project development effort that resulted in contracts with 33 different local development groups, area development groups, and state agencies. A record number of sponsors (49) were served during the year, but the average size of each project was considerably below normal.



R. W. Hammond Chief, Industrial Development Division



The dependence during the year on local, area, and State sponsors was reflected in the concentration of projects in community and area development activities and special studies and projects. Although still representing the largest proportion of total sponsored funds, the volume of activities relating to providing services to business and industry was significantly less than in recent years.

Services to Industry. Management and technical assistance to minority businesses and business and industrial firms in low-income, high-unemployment areas of Georgia.

Community and Area Development. General industrial and economic development research and services for local and area development groups.

Special Studies and Projects. Special studies of environmental constraints on Georgia water-using industries, economic impact of navigable river developments, potentials of producing alumina from kaolin, research priorities in Georgia, land use studies.

International Development. Technical assistance in establishing regional development programs, evaluating natural resources, and promoting exports and productivity in Venezuela and Paraguay.

Market Analysis. Market study of roof decks in 11 states and feasibility study of processing peanut products in south Georgia.

Manpower Development. Direction of registrations of unemployed, development of employment generation programs, and evaluative studies of vocational-technical education. Training Programs. Development and presentation of training programs in community and area development, internship training in investment promotion and industrial development for representatives of foreign agencies, and special seminars in housing, manpower, and development of community leadership.

Housing Programs. Assistance in establishing housing delivery systems and implementing and coordinating area housing programs.

The research, service, and administrative activities of the Division performed with internal funds during fiscal 1971-72 are shown here. The distribution of funds to various activities again reflects the abnormal nature of the year's funding sources. A greater-than-normal proportion of internal funds was invested in the technical services field program to partially compensate for the loss of outside State Technical Services funds. Project development activities were



accelerated during the year in an effort to generate additional sponsored projects and to develop new sources of outside support.

Research and Service Activities in Area Development. Providing supervision, coordination, and administrative support to seven branch offices; field service assistance to local and area development groups throughout the State; identifying the technical information and service needs of Georgia business and industry.

Basic Data Collection and Services. Developing and maintaining basic data collection for use by staff members and others interested in the economic development of the State and region.

Industrial Services. Providing research support with emphasis on market research and feasibility studies aimed at iden-



tifying specific manufacturing opportunities in Georgia; providing short-term management and technical assistance services to established and prospective business and industrial firms throughout Georgia in order to promote the development and expansion of Georgia business and industry; developing and maintaining Georgia's only central source of published manpower information on each county in the State and responding to requests for community and labor market area manpower profiles.

Community Development Activities. Providing research support, including audits of economic resources of selected Georgia communities and the preparation of economic data summaries and profiles; assisting Georgia municipalities in analyzing and evaluating development potentials through the application of civic progress standards and providing follow-up technical assistance in overcoming deterrents to economic growth.

Activities in International Development. Collecting and analyzing economic and industrial data on Latin American countries and identifying international manufacturing opportunities, import sources, and export markets for Georgia business and industry.

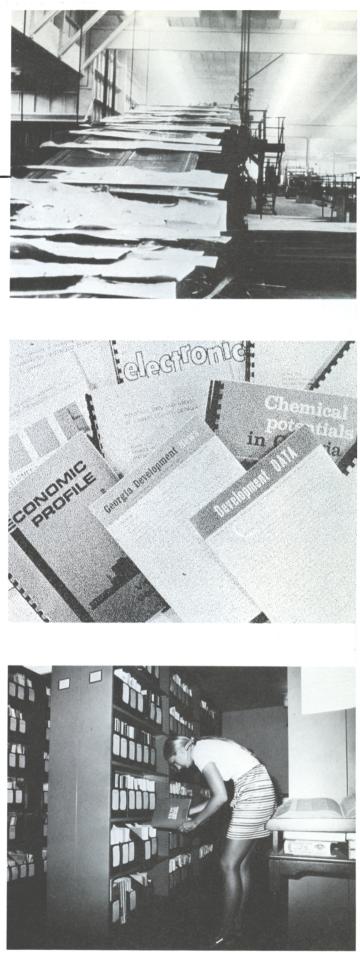
Services to Communities, Development Groups, and Institutions. Providing information, guidance, research, and shortterm technical assistance to more than 75 Georgia communities, industrial and economic development groups, and educational institutions (including other units of Georgia Tech). Research support, including studies of housing problems, investigations of transportation needs, evaluation of natural resources, and special studies of Georgia's resources and potentials.

### Solving Unemployment

Three special studies conducted during the year deserve special mention. An employment generation methodology was applied in a 12-county area in central Georgia under sponsorship of the Heart of Georgia Community Action Council. The project involved a registration of the unemployed, an identification of job openings in the area. and the development of a program for matching employment and training opportunities with the needs and abilities of the unemployed. As an immediate result of this program, more than 400 persons were enrolled in training programs and 848 previously unemployed individuals were placed in jobs, representing a total annual payroll of more than \$2,500,000.

### **New Industry**

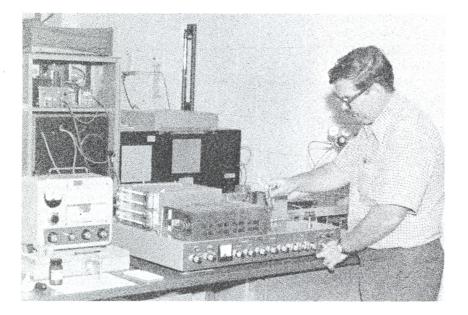
A study of the potentials of producing alumina from domestic kaolin could lead to the development of a billion dollar industry in Georgia through the utilization of one of the State's most abundant natural resources. This landmark study was sponsored by the Georgia Department of Industry and Trade and funded by the Coastal Plains Regional Commission, and has received the endorsement and support of Governor Jimmy Carter and Senator Herman E. Talmadge. Because of the critical significance of the implementation of the findings and recommendations of this study to the national interest and the economic development of rural Georgia, the demand has developed for additional follow-up work by the Industrial Development Division and the Engineering Experiment Station.





### **Peanut Processing**

A study of the feasibility of peanut processing in south Georgia demonstrated the possibilities of cooperative research efforts within the University System. Sponsored by the Southwest Georgia Planning and Development Commission and funded by the Coastal Plains Regional Commission, this study was conducted jointly by the Industrial Development Division and the Agricultural Economics Department of the University of Georgia and was coordinated and administered by the University System's Rural Development Center at Tifton, Georgia. The findings of this study could lead to the development of new processing plants in south Georgia, and the experience of this cooperative effort could lead to new approaches in research relating to the development of agri-industry in Georgia.



Activities of the Office of Program Development began in July, 1971, as a result of needs uncovered by a Task Force on Technology and Economic Development in Georgia that functioned during early 1971. The office was created as a staff operation to assist the Director in guiding EES to greater contributions of solutions to Georgia's pressing problems. The duties of the Office are to continually review the on-going EES activities relative to the EES commitment to fulfill its mission for the state, to assess the technological needs of the state, and to initiate appropriate new research and service programs. An additional function is the coordination of capabilities so that the full resources of EES can be applied more effectively to state needs.

The Technology Applications Group (TAG) functions as a part of the Office of Program Development. The purpose of the Group is to develop projects with federal sponsorship for technology applied for the economic development of Georgia and to its environmental problem areas, to work closely with the Industrial Development Division and the industrial community giving greater technical reinforcement to the IDD activities, and to develop a stronger role of technical support for the various state agencies.

One method used by the Office of Program Development to evaluate the EES contribution is to assess the economic impact of EES on the state. Analysis of this impact for the fiscal year ending in June 1971, shows that the total impact of the EES and its spin-offs amounted to \$104.3 million. Of that amount, \$4.1 million was the direct effect and \$8.6 was the indirect effect of the research program. The industrial development effort accounted for another \$14.4 million, giving a total impact due to EES operations alone of \$27.1 million. The direct impact of the spin-offs was \$30.0 million, with the indirect impact being \$47.2 million. The state tax revenues generated by this economic activity amounted to approximately \$4.2 million, or more than two times the allocation available to the EES for fiscal year 1972.

Major activities of the Technology Applications Group included waste utilization work, characterization and assessment of potentials of mineral-bearing sediments and deposits, and continuation of certain projects previously assigned to the Chemical Sciences & Materials Division. Concurrently, proposal efforts were maintained at a level consistent with the need for future sponsored support.

Howard G. Dean, Jr. Manager, Office of Program Development



#### Georgia Tech Research Institute

The Georgia Tech Research Institute serves as the contract agency for the EES and it handles patent matters in connection with research and development activities. The Research Institute is a nonprofit organization incorporated under the laws of the State of Georgia. The Board of Trustees is composed of four members of the Georgia Tech faculty, four from Georgia Tech alumni, and four from industry at large.

The officers and Board members of the Research Institute were as follows: Richard K. Whitehead, Chairman of the Board; Fuller E. Callaway, Jr., Vice Chairman; Harry L. Baker, Jr., President; Maurice W. Long, Director of Research, Secretary and Assistant Treasurer; Walter L. Bloom, Treasurer; Milton W. Bennett, Assistant Treasurer and Assistant Secretary; and Rudolph L. Yobs, Assistant Secretary. The total membership of the Board of Trustees was Walter L. Bloom, James E. Boyd, Harllee Branch, Jr., Fuller E. Callaway, Jr., Robert H. Ferst, Vernon Crawford, Charles L. Davidson, Jr., Maurice W. Long, Joseph M. Pettit, Roy Richards, William B. Turner, and Richard K. Whitehead, Sr.

Tucker-Castleberry Printing, Inc.

M. W. Long Director Engineering Experiment Station Telephone: 894-3400

Rudolph L. Yobs Assistant Director for Technical Support Telephone: 894-3404

Howard G. Dean, Jr. Manager, Office of Program Development Telephone: 894-3492

Gordon R. Harrison Assistant Director for Applied Sciences Telephone: 894-3430

J. D. Walton Chief, High Temperature Materials Division Telephone: 894-3656

G. W. Leddicotte Chief, Nuclear and Biological Sciences Division Telephone: 894-3601

Gordon W. Harrison Chief, Physical Sciences Division Telephone: 894-3430

John L. Brown Head, Analytical Instrumentation Laboratory Telephone 894-3460 Richard C. Johnson Assistant Director for Systems and Techniques Telephone: 894-3516

D. W. Robertson Chief, Communications Division Telephone: 894-3592

H. A. Ecker Chief, Radar Division Telephone: 894-3523

R. M. Goodman Chief, Sensor Systems Division Telephone: 894-3507

J. W. Dees Chief, Special Techniques Division Telephone: 894-3504

Ross W. Hammond Chief, Industrial Development Division Telephone: 894-3800

Engineering Experiment Station Georgia Institute of Technology Atlanta, Georgia 30332

